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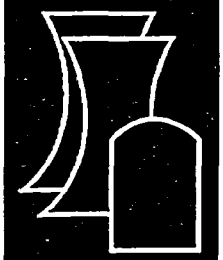

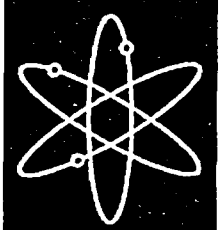

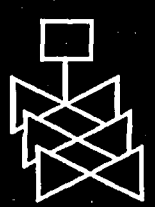

Generic Environmental Impact Statement for License Renewal of Nuclear Plants

Supplement 19

Regarding
Arkansas Nuclear One, Unit 2

Final Report

U.S. Nuclear Regulatory Commission
Office of Nuclear Reactor Regulation
Washington, DC 20555-0001

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NUREG-1437
Supplement 19

Generic Environmental Impact Statement for License Renewal of Nuclear Plants

Supplement 19

Regarding Arkansas Nuclear One, Unit 2

Final Report

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Division of Regulatory Improvement Programs
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

Abstract

The U.S. Nuclear Regulatory Commission (NRC) considered the environmental impacts of renewing nuclear power plant operating licenses (OLs) for a 20-year period in its *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (GEIS), NUREG-1437, Volumes 1 and 2, and codified the results in Title 10 of the Code of Federal Regulations (CFR) Part 51. In the GEIS (and its Addendum 1), the staff identifies 92 environmental issues and reaches generic conclusions related to environmental impacts for 69 of these issues that apply to all plants or to plants with specific design or site characteristics. Additional plant-specific review is required for the remaining 23 issues. These plant-specific reviews are to be included in a supplement to the GEIS.

This supplemental environmental impact statement (SEIS) has been prepared in response to an application submitted to the NRC by Entergy Operations, Inc. (Entergy), to renew the OL for Arkansas Nuclear One, Unit 2 (ANO-2) for an additional 20 years under 10 CFR Part 54. This SEIS includes the NRC staff's analysis that considers and weighs the environmental impacts of the proposed action, the environmental impacts of alternatives to the proposed action, and mitigation measures available for reducing or avoiding adverse impacts. It also includes the staff's recommendation regarding the proposed action.

Regarding the 69 issues for which the GEIS reached generic conclusions, neither Entergy nor the staff has identified information that is both new and significant for any issue that applies to ANO-2. In addition, the staff determined that information provided during the scoping process did not call into question the conclusions in the GEIS. Therefore, the staff concludes that the impacts of renewing the ANO-2 OL will not be greater than impacts identified for these issues in the GEIS. For each of these issues, the staff's conclusion in the GEIS is that the impact is of SMALL[(a)] significance (except for collective offsite radiological impacts from the fuel cycle and high-level waste and spent fuel, which were not assigned a single significance level).

Regarding the remaining 23 issues, those that apply to ANO-2 are addressed in this SEIS. For each applicable issue, the staff concludes that the significance of the potential environmental impacts of renewal of the OL is SMALL. The staff also concludes that additional mitigation measures are not likely to be sufficiently beneficial as to be warranted. The staff determined that information provided during the environmental review did not identify any new issue that has a significant environmental impact.

(a) Environmental effects are not detectable or are so minor that they will neither destabilize nor noticeably alter any important attribute of the resource.

Abstract

The NRC staff's recommendation is that the Commission determine that the adverse environmental impacts of license renewal for ANO-2 are not so great that preserving the option of license renewal for energy-planning decisionmakers would be unreasonable. This recommendation is based on (1) the analysis and findings in the GEIS; (2) the Environmental Report submitted by Entergy; (3) consultation with Federal, State, and local agencies; (4) the staff's own independent review; and (5) the staff's consideration of public comments.

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Executive Summary

By letter dated October 15, 2003, Entergy Operations, Inc. (Entergy) submitted an application to the U.S. Nuclear Regulatory Commission (NRC) to renew the operating license (OL) for Arkansas Nuclear One, Unit 2 (ANO-2) for an additional 20-year period. If the OL is renewed, State regulatory agencies and Entergy will ultimately decide whether the plant will continue to operate based on factors such as the need for power or other matters within the State's jurisdiction or the purview of the owners. If the OL is not renewed, then the plant must be shut down at or before the expiration date of the current OL for ANO-2, which is July 17, 2018.

Section 102 of the National Environmental Policy Act of 1969 (NEPA) (42 USC 4321) directs that an environmental impact statement (EIS) is required for major Federal actions that significantly affect the quality of the human environment. The NRC has issued regulations implementing Section 102 of NEPA in Title 10 of the Code of Federal Regulations (CFR) Part 51. In 10 CFR 51.20(b)(2), the Commission requires preparation of an EIS or a supplement to an EIS for renewal of a reactor OL. In addition, 10 CFR 51.95(c) states that the EIS prepared at the OL renewal stage will be a supplement to the *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (GEIS), NUREG-1437, Volumes 1 and 2.[a]

Upon acceptance of the license renewal application from Entergy, the NRC began the environmental review process described in 10 CFR Part 51 by publishing a notice of intent to prepare an EIS and conduct scoping. The staff visited the ANO-2 site during February 2004 and held public scoping meetings on February 3, 2004, in Russellville, Arkansas. In the preparation of this supplemental environmental impact statement (SEIS) for ANO-2, the staff reviewed the Entergy Environmental Report and compared it to the GEIS; consulted with other agencies; conducted an independent review of the issues following the guidance set forth in NUREG-1555, Supplement 1, the *Standard Review Plans for Environmental Reviews for Nuclear Power Plants, Supplement 1: Operating License Renewal*; and considered public comments received during the environmental review. The public comments received during the scoping process that were considered to be within the scope of the environmental review are provided in Appendix A, Part 1, of this SEIS.

A draft SEIS was published for comment in September 2004. The staff held a public meeting in Russellville, Arkansas, on October 21, 2004, to describe the results of the NRC environmental review, to answer questions, and to provide members of the public with information to assist them in formulating comments on this SEIS. All of the comments received on the draft SEIS

(a) The GEIS was originally issued in 1996. Addendum 1 to the GEIS was issued in 1999. Hereafter, all references to the "GEIS" include the GEIS and its Addendum 1.

were considered by the staff in developing the final SEIS. These comments are addressed in Appendix A, Part 2, of the final SEIS.

This SEIS includes the NRC staff's analysis that considers and weighs the environmental effects of the proposed action, the environmental impacts of alternatives to the proposed action, and mitigation measures for reducing or avoiding adverse effects. It also includes the staff's recommendation regarding the proposed action.

The Commission has adopted the following statement of purpose and need for license renewal from the GEIS:

> The purpose and need for the proposed action (renewal of an operating license) is to provide an option that allows for power generation capability beyond the term of a current nuclear power plant operating license to meet future system generating needs, as such needs may be determined by State, utility, and, where authorized, Federal (other than NRC) decisionmakers.

The goal of the staff's environmental review, as defined in 10 CFR 51.95(c)(4) and the GEIS, is to determine

> ... whether or not the adverse environmental impacts of license renewal are so great that preserving the option of license renewal for energy planning decisionmakers would be unreasonable.

Both the statement of purpose and need and the evaluation criterion implicitly acknowledge that there are factors, in addition to license renewal, that will ultimately determine whether an existing nuclear power plant continues to operate beyond the term of the current OL.

NRC regulations (10 CFR 51.95(c)(2)) contain the following statement regarding the content of SEISs prepared at the license renewal stage:

> The supplemental environmental impact statement for license renewal is not required to include discussion of need for power or the economic costs and economic benefits of the proposed action or of alternatives to the proposed action except insofar as such benefits and costs are either essential for a determination regarding the inclusion of an alternative in the range of alternatives considered or relevant to mitigation. In addition, the supplemental environmental impact statement prepared at the license renewal stage need not discuss other issues not related to the environmental effects of the proposed action and the alternatives, or any aspect of the storage of spent fuel for the facility within the scope of the generic determination in § 51.23(a) ["Temporary storage of spent fuel after cessation of

reactor operation–generic determination of no significant environmental impact"] and in accordance with § 51.23(b).

The GEIS contains the results of a systematic evaluation of the consequences of renewing an OL and operating a nuclear power plant for an additional 20 years. It evaluates 92 environmental issues using NRC's three-level standard of significance – SMALL, MODERATE, or LARGE – developed using the Council on Environmental Quality guidelines. The following definitions of the three significance levels are set forth in footnotes to Table B-1 of 10 CFR Part 51, Subpart A, Appendix B:

SMALL – Environmental effects are not detectable or are so minor that they will neither destabilize nor noticeably alter any important attribute of the resource.

MODERATE – Environmental effects are sufficient to alter noticeably, but not to destabilize, important attributes of the resource.

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

For 69 of the 92 issues considered in the GEIS, the analysis in the GEIS led to the following conclusions:

(1) 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 characteristics.

(2) A single significance level (i.e., SMALL, MODERATE, or LARGE) has been assigned to the impacts (except for collective offsite radiological impacts from the fuel cycle and from high-level waste and spent fuel disposal).

(3) 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 not likely to be sufficiently beneficial to warrant implementation.

These 69 issues were identified in the GEIS as Category 1 issues. In the absence of new and significant information, the staff relied on conclusions as amplified by supporting information in the GEIS for issues designated as Category 1 in Table B-1 of 10 CFR Part 51, Subpart A, Appendix B.

Of the 23 issues that do not meet the criteria set forth above, 21 are classified as Category 2 issues requiring analysis in a plant-specific supplement to the GEIS. The remaining two issues, environmental justice and chronic effects of electromagnetic fields, were not categorized. Environmental justice was not evaluated on a generic basis and must be addressed in a plant-specific supplement to the GEIS. Information on the chronic effects of electromagnetic fields was not conclusive at the time the GEIS was prepared.

This SEIS documents the staff's consideration of all 92 environmental issues identified in the GEIS. The staff considered the environmental impacts associated with alternatives to license renewal and compared the environmental impacts of license renewal and the alternatives. The alternatives to license renewal that were considered include the no-action alternative (not renewing the OL for ANO-2) and alternative methods of power generation. Based on projections made by the U.S. Department of Energy's Energy Information Administration, gas- and coal-fired generation appear to be the most likely power-generation alternatives if the power from ANO-2 is replaced. These alternatives are evaluated assuming that the replacement power generation plant is located at either the ANO-2 site or some other unspecified alternate location.

Entergy and the staff have established independent processes for identifying and evaluating the significance of any new information on the environmental impacts of license renewal. Neither Entergy nor the staff has identified information that is both new and significant related to Category 1 issues that would call into question the conclusions in the GEIS. Similarly, neither the scoping process nor the staff has identified any new issue applicable to ANO-2 that has a significant environmental impact. Therefore, the staff relies on the conclusions of the GEIS for all of the Category 1 issues that are applicable to ANO-2.

Entergy's license renewal application presents an analysis of the Category 2 issues plus environmental justice and chronic effects from electromagnetic fields. The staff has reviewed Entergy's analysis for each issue and has conducted an independent review of each issue. Six Category 2 issues are not applicable, because they are related to plant design features or site characteristics not found at ANO-2. Four Category 2 issues are not discussed in this SEIS because they are specifically related to refurbishment. Entergy has stated that its evaluation of structures and components, as required by 10 CFR 54.21, did not identify the need for refurbishment of these structures and components to support the continued operation of ANO-2 for the license renewal term. In addition, any replacement of components or additional inspection activities are within the bounds of normal plant component replacement, and are not expected to affect the environment outside of the bounds of the plant operations evaluated in the U.S. Atomic Energy Commission's 1977 *Final Environmental Statement Related to Operation of Arkansas Nuclear One, Unit 2.*

Eleven Category 2 issues related to operational impacts and postulated accidents during the renewal term, as well as environmental justice and chronic effects of electromagnetic fields, are discussed in detail in this SEIS. Five of the Category 2 issues and environmental justice apply to both refurbishment and to operation during the renewal term, but are discussed in this SEIS only in relation to operation during the renewal term. For all 11 Category 2 issues and environmental justice, the staff concludes that the potential environmental effects are of SMALL significance in the context of the standards set forth in the GEIS. In addition, the staff determined that appropriate Federal health agencies have not reached a consensus on the existence of chronic adverse effects from electromagnetic fields. Therefore, no further evaluation of this issue is required. For severe accident mitigation alternatives (SAMAs), the staff concludes that a reasonable, comprehensive effort was made to identify and evaluate SAMAs. Based on its review of the SAMAs for ANO-2, and the plant improvements already made, the staff concludes that four candidate SAMAs are potentially cost-beneficial. However, these SAMAs do not relate to adequately managing the effects of aging during the period of extended operation and, therefore, need not be implemented as part of the license renewal pursuant to 10 CFR Part 54.

Mitigation measures were considered for each Category 2 issue. Current measures to mitigate the environmental impacts of plant operation were found to be adequate, and no additional mitigation measures were deemed sufficiently beneficial to be warranted.

If the ANO-2 OL is not renewed and the unit ceases operation on or before the expiration of its current OL, then the adverse impacts of likely alternatives will not be smaller than those associated with continued operation of ANO-2. The impacts may, in fact, be greater in some areas.

The recommendation of the NRC staff is that the Commission determine that the adverse environmental impacts of license renewal for ANO-2, are not so great that preserving the option of license renewal for energy planning decisionmakers would be unreasonable. This recommendation is based on (1) the analysis and findings in the GEIS; (2) the Environmental Report submitted by Entergy; (3) consultation with other Federal, State, and local agencies; (4) the staff's own independent review; and (5) the staff's consideration of public comments.

Abbreviations/Acronyms

°	degree
µCi	microcurie(s)
µCi/ml	microcuries per milliliter
µGy	microgray(s)
µm	micrometer(s)
µSv	microsieverts
ac	acre(s)
ACC	averted cleanup and decontamination costs
ACE	U.S. Army Corps of Engineers
ADAMS	Agencywide Documents Access and Management System
ADEQ	Arkansas Department of Environmental Quality
AEA	Atomic Energy Act of 1954
AEC	U.S. Atomic Energy Commission
AGFC	Arkansas Game and Fish Commission
ALARA	as low as reasonably achievable
ANHC	Arkansas Natural Heritage Commission
ANO-1	Arkansas Nuclear One, Unit 1
ANO-2	Arkansas Nuclear One, Unit 2
AOC	present value of averted offsite property damage costs
AOE	present value of averted occupational exposure
AOSC	present value of averted onsite costs
APE	present value of averted public exposure
AQI	Air Quality Index
ASP	Arkansas State Police
ASWCC	Arkansas Soil and Water Conservation Commission
ATWS	anticipated transient without scram
AWEA	American Wind Energy Association
Bq	becquerel(s)
BMT	basemat melt-through
Btu	British thermal unit(s)
C	Celsius
CCDP	conditional core damage probability
CCF	common cause failure
CCW	component cooling water
CDF	core damage frequency
CE	Combustion Engineering

CEOG	Combustion Engineering Owners Group
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
cfs	cubic feet per second
CHRS	containment heat removal system
Ci	curie(s)
cm	centimeter(s)
COE	cost of enhancement
COPC	chemicals of potential concern
CVCS	chemical and volume control system
CWA	Clean Water Act of 1977 (also known as the Federal Water Pollution Control Act of 1977)
d	day(s)
DBA	design-basis accident
DCH	direct containment heating
DOE	U.S. Department of Energy
DOI	Department of the Interior
DPR	demonstration project reactor
DSM	demand-side management
EDG	emergency diesel generator
EERE	Energy Efficiency and Renewable Energy (DOE)
EFW	emergency feedwater
EIA	Energy Information Administration (of DOE)
EIS	environmental impact statement
ELF-EMF	extremely low frequency-electromagnetic field
EOP	Emergency Operating Procedure
EPA	U.S. Environmental Protection Agency
EPRI	Electric Power Research Institute
EQ	equipment qualification
ER	Environmental Report
ESA	Endangered Species Act of 1973
ESFAS	engineered safety feature actuation system
ESRP	Environmental Standard Review Plan, NUREG-1555, Supplement 1, Operating License Renewal
F	Fahrenheit
FAA	Federal Aviation Administration
FE	(DOE) Fossil Energy

FES	final environmental statement
FR	*Federal Register*
FSAR	final safety analysis report
ft	foot/feet
FWPCA	Federal Water Pollution Control Act (also known as the Clean Water Act of 1977)
FWS	U.S. Fish and Wildlife Service
gal	gallon(s)
GDC	general design criteria
GEIS	Generic Environmental Impact Statement for License Renewal of Nuclear Plants, NUREG-1437
gpm	gallons per minute
GWPS	Gaseous Waste Processing System
ha	hectare(s)
HCLPF	high-confidence, low-probability of failure
HHSI	high head safety injection
HLW	high-level waste
HPSI	high-pressure safety injection
hr	hour(s)
HVAC	heating, ventilation and cooling
Hz	Hertz
in.	inch(es)
IPE	Individual Plant Examination
IPEE	Individual Plant Examination of External Events
ISFSI	independent spent fuel storage installation
ISLOCA	interfacing systems loss-of-coolant accident
IWSA	Integrated Waste Services Association
J	joule(s)
kg	kilogram(s)
km	kilometer(s)
km^2	square kilometer(s)
kV	kilovolt(s)
kV/m	kilovolt per meter
kWh	kilowatt hour(s)

L	liter(s)
lb	pound(s)
LNG	liquefied natural gas
LLW	low-level waste
LOCA	loss-of-coolant accident
LWR	light-water reactor
m	meter(s)
m/s	meter(s) per second
m^2	square meter(s)
m^3/d	cubic meters per day
m^3/s	cubic meter(s) per second
mA	milliampere(s)
MAB	maximum attainable benefit
MACCS2	MELCOR Accident Consequence Code System 2
MGD	million gallons per day
mGy	milligray(s)
mi	mile(s)
mi^2	square mile(s)
mL	milliliter(s)
MOVs	motor-operated valves
mph	miles per hour
mrad	millirad(s)
mrem	millirem(s)
mSv	millisievert(s)
MT	metric ton(s) (or tonne[s])
MTU	metric ton(s)-uranium
MW	megawatt(s)
MWd/MTU	megawatt-days per metric ton of uranium
MW(e)	megawatt(s) electric
MW(t)	megawatt(s) thermal
MWh	megawatt hour(s)
NA	not applicable
NAS	National Academy of Sciences
NCI	National Cancer Institute
NEI	Nuclear Energy Institute
NEPA	National Environmental Policy Act of 1969
NESC	National Electric Safety Code
ng/J	nanogram per joule
NHPA	National Historic Preservation Act of 1966

NIEHS	National Institute of Environmental Health Sciences
NMFS	National Marine Fisheries Service
NO_x	nitrogen oxide(s)
NPDES	National Pollutant Discharge Elimination System
NRC	U.S. Nuclear Regulatory Commission
NREL	National Renewable Energy Laboratory
NWPPC	Northwest Power Planning Council
NWTC	National Wind Technology Center
ODCM	Offsite Dose Calculation Manual
OL	operating license
PAR	passive autocatalytic recombiners
pCi	picocuries(s)
PDS	plant damage state
PM_{10}	particulate matter, 10 microns or less in diameter
ppt	parts per thousand
PRA	Probabilistic Risk Assessment
PSA	Probabilistic Safety Assessment
PSI	pounds per square inch
PSW	plant service water
PWR	pressurized water reactor
RAB	reactor auxiliary building
RAI	request for additional information
RCP	reactor coolant pump
RCS	Reactor Coolant System
REMP	radiological environmental monitoring program
rms	root mean square
RPC	replacement power cost
RWST	Refueling Water Storage Tank
ry	reactor year
s	second(s)
SAG	Severe Accident Guideline
SAMA	Severe Accident Mitigation Alternative
SAMG	Severe Accident Management Guideline
SAR	safety analysis report
SBO	station blackout
SEIS	supplemental environmental impact statement
SER	safety evaluation report

SERI	System Energy Resources, Inc.
SGTR	steam generator tube rupture
SHPO	State Historic Preservation Office
SO_2	sulfur dioxide
SO_x	sulfur oxide(s)
SRWP	Solid Radioactive Waste Program
TBq	terabecquerel
TVA	Tennessee Valley Authority
UALR	University of Arkansas at Little Rock
UDB	urban development boundary
UFSAR	updated final safety analysis report
U.S.	United States
USC	United States Code
USCB	U.S. Census Bureau
USDA	U.S. Department of Agriculture
W/m^2	watts per square meter
yd	yard(s)
yr	year

1.0 Introduction

Under the U.S. Nuclear Regulatory Commission's (NRC) environmental protection regulations in Title 10 of the Code of Federal Regulations (CFR) Part 51, which implement the National Environmental Policy Act of 1969 (NEPA), renewal of a nuclear power plant operating license (OL) requires the preparation of an environmental impact statement (EIS). In preparing the EIS, the NRC staff is required first to issue the statement in draft form for public comment, and then issue a final statement after considering public comments on the draft. To support the preparation of the EIS, the staff has prepared a *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (GEIS), NUREG-1437, Volumes 1 and 2 (NRC 1996, 1999).[a] The GEIS is intended to (1) provide an understanding of the types and severity of environmental impacts that may occur as a result of license renewal of nuclear power plants under 10 CFR Part 54, (2) identify and assess the impacts that are expected to be generic to license renewal, and (3) support 10 CFR Part 51 to define the number and scope of issues that need to be addressed by the applicants in plant-by-plant renewal proceedings. Use of the GEIS guides the preparation of complete plant-specific information in support of the OL renewal process.

Entergy Operations, Inc. (Entergy) operates Arkansas Nuclear One, Units 1 and 2, in west-central Arkansas under OLs DPR-51 and NPF-6, issued by the NRC. Entergy holds the licenses for these units, and is an operating subsidiary of the Entergy Corporation. The OL for Arkansas Nuclear One, Unit 1 was renewed in June 2001, and will expire in 2034. The results of the staff's environmental review for that action can be found in Supplement 3 to NUREG-1437, dated April 2001, which is referenced throughout this document where appropriate. The OL for Arkansas Nuclear One, Unit 2 (ANO-2) will expire on July 17, 2018. On October 15, 2003, Entergy submitted an application to the NRC to renew the ANO-2 OL for an additional 20 years under 10 CFR Part 54. Entergy is a *licensee* for the purposes of its current OL and an *applicant* for the renewal of the OL. Pursuant to 10 CFR 54.23 and 51.53(c), Entergy submitted an Environmental Report (ER) (Entergy 2003a) in which Entergy analyzed the environmental impacts associated with the proposed license renewal action, considered alternatives to the proposed action, and evaluated mitigation measures for reducing adverse environmental effects.

This report is the plant-specific supplement to the GEIS (the supplemental EIS [SEIS]) for the Entergy license renewal application. This SEIS is a supplement to the GEIS because it relies, in part, on the findings of the GEIS. The staff will also prepare a separate safety evaluation report in accordance with 10 CFR Part 54.

(a) The GEIS was originally issued in 1996. Addendum 1 to the GEIS was issued in 1999. Hereafter, all references to the "GEIS" include the GEIS and its Addendum 1.

1.1 Report Contents

The following sections of this introduction (1) describe the background for the preparation of this SEIS, including the development of the GEIS and the process used by the staff to assess the environmental impacts associated with license renewal, (2) describe the proposed Federal action to renew the ANO-2 OL, (3) discuss the purpose and need for the proposed action, and (4) present the status of Entergy's compliance with environmental quality standards and requirements that have been imposed by Federal, State, regional, and local agencies that are responsible for environmental protection.

The ensuing chapters of this SEIS closely parallel the contents and organization of the GEIS. Chapter 2 describes the site, power plant, and interactions of the plant with the environment. Chapters 3 and 4, respectively, discuss the potential environmental impacts of plant refurbishment and plant operation during the renewal term. Chapter 5 contains an evaluation of potential environmental impacts of plant accidents and includes consideration of severe accident mitigation alternatives. Chapter 6 discusses the uranium fuel cycle and solid waste management. Chapter 7 discusses decommissioning, and Chapter 8 discusses alternatives to license renewal. Finally, Chapter 9 summarizes the findings of the preceding chapters and draws conclusions about the adverse impacts that cannot be avoided, the relationship between short-term uses of man's environment and the maintenance and enhancement of long-term productivity, and any irreversible or irretrievable commitment of resources. Chapter 9 also presents the staff's recommendation with respect to the proposed license renewal action.

Additional information is included in appendixes. Appendix A contains public comments related to the environmental review for license renewal and staff responses to those comments. Appendixes B through G, respectively, list the following:

- the preparers of the supplement
- the chronology of NRC staff's environmental review correspondence related to this SEIS
- the organizations contacted during the development of this SEIS
- Entergy's compliance status and copies of consultation correspondence prepared and sent during the evaluation process
- GEIS environmental issues that are not applicable to ANO-2
- severe accident mitigation alternatives.

1.2 Background

Use of the GEIS, which examines the possible environmental impacts that could occur as a result of renewing individual nuclear power plant OLs under 10 CFR Part 54, and the established license renewal evaluation process supports a thorough evaluation of the impacts of the renewal of OLs.

1.2.1 Generic Environmental Impact Statement

The NRC initiated a generic assessment of the environmental impacts associated with the license renewal term to improve the efficiency of the license renewal process by documenting the assessment results and codifying the results in the Commission's regulations. This assessment is provided in the GEIS, which serves as the principal reference for all nuclear power plant license renewal EISs.

The GEIS documents the results of the systematic approach that was taken to evaluate the environmental consequences of renewing the licenses of individual nuclear power plants and operating them for an additional 20 years. For each potential environmental issue, the GEIS (1) describes the activity that affects the environment, (2) identifies the population or resource that is affected, (3) assesses the nature and magnitude of the impact on the affected population or resource, (4) characterizes the significance of the effect for both beneficial and adverse effects, (5) determines whether the results of the analysis apply to all plants, and (6) considers whether additional mitigation measures would be warranted for impacts that would have the same significance level for all plants.

The NRC's standard of significance for impacts was established using the Council on Environmental Quality terminology for "significantly" (40 CFR 1508.27, which requires consideration of both "context" and "intensity"). Using the Council on Environmental Quality terminology, the NRC established three significance levels – SMALL, MODERATE, or LARGE. The definitions of the three significance levels are set forth in the footnotes to Table B-1 of 10 CFR Part 51, Subpart A, Appendix B, 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.

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.

In the GEIS, the staff assigned a significance level to each environmental issue, assuming that ongoing mitigation measures would continue.

In the GEIS, the staff included a determination of whether the analysis of the environmental issue could be applied to all plants and whether additional mitigation measures would be warranted. Issues are assigned a Category 1 or a Category 2 designation. As set forth in the GEIS, **Category 1** issues are those that meet all of the following criteria:

(1) 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 characteristics.

(2) A single significance level (i.e., SMALL, MODERATE, or LARGE) has been assigned to the impacts (except for collective off-site radiological impacts from the fuel cycle and from high-level waste and spent fuel disposal).

(3) 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 not to be sufficiently beneficial to warrant implementation.

For issues that meet the three Category 1 criteria, no additional plant-specific analysis is required in this SEIS unless new and significant information is identified.

Category 2 issues are those that do not meet one or more of the criteria of Category 1, and therefore, additional plant-specific review for these issues is required.

In the GEIS, the staff assessed 92 environmental issues and determined that 69 qualified as Category 1 issues, 21 qualified as Category 2 issues, and 2 issues, environmental justice and chronic effects of electromagnetic fields, were not categorized. Environmental justice was not evaluated on a generic basis and must be addressed in a plant-specific supplement to the GEIS. Information on the chronic effects of electromagnetic fields was not conclusive at the time the GEIS was prepared. Of the 92 issues, 11 are related only to refurbishment, 6 are related only to decommissioning, 67 apply only to operation during the license renewal term, and 8 apply to both refurbishment and operation during the license renewal term. A summary of the findings for all 92 issues in the GEIS is codified in Table B-1 of 10 CFR Part 51, Subpart A, Appendix B.

1.2.2 License Renewal Evaluation Process

An applicant seeking to renew its OL is required to submit an ER as part of its application. The license renewal evaluation process involves careful review of the applicant's ER and assurance

that all new and potentially significant information not already addressed in or available during the GEIS evaluation is identified, reviewed, and assessed to verify the environmental impacts of the proposed license renewal.

In accordance with 10 CFR 51.53(c)(2) and (3), the ER submitted by the applicant must

- provide an analysis of the Category 2 issues in Table B-1 of 10 CFR Part 51, Subpart A, Appendix B, in accordance with 10 CFR 51.53(c)(3)(ii)
- discuss actions to mitigate any adverse impacts associated with the proposed action and environmental impacts of alternatives to the proposed action.

In accordance with 10 CFR 51.53(c)(2), the ER does not need to

- consider the economic benefits and costs of the proposed action and alternatives to the proposed action except insofar as such benefits and costs are either (1) essential for making a determination regarding the inclusion of an alternative in the range of alternatives considered, or (2) relevant to mitigation
- consider the need for power and other issues not related to the environmental effects of the proposed action and the alternatives
- discuss any aspect of the storage of spent fuel within the scope of the generic determination in 10 CFR 51.23(a) in accordance with 10 CFR 51.23(b)
- contain an analysis of any Category 1 issue unless there is significant new information on a specific issue – this is pursuant to 10 CFR 51.53(c)(3)(iii) and (iv).

New and significant information is (1) information that identifies a significant environmental issue not covered in the GEIS and codified in Table B-1 of 10 CFR Part 51, Subpart A, Appendix B, or (2) information that was not considered in the analyses summarized in the GEIS and that leads to an impact finding that is different from the finding presented in the GEIS and codified in 10 CFR Part 51.

In preparing to submit its application to renew the ANO-2 OL, Entergy developed a process to ensure that information not addressed in or available during the GEIS evaluation regarding the environmental impacts of license renewal for ANO-2 would be properly reviewed before submitting the ER, and to ensure that such new and potentially significant information related to renewal of the license for ANO-2 would be identified, reviewed, and assessed during the period of NRC review. Entergy reviewed the Category 1 issues that appear in Table B-1 of 10 CFR Part 51, Subpart A, Appendix B, to verify that the conclusions of the GEIS remained valid with

respect to ANO-2. This review was performed by personnel from Entergy and its support organization who were familiar with NEPA issues and the scientific disciplines involved in the preparation of a license renewal ER.

The NRC staff also has a process for identifying new and significant information. That process is described in detail in *Standard Review Plans for Environmental Reviews for Nuclear Power Plants, Supplement 1: Operating License Renewal* (ESRP), NUREG-1555, Supplement 1 (NRC 2000). The search for new information includes (1) review of an applicant's ER and the process for discovering and evaluating the significance of new information; (2) review of records of public comments; (3) review of environmental quality standards and regulations; (4) coordination with Federal, State, regional, and local environmental protection and resource agencies; and (5) review of the technical literature. New information discovered by the staff is evaluated for significance using the criteria set forth in the GEIS. For Category 1 issues for which new and significant information is identified, reconsideration of the conclusions for those issues is limited in scope to the assessment of the relevant new and significant information; the scope of the assessment does not include other facets of the issue that are not affected by the new information.

Chapters 3 through 7 discuss the environmental issues considered in the GEIS that are applicable to ANO-2. At the beginning of the discussion of each set of issues, there is a table that identifies the issues to be addressed and lists the sections in the GEIS where the issue is discussed. Category 1 and Category 2 issues are listed in separate tables. For Category 1 issues for which there is no new and significant information, the table is followed first by a set of short paragraphs that state the GEIS conclusion codified in Table B-1 of 10 CFR Part 51, Subpart A, Appendix B, and then by the staff's analysis and conclusion. For Category 2 issues, in addition to the list of GEIS sections in which the issue is discussed, the tables list the subparagraph of 10 CFR 51.53(c)(3)(ii) that describes the analysis required and the SEIS sections where the analysis is presented. Discussions of the Category 2 issues are presented immediately following the table.

The NRC prepares an independent analysis of the environmental impacts of license renewal and compares these impacts with the environmental impacts of alternatives. The evaluation of the Entergy license renewal application began with publication of a notice of acceptance for docketing and opportunity for a hearing in the *Federal Register* (FR) (68 FR 65963) on November 24, 2003. The staff published a notice of intent to prepare an EIS and conduct scoping (68 FR 71174) on December 22, 2003. Two public scoping meetings were held on February 3, 2004, in Russellville, Arkansas. Comments received during the scoping period were summarized in the *Environmental Impact Statement Scoping Process: Summary Report – Arkansas Nuclear One, Unit 2, Pope County, Arkansas* (NRC 2004). Comments that are applicable to this environmental review are presented in Part 1 of Appendix A.

The staff followed the review guidance contained in NUREG-1555, Supplement 1, *Standard Review Plans for Environmental Reviews for Nuclear Power Plants, Supplement 1: Operating License Renewal* (NRC 2000). The staff and contractors retained to assist the staff visited the ANO-2 site on February 3 and 4, 2004, to gather information and to become familiar with the site and its environs. The staff also reviewed the comments received during scoping, and consulted with Federal, State, regional, and local agencies. A list of the organizations contacted is provided in Appendix D. Other documents related to ANO-2 were reviewed and are referenced.

A draft SEIS was published for comment in September 2004. The SEIS presents the staff's analysis that considers and weighs the environmental effects of the proposed renewal of the OL for ANO-2, the environmental impacts of alternatives to license renewal, and the mitigation measures available for avoiding adverse environmental effects. Chapter 9, "Summary and Conclusions," provides the NRC staff's recommendation to the Commission on whether or not the adverse environmental impacts of license renewal are so great that preserving the option of license renewal for energy-planning decisionmakers would be unreasonable.

A 75-day comment period began on the date of publication of the U.S. Environmental Protection Agency Notice of Availability of the draft SEIS to allow members of the public to comment on the results of the NRC staff's review. During this comment period, a public meeting was held in Russellville, Arkansas, on October 21, 2004. During this meeting, the staff described the results of the NRC environmental review and answered questions related to it to provide members of the public with information to assist them in formulating their comments.

1.3 The Proposed Federal Action

The proposed Federal action is renewal of the OL for ANO-2. The Arkansas Nuclear One site is located in southwestern Pope County, Arkansas, approximately 91 km (57 mi) northwest of Little Rock, Arkansas, and 109 km (68 mi) east of Fort Smith, Arkansas. The plant has two units; however, only ANO-2 is considered in this SEIS. ANO-2 is a pressurized water reactor designed by Combustion Engineering, with a maximum reactor core power level of 3026 megawatts thermal and a rated electrical output of 1048 megawatts electric. Plant cooling is provided by a closed-cycle cooling system with a natural-draft cooling tower that dissipates heat primarily to the atmosphere. The current OL for Unit 2 expires on July 17, 2018. By letter dated October 15, 2003, Entergy submitted an application to the NRC (Entergy 2003b) to renew this OL for an additional 20 years of operation (i.e., until July 17, 2038).

1.4 The Purpose and Need for the Proposed Action

Although a licensee must have a renewed license to operate a reactor beyond the term of the existing OL, the possession of that license is just one of a number of conditions that must be met for the licensee to continue plant operation during the term of the renewed license. Once an OL is renewed, State regulatory agencies and the owners of the plant will ultimately decide whether the plant will continue to operate based on factors such as the need for power or other matters within the State's jurisdiction or the purview of the owners.

Thus, for license renewal reviews, the NRC has adopted the following definition of purpose and need (GEIS Section 1.3):

> The purpose and need for the proposed action (renewal of an operating license) is to provide an option that allows for power generation capability beyond the term of a current nuclear power plant operating license to meet future system generating needs, as such needs may be determined by State, utility, and where authorized, Federal (other than NRC) decisionmakers.

This definition of purpose and need reflects the Commission's recognition that, unless there are findings in the safety review required by the Atomic Energy Act of 1954 (42 USC 2011 et seq.) or findings in the NEPA environmental analysis that would lead the NRC to reject a license renewal application, the NRC does not have a role in the energy-planning decisions of State regulators and utility officials as to whether a particular nuclear power plant should continue to operate. From the perspective of the licensee and the State regulatory authority, the purpose of renewing an OL is to maintain the availability of the nuclear plant to meet system energy requirements beyond the current term of the plant license.

1.5 Compliance and Consultations

Entergy is required to hold certain Federal, State, and local environmental permits, as well as meet relevant Federal and State statutory requirements. In its ER, Entergy provided a list of the authorizations from Federal, State, and local authorities for current operations as well as environmental approvals and consultations associated with the ANO-2 license renewal. Authorizations and consultations relevant to the proposed OL renewal action are included in Appendix E.

The staff has reviewed the list and consulted with the appropriate Federal, State, and local agencies to identify any compliance or permit issues or significant environmental issues of concern to the reviewing agencies. These agencies did not identify any new and significant environmental issues. The ER states that Entergy is in compliance with applicable environ-

mental standards and requirements for ANO-2. The staff has not identified any environmental issues that are both new and significant.

1.6 References

10 CFR Part 51. Code of Federal Regulations, Title 10, *Energy,* Part 51, "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions."

10 CFR Part 54. Code of Federal Regulations, Title 10, *Energy,* Part 54, "Requirements for Renewal of Operating Licenses for Nuclear Power Plants."

40 CFR Part 1508. Code of Federal Regulations, Title 40, *Protection of Environment*, Part 1508, "Terminology and Index."

68 FR 65963. November 24, 2003. "Notice of Acceptance for Docketing of the Application and Notice of Opportunity for a Hearing Regarding Renewal of License No. NPF-6 for an Additional Twenty-Year Period." *Federal Register*, U.S. Nuclear Regulatory Commission.

68 FR 71174-71175. December 22, 2003. "Notice of Intent to Prepare an Environmental Impact Statement and Conduct Scoping Process." *Federal Register*, U.S. Nuclear Regulatory Commission.

Atomic Energy Act of 1954 (AEA). 42 USC 2011, et seq.

Entergy Operations, Inc. (Entergy). 2003a. *Applicant's Environmental Report – Operating License Renewal Stage Arkansas Nuclear One, Unit 2.* Russellville, Arkansas.

Entergy Operations, Inc. (Entergy). 2003b. *Arkansas Nuclear One – Unit 2, License Renewal Application.* Russellville, Arkansas.

National Environmental Policy Act of 1969, as amended (NEPA). 42 USC 4321, et seq.

U.S. Nuclear Regulatory Commission (NRC). 1996. *Generic Environmental Impact Statement for License Renewal of Nuclear Plants.* NUREG-1437, Volumes 1 and 2, Washington, D.C.

U.S. Nuclear Regulatory Commission (NRC). 1999. *Generic Environmental Impact Statement for License Renewal of Nuclear Plants Main Report, Section 6.3 – Transportation, Table 9.1, Summary of findings on NEPA issues for license renewal of nuclear power plants.* NUREG-1437, Volume 1, Addendum 1, Washington, D.C.

U.S. Nuclear Regulatory Commission (NRC). 2000. *Standard Review Plans for Environmental Reviews for Nuclear Power Plants, Supplement 1: Operating License Renewal.* NUREG-1555, Supplement 1, Washington, D.C.

U.S. Nuclear Regulatory Commission (NRC). 2004. *Environmental Impact Statement Scoping Process: Summary Report – Arkansas Nuclear One, Unit 2, Pope County, Arkansas.* May 20, 2004, Washington, D.C.

2.0 Description of Nuclear Power Plant and Site and Plant Interaction with the Environment

Arkansas Nuclear One, Unit 2 (ANO-2) is located near Interstate Highway 40 (I-40) on a peninsula formed by Lake Dardanelle in southwestern Pope County, Arkansas, approximately 109 km (68 mi) east of Fort Smith and about 91 km (57 mi) northwest of Little Rock. The town of Russellville is about 10 km (6 mi) east-southeast of the site. The site is in the west-central part of the state, approximately 112 km (70 mi) east of the Oklahoma border and about the same distance south from the Missouri border, as shown in Figure 2-1. Arkansas Nuclear One is a two-unit plant, but only ANO-2 is being reviewed for license renewal. Arkansas Nuclear One, Unit 1 (ANO-1) received a renewed license in June 2001, with a license expiration date of May 20, 2034. ANO-2 is equipped with a nuclear steam supply system manufactured by Combustion Engineering that uses a pressurized water reactor (PWR) and a closed-cycle cooling system with a natural-draft cooling tower. The electricity generated is transferred to the switchyards located at the Arkansas Nuclear One site. ANO-2 has a maximum reactor core power level of 3026 megawatts thermal (MW[t]) and a rated electrical output of 1048 megawatts electric (MW[e]). The plant and its environs are described in Section 2.1, and the plant's interaction with the environment is presented in Section 2.2.

2.1 Plant and Site Description and Proposed Plant Operation During the License Renewal Term

ANO-2 is located on the Arkansas Nuclear One site, which occupies 471 ha (1164 ac) in a rural part of west-central Arkansas. Figure 2-2 shows the location of ANO-2 in Arkansas. The site is surrounded by an exclusion area of 1-km (0.7-mi) radius. Entergy Operations, Inc. (Entergy) owns most of the property on the peninsula. The property not owned by Entergy is privately owned. The U.S. Army Corps of Engineers (ACE) also owns easements around Lake Dardanelle.

Based on criteria in the *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (GEIS), NUREG-1437 (NRC 1996, 1999)[a] the region surrounding ANO-2 has a medium population density. Approximately 1260 people compose the nonoutage workforce at the site. Normally, there are 1071 Entergy employees onsite. The remaining 187 people are baseline contractor employees. The plant is located near the towns of London and Russellville, Arkansas. The site is located on a peninsula formed by Lake Dardanelle. Outside the property

(a) The GEIS was originally issued in 1996. Addendum 1 to the GEIS was issued in 1999. Hereafter, all references to the "GEIS" include the GEIS and its Addendum 1.

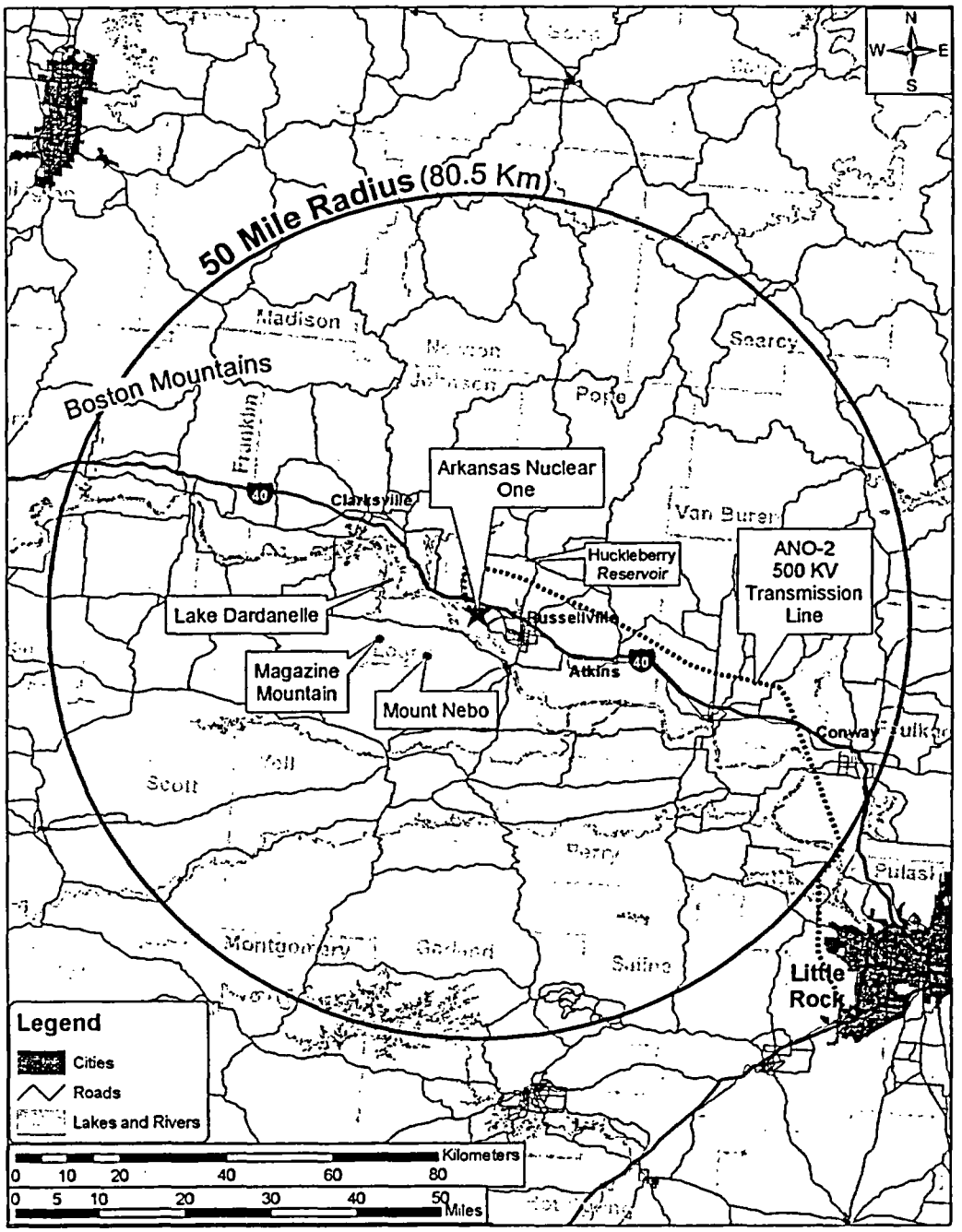

Figure 2-1. Location of Arkansas Nuclear One, Unit 2 80-km (50-mi) Region

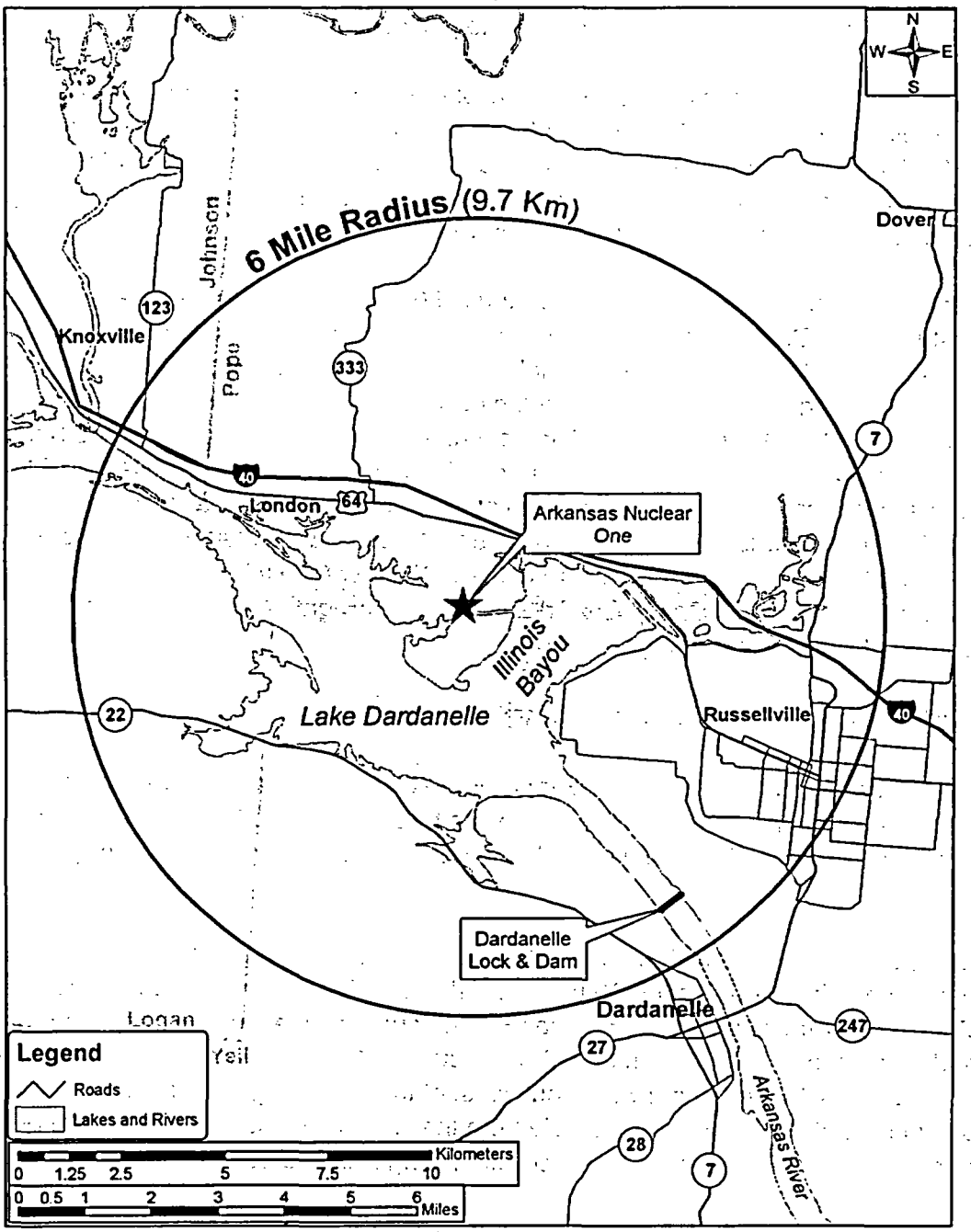

Figure 2-2. Location of Arkansas Nuclear One, Unit 2 10-km (6-mi) Region

line on the southern end of the peninsula, the majority of the land area is forest and residential property. Pasture and croplands are sparse on the peninsula.

The Arkansas Nuclear One site consists primarily of meadows, with surface elevations on the peninsula ranging from about 120 to 150 m (400 to 500 ft). The site has excellent natural drainage. Surface runoff from the site is collected in storm water drains, the intake canal, and the emergency cooling pond from which it is discharged to Lake Dardanelle. The average annual rainfall at the site is approximately 124 cm (49 in.).

Lake Dardanelle is part of the Arkansas River and is 80 km (50 mi) long. The lake was created by the construction of Dardanelle Lock and Dam as part of a multi-purpose project for improvement of the Arkansas River. Dardanelle Lock and Dam facilitates navigation on the river and provides for generation of hydroelectric power, as well as recreational and fish and wildlife resources. The lake was one of 17 impoundments built along the Arkansas River to provide a 724-km (450-mi) navigable channel from the Mississippi River to Catoosa, Oklahoma. Lake Dardanelle is more than 18 m (60 ft) deep at its lower end, and its average depth is 3 m (10 ft). The lake has a surface area of approximately 14,975 ha (37,000 ac) and a storage capacity of 6×10^8 m^3 (486,000 ac-ft). The Arkansas Nuclear One site is about 9.5 km (6 mi) upstream from the Dardanelle Dam. The Arkansas River navigation channel is about 2.2 km (1.4 mi) south of the reactor buildings.

2.1.1 External Appearance and Setting

The cooling tower for ANO-2 is the most distinctive feature of the site and can be seen from a considerable distance. The site is on a 3.2-km-wide by 3.2-km-long (2-mi-wide by 2-mi-long) peninsula on Lake Dardanelle. The peninsula elevation varies from 120 to 150 m (400 to 500 ft).

North of the site, the land gradually ascends to 305 m (1000 ft) to the Boston Mountains, which have a maximum height of 823 m (2700 ft). The Arkansas River flows along the base of the Boston Mountains. Across from the Arkansas River, south and west of the site, is a range of hills, with Mount Nebo at an elevation of 573 m (1880 ft). Magazine Mountain with an elevation of 927 m (3042 ft), is 40 km (25 mi) west-southwest of the site. Magazine Mountain, is the highest point in the state and is clearly visible from the site. The land east and south of the site is moderately level, although it is interspersed with rolling hills and covered with woods.

The geological features of the site are fairly simple. Under the site is a 4- to 7-m (13- to 24-ft) - deep layer of heavy clay or silty clay, which rests on horizontally laid hard shale and sandstone of the McAlester formation. The nearest geological faults are 4 to 8 km (2.5 to 5 mi) from the site and have not been active for more than 65 million years. After intermittent submergence by relatively shallow seas during most of the Paleozoic Period, dramatic episodes of ocean-trough

development and thick sedimentary and volcanic depositions occurred during the late Mississippian time. Mountain folding and faulting, which caused the bedrock features seen today, occurred during the subsequent Pennsylvanian time. The bedrock under the site is part of a large syncline, known as the Scranton syncline, which lies in an east and west direction (AEC 1973).

Entergy has an independent spent fuel storage installation (ISFSI) on the Arkansas Nuclear One site. This ISFSI is authorized pursuant to the general license issued in 10 CFR 72.210. The ISFSI is outside the scope of this OL renewal review.

2.1.2 Reactor Systems

The two units at Arkansas Nuclear One are both PWRs. ANO-2, the unit that is the subject of the current license renewal application, has a Combustion Engineering-supplied nuclear steam supply system and a two-loop reactor system. ANO-2 was licensed and began commercial operation in 1980 (Entergy 2003a), and was initially licensed for an output of 2815 MW(t). In 2002, NRC approved an increase to the maximum reactor core power level to 3026 MW(t), which corresponds to 1048 MW(e).

The primary structures at ANO-2 are its reactor building and auxiliary building, and a common turbine building that is shared with ANO-1. In addition, ANO-2 has a natural-draft cooling tower. The reactor and nuclear steam supply systems are housed in the reactor building. The mechanical and electrical systems required for the safe operation of ANO-2 are located in the auxiliary and reactor buildings. Figure 2-3 shows the general layout of the buildings and structures at the site (Entergy 2003a).

The reactor containment structures for ANO-2 are designed with engineered safety features for protecting the public and plant personnel from an accidental release of radioactive fission products in the unlikely event of a loss-of-coolant accident. The containment structure can withstand an internal pressure of 407 kilopascals (59 psi) above atmospheric pressure. The safety features employed at ANO-2 will help localize, control, mitigate, and terminate events to keep exposure levels to the public below applicable regulatory requirements and guidelines. The reactor is controlled using a combination of chemical controls and solid absorber materials (control rods).

The fuel used in ANO-2 is low enriched uranium oxide enclosed in Zircaloy. The individual fuel rod average burnup is not to exceed 60,000 megawatt-days per metric ton (Entergy 2003a).

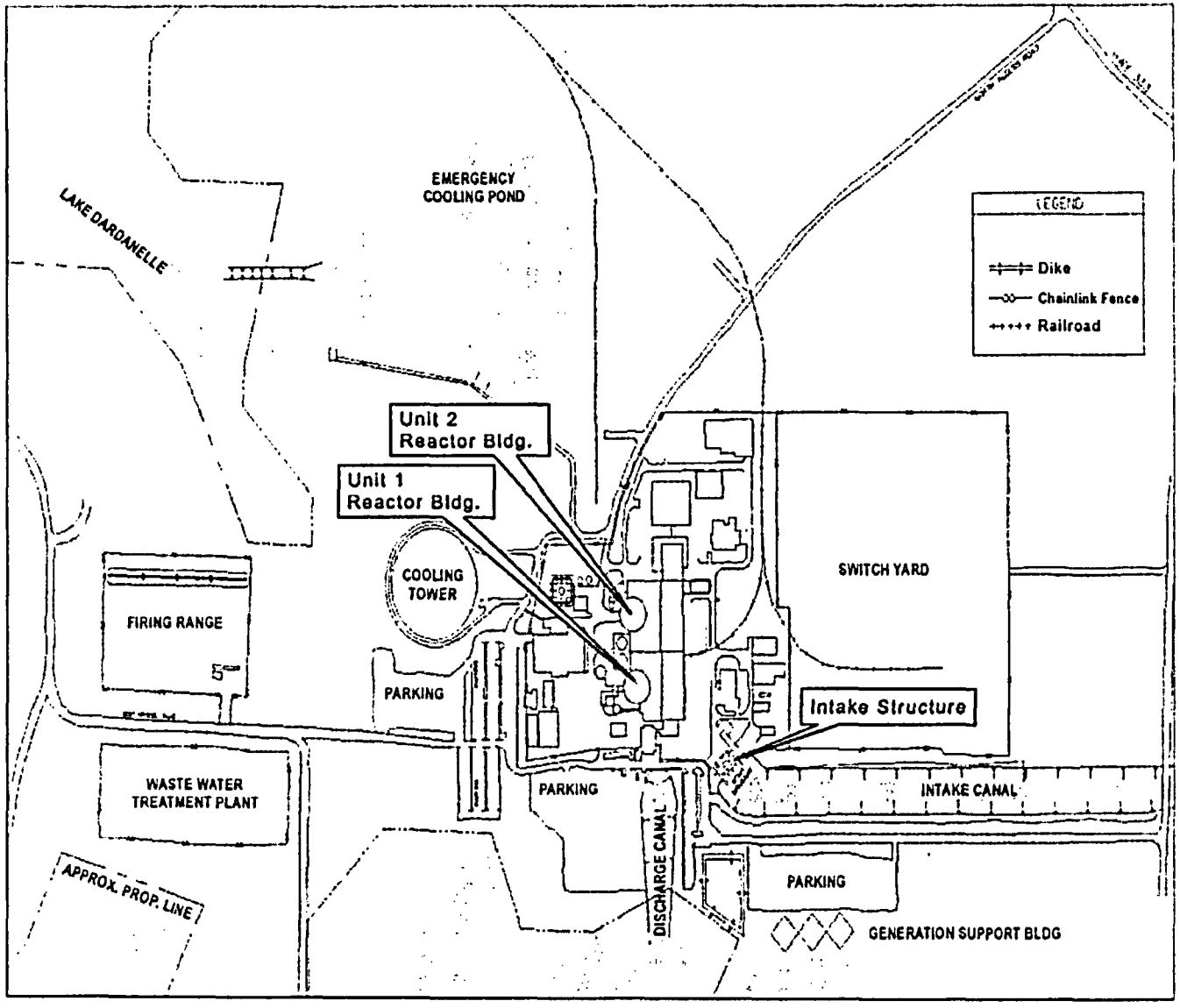

Figure 2-3. Arkansas Nuclear One Site Features

2.1.3 Cooling and Auxiliary Water Systems

ANO-2 uses a closed-cycle cooling system equipped with a natural-draft cooling tower to dissipate waste heat to the atmosphere. After moving through the condenser, circulating water rejects waste heat to the atmosphere through the natural-draft cooling tower. Evaporation in the cooling tower occurs at an average rate of approximately 625 L/s (9900 gpm) with the maximum evaporation rate expected to be approximately 751 L/s (11,900 gpm) (NRC 1977). Remaining waste heat is discharged in the form of blowdown from the circulating water system to a 158-m (520-ft)-long canal that discharges into Lake Dardanelle. This blowdown is mixed with the ANO-1 circulating water system discharge.

The ANO-2 service water system is the source of cooling water for the closed-loop component cooling water system, cooling tower makeup water, and if necessary, the emergency cooling pond. For the ANO-2 service water system, water is drawn from the Illinois Bayou arm of Lake Dardanelle through a 1341-m (4400-ft)-long canal to the ANO-2 intake structure at an average rate of approximately 1000 L/s (16,000 gpm) or about 23 million gpd (NRC 1977; Entergy 2003a). As the water enters the intake structure at an average velocity of approximately 0.10 m/s (0.34 ft/s) (NRC 1977), it passes through bar racks and traveling screens designed to intercept debris. After passing through the traveling screens, the water is pumped to the service water system. Although part of the intake structure, the intake screens and pumps associated with Unit 2 are dedicated only to that unit, and are not associated with Unit 1 during normal operation. There is no communication between the water boxes behind the screens.

There are barriers deployed along the water intake canal and the discharge embankment. One barrier is a block net barrier that is deployed seasonally to control the movement of small fish (primarily threadfin shad) prior to entry into the intake canal from the Illinois Bayou. The other barriers are used for security purposes.

2.1.4 Radioactive Waste Management Systems and Effluent Control Systems

Arkansas Nuclear One uses liquid, gaseous, and solid radioactive waste management systems to collect and process the liquid, gaseous, and solid wastes that are the by-products of operations, before they are released to the environment. The waste disposal systems meet the design objectives of Title 10 of the Code of Federal Regulations (CFR) Part 50, Appendix I (Numerical Guide for Design Objectives and Limiting Conditions for Operation to Meet the Criterion, "As Low As Reasonably Achievable" (ALARA) for Radioactive Material in Light-Water-Cooled Nuclear Power Reactor Effluents). Radioactive material in the reactor coolant is the source of gaseous, liquid, and solid radioactive wastes in PWRs. Radioactive fission products build up in the fuel as a consequence of the fission process. These fission products mostly are

contained in the sealed fuel rods, but small quantities escape and contaminate the reactor coolant. Neutron activation of the primary coolant system also is responsible for coolant contamination.

Nonfuel solid wastes result from treating and separating radionuclides from gases and liquids and from removing contaminated material from various reactor areas. Solid wastes also consist of reactor components, equipment, and tools removed from service, as well as contaminated protective clothing, paper, rags, and other trash generated from plant design modifications, operations, and routine maintenance activities. Solid wastes may be shipped to a waste processor for volume reduction before disposal at a licensed burial site. Spent resins and filters are typically dewatered before packaging for shipment to a licensed offsite processing or disposal facility.

Fuel rods that have exhausted a certain percentage of their fuel and are removed from the reactor core for disposal are called spent fuel. The reactor core is refueled approximately every 18 months. Currently, spent fuel is stored in the spent fuel pool located in the reactor building or in the ISFSI located onsite (Entergy 2003a).

The *Offsite Dose Calculation Manual* (ODCM) for Arkansas Nuclear One (Entergy 2003c), which is subject to NRC inspection, describes the methods and parameters used for calculating offsite doses resulting from radioactive gaseous and liquid effluents. It is also used for calculating gaseous and liquid effluent monitoring alarm/trip set points for release of effluents from Arkansas Nuclear One. Operational limits for releasing liquid and gaseous effluents are specified to ensure compliance with NRC regulations (NRC 1991).

In December 2000, Entergy submitted a request for a license amendment for a power uprate at ANO-2 from 2815 to 3026 MW(t). In April 2002, NRC issued an "Environmental Assessment and Finding of No Significant Impact Related to a Proposed License Amendment to Increase the Licensed Power Level," addressing potential environmental impacts resulting from increasing the licensed power level at ANO-2 to 3026 MW(t). The staff concluded that no significant radiological environmental impacts would be associated with the increase in generating capacity, although the power uprate would result in a small increase of radiological releases assuming a linear relationship between releases and the power increase (NRC 2002).

The systems used at ANO-2 for processing liquid waste, gaseous waste, and solid waste are described in the following sections.

2.1.4.1 Liquid Waste Processing Systems and Effluent Controls

Radioactive liquid waste generated from the operation of ANO-2 may be released to Dardanelle Reservoir in accordance with the limits specified in the ODCM. Liquid wastes enter the reservoir through the discharge canal.

Liquid waste is processed by two major systems: (1) the boron management system, which processes liquids from reactor coolant system bleed and drains, reactor coolant auxiliary system relief valves and drains, and radwaste system relief valves and drains, and (2) the waste management system, which processes waste from various floor drains and sumps. The liquid radwaste system is used to reduce the radioactive material concentrations in liquid wastes before discharge to ensure that they are consistent with limits specified in the ODCM.

Liquids entering the boron management system are degasified to remove hydrogen and fission product gases. The liquid wastes are then transferred to receiver tanks that provide temporary storage to allow for radioactive decay, thus maintaining the radioactivity of releases to the environment ALARA and ensuring that the concentrations in effluent are below the ODCM limits. Wastes from the receiver tanks are processed through a vendor-supplied, skid-mounted processing system or the installed pre-concentrator filter and pre-concentrator ion exchanger to the waste condensate tanks or the boric acid condensate tank. Sampling and release of liquid waste from the monitor tank is performed on a batch basis, rather than a continuous basis, to provide better control over effluent discharge. If the activity level in the monitor tank is within discharge limits, the liquid may be released to the circulating water system discharge in a controlled, monitored fashion to meet the administrative limits in the ODCM. If radionuclide levels in the liquids exceed the discharge limits, they are returned to the receiver tank for additional decay time and treatment.

Liquids entering the waste management system are expected to contain lower levels of activity than those in the boron management system, and are collected in one of two sections of a drain tank. When there is sufficient volume in the online waste tank, the contents are transferred to the boron management system holding tank for processing either with boron management system wastes or directly with the vendor processing skid to a waste condensate tank or a boric acid condensate tank. The holding tank waste may be recirculated for processing prior to transfer. If radionuclide concentrations in the filtered waste tank exceed discharge limits, the wastes are transferred to the clean liquid radwaste system for additional treatment.

Liquid effluents are monitored continuously as wastes are discharged, and effluent release is automatically discontinued if monitors indicate that radionuclide concentrations in the wastes exceed permitted levels. Waste tanks are vented to a gas collection header and purged with nitrogen to remove any accumulated gases.

Controls for limiting the release of radiological liquid effluents are described in the ODCM. Controls are based on (1) concentrations of radioactive materials in liquid effluents and projected dose or (2) dose commitment to a member of the public. Concentrations of radioactive materials that may be released in liquid effluents to unrestricted areas are limited to the concentration specified in 10 CFR Part 20, Appendix B, Table 2, for radionuclides other than dissolved or entrained noble gases. The total concentration of dissolved or entrained noble gases in liquid releases is limited to 7.4 Bq/mL (2×10^{-4} µCi/ml). The ODCM dose limits are 0.015 mSv (1.5 mrem) to the total body and 0.05 mSv (5 mrem) to the critical organ during any calendar quarter, and 0.03 mSv (3 mrem) to the whole body and 0.10 mSv (10 mrem) to the critical organ during the calendar year. Radioactive liquid wastes are subject to the sampling and analysis program described in the ODCM.

During calendar year 2002, ANO-2 released a total of 2.06×10^{13} Bq (557.6 Ci) of radioactive material in liquid effluents. There were 107 batch releases with a total volume of 1.33×10^{12} L of dilution water (Entergy 2003c).

Entergy does not anticipate any increase on an annual basis in liquid waste releases during the renewal period (Entergy 2003c).

2.1.4.2 Gaseous Waste Processing Systems and Effluent Controls

Radioactive gases generated by fission and neutron activation of materials in the plant are managed by the Gaseous Waste Processing System (GWPS). Radioactive constituents in gaseous effluents include noble gases, iodine, tritium, and fine particulate materials. Radioactive gaseous effluents generated from operation of ANO-2 are released to the atmosphere through the main vent stacks or the turbine building ventilation exhaust. Smaller, intermittent releases may also take place through the emergency air lock, the plant compressed air system, the main steam line penetrations, the containment equipment hatch, and the auxiliary feedwater pumps.

The GWPS collects, stores, and disposes of gases from the liquid radwaste vacuum degasifiers, the volume control tanks, and other miscellaneous hydrogenated sources associated with the primary reactor cooling system. During normal operation, the GWPS is designed to store gases to allow for radioactive decay before release. The GWPS consists of a surge tank, two compressors, waste gas decay tanks, and several filter systems. Each of the filter systems contains a roughing filter, a high-efficiency particulate air filter, and a charcoal absorber. The gas storage tanks are sampled prior to release via the gaseous waste discharge header. Both activity and flow rates in the discharge stream are continuously monitored to ensure that the effluents comply with discharge limits.

The GWPS also processes effluents from the auxiliary system equipment and tanks, the spent fuel storage area ventilation, and the radwaste area ventilation. These effluents contain air and are separated from the hydrogenated primary system effluents to minimize the potential for explosion. These effluents typically contain low levels of activity and are released directly to the station vent plenum through a filter system. These effluents are continuously monitored as they are released, and are diverted to the GWPS surge tank for additional storage and decay if they exceed discharge limits.

Entergy maintains gaseous releases within ODCM limits. The GWPS is used to reduce the radioactive material in gaseous effluents prior to discharge to meet the dose design objectives in 10 CFR Part 50, Appendix I. In addition, the limits in the ODCM are designed to provide reasonable assurance that radioactive material discharged in gaseous effluents would not result in the exposure of a member of the public in an unrestricted area in excess of the limits specified in 10 CFR Part 20, Appendix B.

The quantities of gaseous effluents released from ANO-2 are controlled by the administrative limits defined in the ODCM. The controls are specified for dose rate, dose due to noble gases, and dose due to iodine and radionuclides in particulate form. For noble gases, the dose rate limit at or beyond the site boundary is 5 mSv/yr (500 mrem/yr) to the total body and 30 mSv/yr (3000 mrem/yr) to the skin. For iodine and particulates with half lives greater than 8 days, the limit is 15 mSv/yr (1500 mrem/yr) to any organ. The limit for air dose due to noble gases released in gaseous effluents to areas at or beyond the site boundary during any calendar quarter is 0.05 mGy (5 mrad) for gamma radiation and 0.1 mGy (10 mrad) for beta radiation. For any calendar year, the limit is 0.1 mGy (10 mrad) for gamma radiation and 0.2 mGy (20 mrad) for beta radiation. The radioactive gaseous waste sampling and analysis program specifications in the ODCM address the gaseous release type, sampling frequency, minimum analysis frequency, type of activity analysis, and the lower limit of detection (Entergy 2003c).

During 2002, ANO-2 released 1.4×10^{12} Bq (28.1 Ci) in ground-level gaseous releases. These releases were made up of fission gases, iodines, and particulates (Entergy 2003c).

Entergy does not anticipate any increase on an annual basis in gaseous waste releases during the license renewal term (Entergy 2003a).

2.1.4.3 Solid Waste Processing

The Solid Radioactive Waste Program (SRWP) at Arkansas Nuclear One provides for solidification, stabilization, encapsulation, and packaging of wastes. The SRWP processes wastes from the liquid and gaseous effluent treatment systems, as well as other miscellaneous solid wastes generated during plant operation and maintenance. Solid waste is packaged in containers to meet the applicable requirements of 10 CFR Parts 61 and 71 for transportation

and disposal. The SRWP provides the capability for preparing solid waste that can be shipped to an offsite treatment or disposal facility. The system is designed to maintain radiation exposure ALARA for personnel who handle solid wastes and to minimize the quantities of solid waste generated at the plant.

The SRWP manages high specific activity wastes from the liquid and gaseous effluent treatment systems, which consist mainly of spent ion exchanger resin and filter cartridges. Spent ion exchanger resin is transferred to a storage tank where it is held for radioactive decay. The resins are dewatered or solidified prior to shipment offsite for disposal. Radioactive filters are transported from each filter housing to the waste disposal area. Other dry active wastes are packaged in a low-level waste work area. Volume reduction treatments such as shredding or compaction may be used where appropriate. All solid wastes are packaged in containers suitable for transfer to an offsite treatment or disposal facility.

Entergy stores both high specific activity wastes and dry active wastes at Arkansas Nuclear One in an onsite Low-Level Radioactive Waste Storage Building where the wastes are prepared for shipment to offsite treatment or disposal facilities. The storage facility is designed to accommodate more than 5 years of expected waste generated at ANO-2, based on normal operation and generation. The functions of the facility include interim storage of high specific activity wastes, dry active wastes, and other radioactively contaminated materials; receiving, sorting, compacting, packaging, and shipment of dry active waste; and office space for radwaste management activities. The high specific activity wastes storage area provides shielding as needed to minimize doses to nearby workers, as well as remote-handling equipment for high specific activity wastes containers. Dose rates within the facility are continuously monitored. The facility ventilation system operates at negative pressure, and effluents are continuously monitored after passing through a high-efficiency particulate air filter system to remove particulate materials. A separate shielded facility is available for temporary storage of radioactively contaminated but reusable tools and equipment.

All radioactive waste shipments from ANO-2 are packaged in accordance with NRC and U.S. Department of Transportation requirements. The type and quantities of solid radioactive waste generated and shipped from Arkansas Nuclear One would vary from year to year depending on plant activities. Currently, the radioactive waste is shipped to licensed facilities in Oak Ridge, Erwin, and Memphis, Tennessee. In 2002, 19 shipments consisting of approximately 432 cubic meters of solid waste (spent ion exchange resins, dry compressible waste, contaminated equipment, and irradiated components) were shipped from Arkansas Nuclear One (Entergy 2003c).

2.1.5 Nonradioactive Waste Systems

Nonradioactive wastes at ANO-2 are generated primarily from plant maintenance and cleaning processes. The wastes are produced by the boiler blowdown, water treatment sludges and other wastes, boiler metal cleaning wastes, floor and yard drains, and storm water runoff. Processes used to control the pH in the coolant, control scale, regenerate resins, and clean and defoul the condenser produce some chemical and biocide wastes. The waste liquids are typically combined with cooling water discharges. Sanitary waste water is treated at an onsite facility before discharge under a National Pollutant Discharge Elimination System (NPDES) permit (see Section 2.2.3) from the Arkansas Department of Environmental Quality (ADEQ) (Entergy 2003a).

Nonradioactive gaseous effluents result from operation of the oil-fired boiler used to heat the plant and from testing of the emergency diesel generators. Discharge of regulated pollutants is minimized by use of low-sulfur fuels and is within Arkansas air quality standards (Entergy 2003a).

2.1.6 Plant Operation and Maintenance

Routine maintenance performed on plant systems and components is necessary for safe, reliable operation of a nuclear power plant. Some of the maintenance activities conducted at ANO-2 include inspection, testing, and surveillance to maintain the current licensing basis of the plant and to ensure compliance with environmental and public safety requirements. Certain activities can be performed while the reactor is operating. Others require that the plant be shut down. Long-term outages are scheduled for refueling and for certain types of repairs or maintenance, such as replacement of a major component. Scheduled refueling outages commonly occur every 18 months and last approximately 30 days. Based on the activities scheduled for the outage, an additional 1300 to 1400 workers may typically be onsite during an outage. During the license renewal term, it is not expected that additional temporary staff will be needed during outages (Entergy 2003a).

Entergy performed an aging management review; the results are described in Section 3 of its license renewal application (Entergy 2003e). Section 3 has a summary of the information from the aging management review; the aging management programs are described in Appendix B of the application. The results of the review are compared with NUREG-1801, *Generic Aging Lessons Learned (GALL) Report* (NRC 2001a). This review fulfills the requirements of 10 CFR 54.21(a). The aging management review identified some new inspection activities necessary to continue operation of ANO-2 during the license renewal term. Entergy does not expect to add additional non-outage staff during the license renewal term (Entergy 2003a).

2.1.7 Power Transmission System

One approximately 146-km (91-mi)-long, 500-kV, single-circuit transmission line connects ANO-2 to the electric grid. It extends from the existing ANO-2, 500-kV station switchyard southeasterly via the Mayflower substation (southwest of Mayflower) to the Mabelvale substation (southwest of Little Rock) (Entergy 2003a). Figure 2-4 shows the location of the ANO-2 transmission line. This 500-kV transmission line was constructed at the same time ANO-2 was constructed, and was energized in 1976 (Entergy 2003a). If ANO-2 was removed from service, this transmission line would continue to carry area transmission loads (Entergy 2003a).

The transmission line right-of-way is 55 m (180 ft) wide (NRC 2001b), encompasses 730 ha (1804 ac) (Table 2-1), and crosses land that consists of rural property, forestland, and to a limited degree, agricultural and timber production operations (Entergy 2003a). The transmission line right-of-way does not cross State or Federal parks, wildlife refuges, or wildlife management areas (Entergy 2003a).

Vegetation management along the ANO-2 transmission line right-of-way is performed approximately every 4 years and consists of mechanical and manual clearing only. No herbicides are used. Mechanical clearing employs tractors with mowing and tree-cutting equipment in the open areas of the right-of-way, while manual clearing involves cutting trees around poles, down guys, anchor rods, and structure legs and foundations, and at fences and road crossings. Hazard trees (trees that pose an immediate threat to line reliability because they are leaning toward the line or are subject to falling on the line because of advanced soil erosion) outside the right-of-way are also removed or topped. Semiannually, an aerial survey of the transmission line right-of-way is performed to identify issues that would cause potential operational problems (e.g., erosion, vegetation control, equipment maintenance, etc.) (Entergy 2003a, b).

Table 2-1. Arkansas Nuclear One, Unit 2 Transmission Line Right-of-Way

Substation	Number of Lines	kV	Approximate Distance		Corridor	Right-of-way Width		Right-of-way Area	
			km	(mi)		m	(ft)	hectares	(acres)
Mabelvale	1	500	146	91	Southeast	55	180	730	1804

Source: Entergy 2003a.

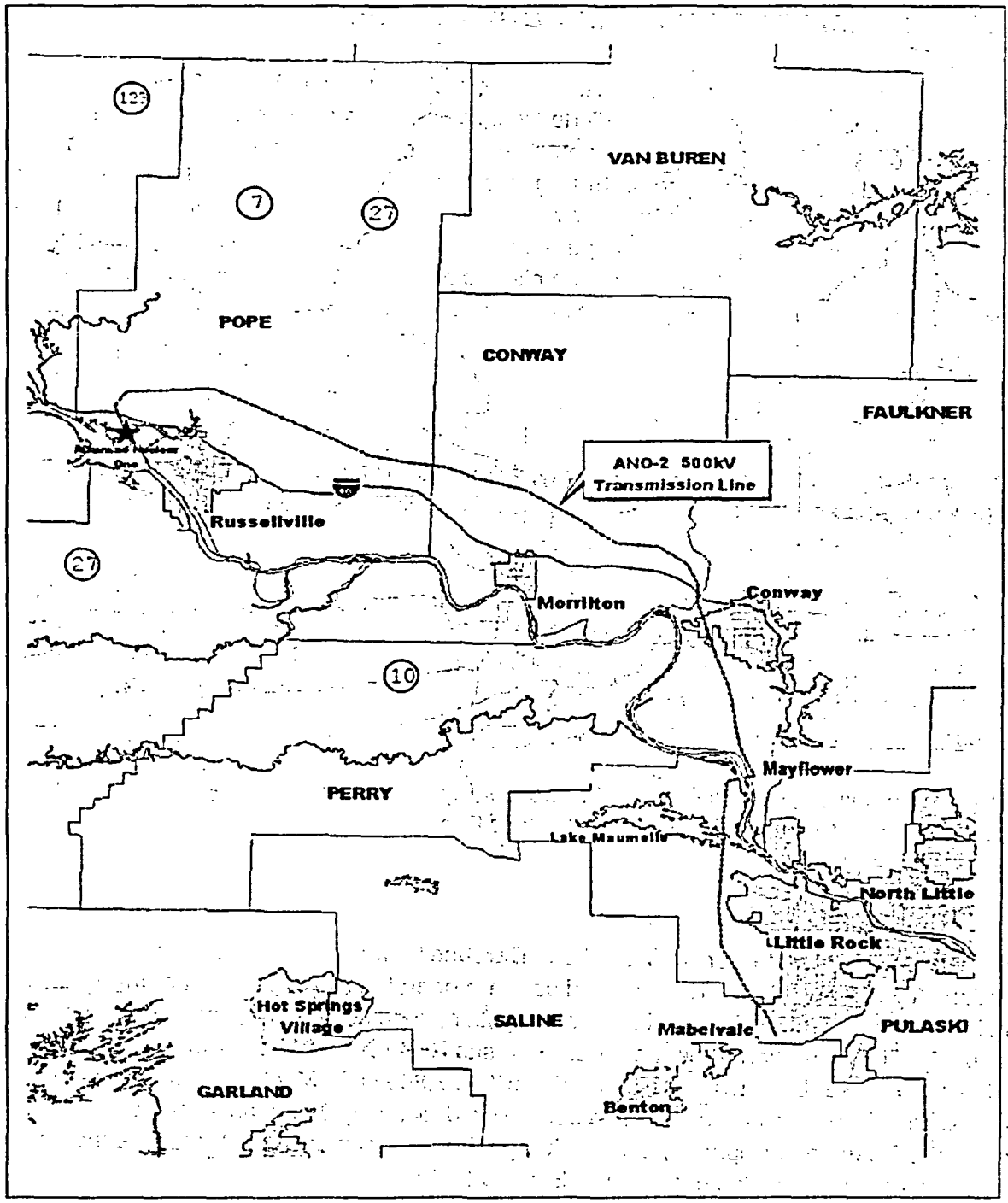

Figure 2-4. Arkansas Nuclear One, Unit 2 Transmission Line

2.2 Plant Interaction with the Environment

Sections 2.2.1 through 2.2.8 provide general background information about the environment near ANO-2. Detailed descriptions are included where needed to support the analysis of potential environmental impacts of refurbishment and operation during the license renewal term, as discussed in Chapters 3 and 4. Entergy's evaluation of structures and components, as required by 10 CFR 54.21, did not identify any major plant refurbishment activities or modifications necessary to support the continued operation of ANO-2 beyond the end of the existing operating license. Section 2.2.9 describes the historic and archaeological resources in the area, and Section 2.2.10 describes possible impacts associated with other Federal project activities.

2.2.1 Land Use

ANO-2 is located in southwestern Pope County, Arkansas. The plant site is approximately 10 km (6 mi) west-northwest of the town of Russellville, which is also the county seat of Pope County.

The plant site occupies 471 ha (1164 ac). The plant site is on a peninsula in Lake Dardanelle, which is formed by the Dardanelle Lock and Dam on the Arkansas River. The site topography is primarily flat. The peninsula is approximately 3 km (2 mi) wide by 3 km (2 mi) long. Forests and residential development cover the majority of the peninsula. Pasture and croplands are insignificant to nonexistent on the peninsula.

The site is in an unincorporated portion of Pope County. No land-use or zoning restrictions are applicable to land within unincorporated portions of Pope County.

2.2.2 Water Use

The primary source of water for ANO-2 is Lake Dardanelle, which is the impoundment created by Dardanelle Lock and Dam. The lock and dam are operated by ACE as part of the Arkansas River Navigation Project, which provides for navigation, flood control, hydropower production, water supply, and recreation throughout the Arkansas River Basin. The average annual flow for the Arkansas River at Lake Dardanelle is 1070 m^3/s (37,800 cfs). Monthly average stream flows of less than 40 m^3/s (1400 cfs) have been recorded in only 3 months since 1977. Currently, ACE has no anticipated plans to change the operation of Lake Dardanelle that might affect the water supply available to ANO-2 (Entergy 2000).

The demand for Lake Dardanelle water from other downstream users is low, and there is no reported water availability problem on the lake. Other than Arkansas Nuclear One, there are

only three registered off-stream users of water from the lake. During 2000, about 0.14 m^3/s (5 cfs) was diverted from the lake for irrigation, mining, and water supply uses (ASWCC 2002). Although relatively small, the consumptive loss of water at ANO-2 removes water from potential hydropower uses downstream. Entergy, therefore, annually pays ACE for the loss of water that would otherwise be used for hydropower generation at Dardanelle Lock and Dam. Compensation in the amount of approximately $11,000 per year is made for combined evaporative water losses from both generating units at Arkansas Nuclear One.

Evaporative losses from the ANO-2 cooling tower are estimated to average 0.62 m^3/s (22 cfs) annually with the maximum annual average of 0.76 m^3/s (27 cfs). No groundwater is withdrawn for either ANO-1 or ANO-2. Both units share about 1.1 L/s (17 gpm) of water purchased from City Corporation water system, which is owned by the City of Russellville. This purchased water is used to serve potable water demands at both units.

2.2.3 Water Quality

Besides serving the needs of ANO-2, Lake Dardanelle serves a variety of other uses. Its water quality has been designated as suitable for the propagation of fish and wildlife, primary and secondary contact recreation, and public and industrial water supplies.

Discharges from the plant's cooling tower blowdown, liquid radioactive waste system, sanitary waste system, sumps, and drains are returned to Lake Dardanelle via the discharge canal. Pursuant to the Federal Water Pollution Control Act (33 USC 1251), also known as the Clean Water Act of 1977, the water quality of plant effluent discharges is regulated through the NPDES. ADEQ is delegated by the U.S. Environmental Protection Agency to issue the NPDES permit. The current permit (AR0001392) was issued on January 1, 2003, and is due to expire on December 31, 2007 (ADEQ 2002). The requirements of any new or amended regulations promulgated by the U.S. Environmental Protection Agency or the ADEQ would be addressed in future permits. Under the conditions of the NPDES permit, discharge limitations are imposed on total residual oxidants, oil and grease, temperature, zinc, and pH. Biomonitoring of the plant discharge is also required under the terms of the permit.

2.2.4 Air Quality

ANO-2 is located in west-central Arkansas, approximately midway between Fort Smith and Little Rock. It is on Lake Dardanelle at an elevation of about 120 m (400 ft) above mean sea level. To the north of the site are the Boston Mountains, and the Ouachita Mountains are to the south.

Pope County, in which ANO-2 is located, is hot in the summer and moderately cool during the winter, and has fairly heavy rainfall that is well distributed throughout the year (USDA 1981).

Climatological records for Russellville, which would generally be representative of the site, show normal daily maximum temperatures ranging from about 11°C (51°F) during January to about 34°C (93°F) during July; normal daily minimum temperatures range from about -3°C (27°F) during January to about 21°C (69°F) during July. Precipitation averages about 124 cm (49 in.) per year, with an average of about 7 cm (3 in.) of snow per year. Based on statistics for the 30-year period from 1954 through 1983, the probability of a tornado striking the site is estimated to be approximately 3×10^{-4} per year (Ramsdell and Andrews 1986).

The primary wind resources in Arkansas are found in the Ouachita Mountains south of the site and in the Boston Mountains north of the site (Elliott et al. 1986). In these areas, wind power densities are estimated to be in the 400 to 500 W/m^2 range at 50 m (164 ft) above ground. For the remainder of the state, the wind power density is estimated to be less than 300 W/m^2.

Pope County is in the Central Arkansas Intrastate Air Quality Control Region (40 CFR 81.138). Air quality for this air quality control region is designated as better than national standards in attainment, or unclassifiable for all primary pollutants (40 CFR 81.304). Air quality indices (40 CFR Part 58, Appendix G), which are calculated for metropolitan statistical areas, provide air quality information for the public. The closest metropolitan statistical area to the Arkansas Nuclear One site is the Little Rock/North Little Rock area, which is approximately 75 mi from the site. During the years 2000, 2001, and 2002, the average number of days the Air Quality Index (AQI) for the Little Rock area exceeded 100 was about 10 days per year. Ozone concentrations caused the AQI to exceed 100 each of these days (EPA 2003). An AQI of 100 or less indicates good to moderate air quality. Air quality in Pope County is expected to be better than the air quality in the Little Rock area.

Several diesel generators and boilers are used at the Arkansas Nuclear One site. Emissions from these generators and boilers are limited by an air permit issued by ADEQ under the Clean Air Act (42 USC 2011). The permit limits the fuel usage and hours of operation of these emission sources. In practice, the sources are only operated a small fraction of the permitted hours.

The Caney Creek and Upper Buffalo Wilderness Areas are the closest wilderness areas to the site. These areas are designated in 40 CFR 81.404 as mandatory Class I Federal areas in which visibility is an important value. The Caney Creek Wilderness Area is more than 160 km (100 mi) from the Arkansas Nuclear One site, but the Upper Buffalo Wilderness Area is within 80 km (50 mi) of the site.

2.2.5 Aquatic Resources

Lake Dardanelle was created when Dardanelle Lock and Dam was constructed on the Arkansas River. The river was impounded and the lake formed in 1967. The water level of the lake is controlled at Dardanelle Dam and other dams on the Arkansas River. The cooling water intake structure for ANO-1 and ANO-2 is located at the end of a constructed canal that connects to the Illinois Bayou embayment. Discharge from both units is through a small canal connecting to the discharge embayment and Lake Dardanelle.

Lake Dardanelle also is designated as suitable for propagation of fish and wildlife, recreation, and public and industrial water supplies. The water quality of Lake Dardanelle is monitored by ADEQ. Water-based recreation activities, such as boating and fishing, are a focal point of interest, and the lake supported more than 40 fishing tournaments in 2004. Additionally, the region around the lake is used for camping, picnicking, sightseeing, photography, and nature studies. The lake also has a commercial fishing industry.

The various trophic communities of Lake Dardanelle have been surveyed and monitored over the years (Rickett 1994). Phytoplankton populations are diverse and fluctuate seasonally. Green algae (Chlorophyta) are the dominant algal group throughout the year. Diatoms (Chrysophyta) are secondary in abundance and the bluegreens (Cyanophyta) and dinoflagellates (Pyrrhophyta) are minor constituents. Zooplankton abundance varies seasonally. Rotifers dominate during the early summer. Other zooplankton species occurring at Lake Dardanelle include *Kellicottia bostoniensis*, *Platyias patulus*, *Brachionus* spp., *Keratella cochlearis*, *Polyarthra* sp., and *Leptodora kindtii*. The benthic community includes Chironomidae, Oligochaeta, and Sphaeriidae (Rickett and Watson 1994). Additional benthic organisms that have been introduced into Lake Dardanelle include the *Corbicula fluminea* and *Dreissena polymorpha*. However, observations by Entergy staff have indicated that the numbers of these introduced mollusks has been decreasing over the last few years.

The fish community of the area varies with the currents that exist in various parts of the lake. Flathead catfish (*Pylodictis olivaris*), channel catfish (*Ictalurus punctatus*), and blue catfish (*Ictalurus furcatus*) occur where there is a current. Largemouth bass (*Micropterus salmoides*), spotted bass (*Micropterus punctulatus*), green sunfish (*Lepomis cyanellus*), bluegill sunfish (*Lepomis macrochirus*), black crappie (*Pomoxis nigromaculatus*), white crappie (*Pomoxis annularis*), and warmouth (*Lepomis gulosus*) are found in slack water areas of Lake Dardanelle and Illinois Bayou.

The fish community near the site also changes seasonally. Striped bass (*Morone saxatilis*) and white bass (*Morone chrysops*) are generally more abundant in the spring. Rough or commercial fishes are generally abundant throughout the year. These fish include European carp (*Cyprinus carpio*), bigmouth buffalo (*Ictiobus cyprinellus*), black buffalo (*Ictiobus niger*),

smallmouth buffalo (*Ictiobus bubalus*), carpsuckers (*Carpiodes* spp.), freshwater drum (*Aplodinotus grunniens*), and redhorses (*Moxostoma* spp.). The most important forage fish species in the lake are gizzard shad (*Dorosoma cepedianum*) and threadfin shad (*Dorosoma petenense*).

Arkansas Nuclear One is considered to be beneficial to fish and wildlife of the region. The site provides a number of diverse habitats such as fields, hardwood stands, conifer stands, and wetlands. There are numerous transitional areas or edge communities resulting in high-quality habitats for species diversity. The cooling water intake canal provides habitat for numerous species of fish. During warm months, the intake flow mixes warm, less oxygenated surface water with cool, more highly oxygenated channel water from Illinois Bayou, thus providing a highly productive habitat within the canal. Numerous species of fish and waterfowl migrate to the warm water effluent during cold water conditions. The use of the intake and discharge canals by fish communities provides a fishery for the local sports fishers. A variety of recreationally important fish species are thought to congregate in the vicinity of the block net barrier in the Illinois Bayou Embayment at the mouth of the intake canal, as well as the security barrier in the discharge embayment. The fish are probably attracted to the nets in what is otherwise a rather scoured and muddy bottom in the waterways.

A small, inundated wetland south of the effluent bay provides habitat for mammals, fish, reptiles, amphibians, and waterfowl. The aquatic environment at the site provides habitat for fish and wildlife, thus providing fishing, hunting, and other recreational opportunities for the public throughout the area.

Based on consultation with the U.S. Fish and Wildlife Service (FWS), one species of fish, the Arkansas shiner (*Notropis girardi*), is Federally listed as threatened and has been reported from the Arkansas River (Table 2-2) (Entergy 2003a). This small (usually less than 5 cm [2 in.]) shiner is straw-colored with silvery sides, and has scattered brown flecks on its sides behind the head.

The Arkansas River shiner was thought to occur throughout the Arkansas River main channel and its major tributaries. Because of declines in stream flow during the summer months when

Table 2-2. Federally Listed and Arkansas State-Listed Aquatic Species Potentially Occurring in Pope County, Arkansas, in the Vicinity of Arkansas Nuclear One, Unit 2

Scientific Name	Common Name	Federal Status[a]	State Status[a]
Notropis girardi	Arkansas River shiner	Threatened	No listing

(a) Source: Entergy 2003a, 2004b

the shiner is spawning, its distribution has decreased to a few stream reaches in Kansas, Oklahoma, and Texas (Kansas Wildlife and Parks 2004). It is likely extirpated from the Arkansas River in Arkansas (FWS 2004a). Critical habitat has been designated for the Arkansas River shiner, but not in Arkansas or Lake Dardanelle.

Consultation with the Arkansas National Heritage Commission (ANHC) and Arkansas Game and Fish Commission (AGFC) was initiated by Entergy in September 2002 with letters requesting information about the presence of State listed species on and in the vicinity of ANO-2 and its transmission line right-of-way. No State-listed aquatic species were identified by either the ANHC or AGFC as occurring on or in the vicinity of ANO-2 or its transmission line right-of-way (Entergy 2003a).

2.2.6 Terrestrial Resources

ANO-2 and its associated transmission line right-of-way lie within the oak-hickory biome of the eastern deciduous forest. This biome ranges from dense forests of oaks (*Quercus* spp.) and hickory (*Carya* spp.) to more open savanna habitat. Eastern redcedar (*Juniperus virginiana*) and shortleaf pine (*Pinus echinata*) are common in the open habitats (NRC 2001b).

The ANO-2 site is largely industrial and has experienced extensive alteration of its original vegetation cover. Vegetation at the site includes mixed pine and hardwood forest and disturbed, early successional habitat (Table 2-3). Approximately 2 ha (5 ac) of wetlands are present on the site (Table 2-3) (NRC 2001b). The transmission line right-of-way crosses lands that consist of rural property, forestland, and to a limited degree, agricultural and timber production operations (Entergy 2003a).

Mammals at the ANO-2 site and transmission line right-of-way include white-tailed deer (*Odocoileus virginianus*), raccoon (*Procyon lotor*), red and grey foxes (*Vulpes fulva* and *Urocyon cinereoargenteus*), eastern gray and fox squirrels (*Sciurus carolinensis* and *S. niger*), eastern chipmunk (*Tamias striatus*), and a variety of mice and voles. White-tailed deer are the most important game mammal (NRC 2001b).

The open water of Lake Dardanelle (Table 2-3) and the emergent wetland habitat support a number of migrant waterfowl species, including common mergansers (*Mergus merganser*) and double-crested cormorants (*Phalacrocorax auritus*). Osprey (*Pandion haliaetus*) use the lake areas near the ANO-2 site. American white pelicans (*Pelecanus erythrorhynchos*) use the open water habitats of the reservoir. Great blue herons (*Ardea herodias*) nest in trees near the site (NRC 2001b).

Table 2-3. Land Cover at the Arkansas Nuclear One, Unit 2 Site

Land Cover Class	Area, ha (acres)	Percentage of Site
Mixed pine-hardwood forest	187 (461)	40
Early successional habitats	196 (485)	41
Developed areas	73 (180)	15
Open water	12 (30)	3
Wetlands	2 (5)	1

Source: Entergy 2003a and NRC 2001b.

No State-listed species were identified by ANHC as occurring on or in the vicinity of the ANO-2 site or its transmission line right-of-way. However, ANHC identified two plant species that occur in the vicinity of the transmission line right-of-way and three habitat areas crossed by the transmission line right-of-way that are of special concern (Table 2-4) (Entergy 2003a).

Table 2-4. Plant Species and Habitat Areas of Special Concern Along the Arkansas Nuclear One, Unit 2 Transmission Line Right-of-Way

Name	Common Name	Federal Status	State Status	Reason for ANHC Listing
Plants				
Philadelphus hirsutus	mock orange	None	None	Uncommon in the state; disjunct from its eastern range
Castanea pumila var. *ozarkensis*	Ozark chinquapin	None	None	Declining numbers due to chestnut blight
Habitats				
Illinois Bayou	--	None	Extraordinary Resource Waters	Limitations on new impacts
Cadron Creek	--	None	Extraordinary Resource Waters	Limitations on new impacts
Goose Pond Natural Area	--	None	Natural area[a]	Conservation easement to ANHC

(a) Owned and managed by AGFC.
Source: Entergy 2003a.

FTN Associates, Ltd. (FTN) surveyed extensive portions of the ANO-2 transmission line right-of-way dominated by native vegetation on October 11 and 12, 2002. FTN evaluated these areas for presence of individuals and potential habitats for mock orange (*Philadelphus hirsutus*), Ozark chinquapin (*Castanea pumila* var. *ozarkensis*), and Bachman's sparrow (*Aimophila aestivalis*). Bachman's sparrow is a state of Arkansas Watch List Species that is of conservation concern. None of these three species were observed. Potential habitat for mock orange and Ozark chinquapin was not observed. In the case of Bachman's sparrow, the presence of potential habitat was inconclusive. Field surveys were not conducted of segments of the right-of-way that passed through agricultural or roadside areas, or other areas that were highly disturbed and/or dominated by introduced woody species (FTN 2004).

The only Federally listed terrestrial species protected under the Endangered Species Act (16 USC 1531) known to occur in the vicinity of the ANO-2 site and its transmission line right-of-way are the endangered least tern (*Sterna antillarum*) (interior population only) (FWS 2004b), threatened bald eagle (*Haliaeetus leucocephalus*) (Entergy 2003a; FWS 2004a), and endangered gray bat (*Myotis grisescens*) (Entergy 2003a) (Table 2-5). No critical habitat has been designated for any of these Federally listed species (FWS 2004a). No Federally listed plant species are known to occur in the vicinity of the ANO-2 site or its transmission line right-of-way (Entergy 2003a, 2004a). There are no other species currently proposed for formal listing or considered candidates for listing in the vicinity (FWS 2004b).

The gray bat was listed by FWS as endangered in 1976 throughout its range primarily due to human disturbance and impoundment of waterways (Storming Media 2004). Gray bats are year-round cave residents, but they migrate between caves located in wintering and summering

Table 2-5. Federally Listed Threatened and Endangered Species Present in the Vicinity of the Arkansas Nuclear One, Unit 2 or Its Transmission Line Right-of-Way

Scientific Name	Common Name	Federal Status[a]	State Status[b]
Haliaeetus leucocephalus	bald eagle	Threatened	Inventory Element[c]
Myotis grisescens	gray bat	Endangered	Inventory Element
Sterna antillarum	least tern (interior population)	Endangered	Inventory Element

(a) Source: Entergy 2003a, 2004b.
(b) Source: ANHC 2002.
(c) Inventory Element: Species of conservation concern that may be rare, peripheral, or of an undetermined status in Arkansas.

areas of the midwestern and southeastern United States. Populations are mainly concentrated in Alabama, Arkansas, Missouri, Tennessee, and Kentucky. The gray bat is known to occur near ANO-2, where it resides in caves upstream of Dardanelle Lock and Dam. However, these caves are 16 km (10 mi) from ANO-2 and 3.2 km (2 mi) from the transmission line right-of-way. No cave habitat is known to occur on the ANO-2 site or within its transmission line right-of-way (NRC 2001b).

Arkansas ranks in the top 10 states in the number of winter bald eagle sightings (AGFC 2004). More than 1000 bald eagles are counted each winter, nearly triple the 368 recorded in 1979. The bald eagle is a winter transient to the Lake Dardanelle area, where birds forage during colder periods of the winter months. Nest sites have been reported at several localities on Lake Dardanelle, but none are within 16 km (10 mi) of ANO-2, and none are within the transmission line right-of-way (Entergy 2003a). Eagles also are not known to use the shoreline of Lake Dardanelle in the vicinity of ANO-2 for roosting or foraging (Entergy 2003a; NRC 2001b).

Interior least terns are present along the Arkansas and Red Rivers from April through August. They nest in small colonies on exposed salt flats, reservoir beaches, and river sandbars. Major threats include predation, human disturbance, and the construction and operation of main stem reservoirs. The interior least tern requires sandbars with very low vegetation cover and protection from predators and flooding. These conditions are not present at the ANO-2 site or along its transmission line right-of-way. The interior least tern breeds on sandbars along the Arkansas River near Atkins and Clarksville, Arkansas; however, these nesting locations are beyond a 16-km (10-mi) radius from ANO-2 and its transmission line right-of-way (NRC 2001b).

FTN conducted field surveys within the Arkansas Nuclear One site boundary on October 8 and 9, 1999, in support of the license renewal SEIS for ANO-1. At that time, the bald eagle was considered to be the only Federally listed species that could occur within the Arkansas Nuclear One site boundary (FTN 2004). No eagle nest or roost sites or foraging areas were reported from within the Arkansas Nuclear One site boundary (FTN 2004; NRC 2001b). FTN also conducted field surveys of extensive portions of the ANO-2 transmission line right-of-way that are dominated by native vegetation on October 11 and 12, 2002. FTN evaluated these right-of-way segments for presence of the bald eagle, interior least tern, and gray bat, and potential habitat for these species. None of these three species or potential habitat was observed (FTN 2004).

2.2.7 Radiological Impacts

Entergy has conducted a radiological environmental monitoring program (REMP) around the Arkansas Nuclear One site since 1974 (Entergy 2003d). Through this program, radiological

impacts to workers, the public, and the environment are monitored, documented, and compared to applicable standards. The objectives of the REMP are to:

- analyze important pathways for anticipated types and quantities of radionuclides released into the environment
- consider the possibility of a buildup of long-lived radionuclides in the environment and identify physical and biological accumulations that may contribute to human exposures
- consider the potential radiation exposure to plant and animal life in the environment surrounding the site
- correlate levels of radiation and radioactivity in the environment with radioactive releases from station operation.

Recent radiological releases are summarized in the following annual reports: *Arkansas Nuclear One – Units 1 and 2 Environmental Operating Report for 2002* (Entergy 2003d) and the *Arkansas Nuclear One – Units 1 and 2, Operating License Nos. DPR-51 and NPF-6 Annual Radioactive Effluent Release Report, January 1 through December 31, 2002* (Entergy 2003c). The limits for all radiological releases are specified in the ODCM; these limits are designed to meet Federal standards and requirements. The REMP includes monitoring of the aquatic environment (fish, invertebrates, and shoreline sediment), atmospheric environment (airborne radioiodine, gross beta and gamma), terrestrial environment (vegetation), and direct radiation (Entergy 2003d).

A review of the historical data on releases and the resultant dose calculations revealed that the doses to a maximally exposed individual in the vicinity of Arkansas Nuclear One were a small fraction of the limits specified in the U.S. Environmental Protection Agency's environmental radiation standards in 40 CFR Part 190, as required by 10 CFR 20.1301(d). During 2002 (the most recent year for which data were available), the total effective dose equivalent resulting from licensed activities inside the site boundary was 0.00011 mSv (0.011 mrem) for the total body, which was 0.04 percent of the 40 CFR Part 190 limit of 0.25 mSv (25 mrem). The dose limits are calculated on a per-reactor basis. For the liquid pathway, the dose limit is calculated using the adult as the maximally exposed individual via the aquatic foods (sport freshwater fish) and the potable water pathways. For dose resulting from exposure to iodine-131, tritium, and particulates in gaseous effluents, the child is the controlling age group.

Entergy does not anticipate any significant changes to the radioactive effluent releases or exposures from ANO-2 operations during the license renewal term; therefore, the impacts to the environment are expected to be similar to those in recent years (Entergy 2003a).

2.2.8 Socioeconomic Factors

The staff reviewed the Entergy Environmental Report (Entergy 2003a) and information obtained from several county, city, and economic development staff during the February 2004 site visit to Pope and Yell Counties or via telephone interviews. The following information describes the economy, population, and communities near the ANO-2 site.

2.2.8.1 Housing

ANO-1 and ANO-2 employ approximately 1260 people on a full-time basis, with more than 85 percent of the normal operating workforce composed of Entergy employees. Approximately 78 percent of these employees (plant and contract employees) live in Pope County, about 9 percent in Yell County, and about 8 percent in Johnson County, and the remainder live in other locations (Table 2-6). Because approximately 94 percent of the Entergy and baseline contractor employees live in Pope, Yell, and Johnson Counties and Pope County is where the plant is located, the focus of the socioeconomic analysis is on these three counties. Information is not available for the individual units, but only for the entire facility. Roughly half of plant employee and resource use is associated with ANO-2.

Between 1990 and 2000, total housing units in Pope County increased from 18,430 to 22,851 (USCB 2000a) (Table 2-7). Housing availability in the three-county area is not limited by growth-control measures. The number of housing units in the three-county area has increased by more than 20 percent since 1990, and the number of occupied units has increased at a slightly slower rate, so the number and percentage of vacancies have grown during the decade from about 10 percent to about 11 percent.

Entergy refuels ANO-2 on an 18-month cycle. Refueling and maintenance outages typically last approximately 30 days. Depending on the scope of these outages, an additional 1300 to 1400 workers are typically onsite. The number of workers required for normal plant outages during the period of extended operation is expected to be consistent with the number of additional workers used for past outages (Entergy 2003a). These temporary employees primarily stay at hotels, motels, and temporary rental housing available in Pope, Johnson, and Yell Counties.

Table 2-6. Permanent Employee Residence Information by County and City in the Vicinity of Arkansas Nuclear One

County and City[a]	Number of Employees (Entergy and Baseline Contractor Employees)	Percent of Employees
POPE COUNTY		
Russellville	722	57.4
Dover	112	8.9
London	59	4.7
Atkins	40	3.2
Pottsville	28	2.2
Total Named Places	961	76.4
Total Pope County	976	77.6
JOHNSON COUNTY		
Clarksville	38	3.0
Lamar	38	3.0
Knoxville	10	0.8
Total Named Places	86	6.8
Total Johnson County	99	7.9
YELL COUNTY		
Dardanelle	70	5.6
Havana	10	0.8
Ola	10	0.8
Total Named Places	90	7.2
Total Yell County	111	8.8
Other Counties	72	5.7
Grand Total	1258	100.0

(a) Addresses are for both incorporated cities and towns and for rural areas with the same zip code. Only cities and towns that are home to at least 10 employees are shown.

Source: Entergy 2003a.

Table 2-7. Housing Units and Housing Units Vacant (Available) by County During 1990 and 2000

	1990	2000	Approximate Percentage Change
POPE COUNTY			
Housing Units	18,430	22,851	24.0
Occupied Units	16,828	20,701	23.0
Vacant Units	1602	2150	34.2
YELL COUNTY			
Housing Units	7984	9926	24.3
Occupied Units	7059	8738	23.8
Vacant Units	925	1188	28.4
JOHNSON COUNTY			
Housing Units	7868	9157	16.4
Occupied Units	6907	7922	14.7
Vacant Units	961	1235	28.5

Sources: NRC 2001b; USCB 2000a.

2.2.8.2 Public Services

Public services include water supply, education, and transportation.

- **Water Supply**

Public water systems within a 16-km (10-mi) radius of Arkansas Nuclear One use either groundwater or surface water sources. The area has six public water systems that serve the incorporated towns and rural areas. The West Crow Mountain Water Association, previously reported in the ANO-1 SEIS (NRC 2001b), has merged with the Tri-County Regional Water District (Yusuf 2002). Table 2-8 shows source and capacity information on selected water supply systems in communities near Arkansas Nuclear One and the area served by each (Yusuf 2002). The cities of Russellville, Dover, and London are primarily served with surface water from the Illinois Bayou. Large areas of rural Pope County are not served by public water supplies.

In 1997, City Corporation water system completed construction of a new water supply source, the Huckleberry Creek Reservoir. The new reservoir, which significantly increased the system

Table 2-8. Major Public Water Supply Systems Within a 16-km (10-mi) Radius of Arkansas Nuclear One – 2002

Water System	Source	Maximum Daily Capacity m^3/day	(MGD)	Average Daily Capacity m^3/day	(MGD)	Area Served
City Corporation water system (Huckleberry Creek)	100 percent surface from Illinois Bayou and Huckleberry Creek	70,030	(18.50)	25,655	(6.78)	City of Russellville
Dardanelle Waterworks	80 percent groundwater, 20 percent surface	9,305	(2.46)	1,703	(0.45)	City of Dardanelle
Dover Waterworks	100 percent surface from City Corporation (Illinois Bayou and Huckleberry Creek)	1,090	(0.29)	602	(0.16)	City of Dover and surrounding rural areas
London Waterworks	100 percent surface from City Corporation (Illinois Bayou and Huckleberry Creek)	818	(0.22)	367	(0.10)	City of London and surrounding rural areas
Northeast Yell County Water Association, Inc.	67 percent surface, 33 percent groundwater from Danville Water Department (Cedar Piney Reservoir)	5,046	(1.33)	2,324	(0.61)	Rural Yell, Conway, and Perry Counties
Tri-County Regional Water Distribution District	100 percent surface from City Corporation (Illinois Bayou) and Atkins Water Department (Galla Creek Lake)	17,034	(4.51)	3,861	(1.02)	Rural Pope County from north of London east to Conway County line

Source: Arkansas Department of Health, facsimile correspondence dated September 25, 2002 (Yusuf 2002).

capacity, provides residential and industrial customers in the area with a reliable supply of high-quality potable water.

Entergy and the City Corporation water system have also worked together to make several changes in the water system near the plant. Additional water storage and pumping stations have been added to reduce short-term shortages that occurred in the past. According to representatives of the City Corporation water system, Arkansas Nuclear One does not cause capacity or flow concerns for the system, and the system should be able to meet the site's water demands in the foreseeable future (Church 2002).

- **Transportation**

Pope County is on the north side of the Arkansas River and is served by I-40, which runs east and west through the southern part of the county. In addition, two-lane U.S. Highway 64 runs parallel to I-40. The primary state highways in Pope County are Highways 7 and 27. The U.S. Forest Service has designated Highway 7 a National Forest Scenic Byway for part of its route in Arkansas. In addition, the State of Arkansas has designated Highway 7 as a State Scenic Byway. Highways 7 and 27 both are considered to be scenic highways. Secondary state highways in Pope County are Highways 124, 164, and 333. Highway 333 provides access to the Arkansas Nuclear One site from two intersections with U.S. Highway 64. The Arkansas Highway and Transportation Department was contacted for information regarding highway traffic counts near Arkansas Nuclear One (Boyles 2002). Arkansas Highway and Transportation Department traffic count information is summarized in Table 2-9.

Yell County is not served by the interstate highway system, but has ready access to the I-40 corridor via Arkansas Scenic Highways 10, 22, 27, and 154. State Highways 60 and 247 complete the major road network in the county. Johnson County is served by the I-40 corridor, as well as U.S. Highway 64 and State Highways 21, 103, and 123 (NRC 2001b).

2.2.8.3 Offsite Land Use

The Arkansas Nuclear One site is centrally situated on a peninsula that extends into Lake Dardanelle. Outside the site boundary, the majority of the area is forested with small areas of open grassland and residential development, which is typical of land near Lake Dardanelle. Much of the property along the shoreline of Lake Dardanelle is owned by the U.S. Government and is managed and maintained by ACE in a natural condition.

Pope County encompasses an area of approximately 822 mi^2 (526,080 ac). The land in the county consists of approximately 68.5 percent forest, 25.5 percent agriculture (crops and

Table 2-9. Arkansas Highway and Transportation Department Traffic Counts (Cars/Day) for Highways Near Arkansas Nuclear One

Location	1999	2000	2001
State Highway 333 near the east intersection with U.S. Highway 64	–	2700	2400
State Highway 333 near the west intersection with U.S. Highway 64	–	–	1400
U.S. Highway 64 west of London	–	2900	2500
U.S. Highway 64 near Mill Creek	6900	9500	7000

Source: Boyles 2002.

pasture), 2.6 percent water, and 2.5 percent urban (residential and commercial/industrial) (Entergy 2003a). About 60 percent of Pope County is mountainous or hilly with elevations ranging from approximately 137 m (450 ft) to approximately 640 m (2100 ft) above mean sea level. Most of this area is too steep for intensive use so it is used mainly for woodland and pasture. Less steep areas are suitable for improved pasture and truck crops. About 40 percent of Pope County is level to gently sloping hilltops, valley fill, and alluvial fill. Bottom lands along the Arkansas River are intensively farmed. The main crops include soy beans, rice, wheat, and grain sorghum. Acreage in crops and pasture has been declining in the Pope County area as more land is converted to urban development.

Residential development is expected to continue around Lake Dardanelle because of the availability of desirable lakefront property. Pope County has experienced moderate population growth and moderate land-use changes in the last 10 years. Future lakefront development would be facilitated by the presence of roads and water service, which are an indirect impact of the tax payments made by Entergy for Arkansas Nuclear One.

2.2.8.4 Visual Aesthetics and Noise

From the air, the principal visual features of the area are Lake Dardanelle and the countryside, which is generally wooded and residential. The position of the plant relative to Lake Dardanelle is such that the ANO-2 reactor building is only visible from the water within the first few kilometers to the south, southwest, and southeast. The cooling tower of ANO-2, however, is visible from at least 16 km (10 mi) away, and its plume can be seen from a much greater distance. From the lake, the shoreline appears to be mostly wooded, with housing developments and boat launches (NRC 2001b).

Because of the woods and topography, noise from Arkansas Nuclear One is generally not an issue. The only sounds heard offsite are from the plant loudspeakers and security force shooting range, which can be heard on the lake (NRC 2001b).

2.2.8.5 Demography

Entergy used 2000 census data and a geographic population analysis from the Arkansas State Census Data Center at the University of Arkansas at Little Rock to assess the impact of the proposed action to the region (UALR 2002a). Geographical Information System software (ArcView,® Version 8.1) was used in this analysis to determine the overall resident population and demographic characteristics within an 80-km (50-mi) concentric radial grid surrounding the site. The Census Data Center's method used 22.5° directional segments and 16 radial distances. The method assigned a block group to a geographical subsector within the grid if the centroid for the block group lay within the segment, which tends to underestimate the total population within 80 km because it leaves out partial block groups where the centroid is outside

80 km. NRC staff's current procedure is to assign a block group to the 80-km radius if any part of the block group is within 80 km. This procedure tends to overestimate the population within 80 km, because it includes population beyond 80 km.

Entergy's analysis of the 2000 census data indicates that 87,468 people live within 32 km (20 mi) of the site, which equates to a population density of 27 people/km^2 (70 people/mi^2). NRC's estimate is 99,033 total persons and a density of 30 people/km^2 (79 people/mi^2). According to the GEIS sparseness index, Arkansas Nuclear One is classified as Category 3 sparseness (having 60 to 120 persons per mi^2 within 20 miles). The NRC staff's analysis resulted in the same conclusion.

Entergy's analysis of the 2000 census data showed that 267,664 people live within 80 km (50 mi) of the site, which equates to a population density of 13 persons/km^2 (34 persons/mi^2). NRC staff estimates this number at 311,904 and 15 persons/km^2 (40 persons/mi^2). According to the GEIS proximity index, the site is classified as Category 1 proximity (no city with 100,000 or more people and less than 50 persons per mi^2 within 80 km [50 mi]) by either estimate. According to the GEIS sparseness and proximity matrix, the combination of sparseness, Category 3, and proximity Category 1 results in the conclusion that the site is located in a medium population area. The NRC staff reviewed Entergy's calculations of sparseness and proximity and confirmed this conclusion.

All or parts of 19 Arkansas counties are located within 80 km (50 mi) of the Arkansas Nuclear One site. Nearby towns include Russellville (Pope County), Clarksville (Johnson County), and Dardanelle (Yell County). Pope, Johnson, and Yell Counties have a combined total population of approximately 98,389 (USCB 2000a, b, c). From 1990 to 2000, Pope County had an annual growth rate of 1.9 percent, Johnson County had an annual growth rate of 2.5 percent, and Yell County had an annual growth rate of 1.9 percent. All three counties had a faster growth rate than that of Arkansas as a whole during this same time period. From 1990 to 2000, Arkansas' annual population growth rate was 1.3 percent (USCB 2000d). Table 2-10 shows estimated populations and annual growth rates through 2040 for the three counties with the greatest potential to be socioeconomically affected by license renewal activities.

- **Workforce**

In 2000, Pope County employed 4834 people in major manufacturing facilities, compared with 3040 people in Johnson County and 2936 in Yell County (USCB 2000e, f, g). The State of Arkansas reports that the Arkansas Nuclear One site is the second largest employer in Pope County, following ConAgra. ANO-2 by itself would rank somewhere between third and fifth. Other major employers with at least 250 employees include St. Mary's Regional Medical Center, Arkansas Tech University, Tyson Foods, Wal-Mart, and Friendship Community Care (Arkansas Department of Economic Development 2004).

Table 2-10. Population Growth in Pope County, Arkansas – 1970 to 2040

	Pope County		Johnson County		Yell County	
	Population	Annual Growth Percent	Population	Annual Growth Percent	Population	Annual Growth Percent
1970[a]	28,607	–	13,630	–	14,208	--
1980[a]	38,964	3.6	17,423	2.8	17,026	2.0
1990[a]	45,883	1.8	18,221	0.5	17,759	0.4
2000[b]	54,469	1.9	22,781	2.5	21,139	1.9
2010[c]	61,899	1.4	23,418	0.3	23,620	1.2
2020[c]	69,014	1.1	24,040	0.3	25,997	1.0
2030[c]	76,057	1	24,655	0.3	28,350	0.9
2040[c]	83,100	0.9	25,270	0.2	30,703	0.8

(a) NRC 2001b.
(b) USCB 2000a, b, c.
(c) UALR 2002b.
-- = No data available.

The transient population in the vicinity of Arkansas Nuclear One can be identified as daily or seasonal. Daily transients are associated with places where a large number of people gather regularly, such as local businesses, industrial facilities, and schools. Seasonal transients result from the use of weekend recreational areas such as Lake Dardanelle or Mount Nebo, which is located about 13 km (8 mi) directly south of the plant.

- **Migrant Farm Labor**

Migrant farm workers are individuals whose employment requires travel to harvest agricultural crops. These workers and other seasonal workers involved in food processing may or may not have a permanent residence. Some migrant workers may follow the harvesting of crops, particularly fruit, throughout the south-central U.S. rural areas. Others may be permanent residents near Arkansas Nuclear One who travel from farm to farm harvesting crops.

Migrant workers can be members of minority or low-income populations. Because they travel and can spend a significant amount of time in an area without being actual residents, migrant workers may be unavailable for counting by census takers. If uncounted, these workers would be underrepresented in U.S. Census Bureau minority and low-income population counts.

In the year 2000, the U.S. Department of Health and Human Services funded a county-level estimate of seasonal workers and their dependents in Arkansas (Larson 2000). According to that profile, Pope County had 118 migrant workers and dependents, Johnson County had 502, and Yell County had none, for a total of 620. It should be noted that the study excludes seasonal work in the meat industry, so the estimate is probably low for the three-county area because of the importance of poultry processing in the local economy.

2.2.8.6 Economy

Property taxes are used to fund schools, police and fire protection, road maintenance, and other municipal services. Property taxes may be levied by counties, cities, towns, villages, school districts, and special districts. The continued availability of Arkansas Nuclear One and the associated tax base is an important feature in the ability of Pope County to continue to invest in infrastructure and to draw industry and new residents. ANO-2 is roughly half of the assessed valuation of the Arkansas Nuclear One site. In 2002, Entergy paid approximately $8.5 million in property taxes for Arkansas Nuclear One, making Entergy the largest industrial tax payer in the county. Table 2-11 identifies the distribution of these taxes within the four principal Pope County tax units. Based on the information in this table, taxes associated with Arkansas Nuclear One make up approximately 43 percent, 55 percent, and 43 percent of the locally generated property tax revenues for the county general, roads, and library budgets, respectively, with roughly half from ANO-2. The majority of Entergy's property taxes for Arkansas Nuclear One are allocated to the Russellville School District. In 2002, Entergy's taxes made up about 49 percent of the locally generated property tax revenues for the school district.

Table 2-11. Entergy Property Tax Distribution for Arkansas Nuclear One – 2002

Taxing Unit	2002 Approved Budget[a]	County Revenue from Property Taxes[a]	Entergy Tax Distribution[c]	Percent of County Property Tax Revenue from Entergy
County General	$7,236,541	$508,722	$220,893	43
County Roads	$3,798,811	$999,579	$549,167	55
County Library	$809,932	$508,722	$220,893	43
Russellville School District	$28,685,177[b]	$14,413,959	$7,090,478	49

(a) Lutrel 2003.
(b) Russellville School District 2003.
(c) McAlister 2003.

2.2.9 Historic and Archaeological Resources

This section discusses the cultural background and the known historic and archaeological resources at the Arkansas Nuclear One site and in the surrounding area.

2.2.9.1 Cultural Background

The area around the site is rich in prehistoric and historic Native American and historic Euro-American resources. This part of west-central Arkansas has an archaeological sequence that extends back about 12,000 years, although human use of the region was probably limited during the first few thousand years of human presence. Similar to much of the surrounding southeastern states, archaeological periods defined for this part of Arkansas fall into several sequential cultural periods of Native American occupation: the Paleo-Indian Era (about 9500 B.C. to 8000 B.C.), the Archaic Era (8000 B.C. to 500 B.C.), the Woodland Era (500 B.C. to A.D. 900), the Mississippian Era (A.D. 900 to A.D. 1541), and the Historic era, initiated by the initial intrusion of Spanish explorers into the area (A.D. 1541 to A.D. 1850) (Schambach and Newell 1990).

The prehistoric periods were marked by initial reliance on big game hunting subsistence, followed by increased use of smaller game animals and plant foods in the Archaic Era. Trends toward more sedentary villages with greater reliance on cultivated crops began late in the Woodland era and increased in importance in the following Mississippian era. In Arkansas, the Mississippian cultures were largely focused in the eastern part of the state, along the Mississippi River valley. In the region of western Arkansas, including the Arkansas River valley, contemporaneous cultures included the Caddoan groups who, like the Mississippians, grew cultivated crops, but, unlike their neighbors to the east, continued to rely heavily on hunting, fishing, and gathering of wild plants.

Following initial contact by the Spanish, and later Euro-American settlers, the Native American Historic era in the vicinity of the present Arkansas Nuclear One site was marked by nearly continual occupation and visits by several tribes as they coped with the Euro-American expansion into their former homelands (Sabo 1992). Before a large land cession in 1808, the region north of the Arkansas River was primarily occupied by the Osage, while the area south of the river was occupied by the Quapaw until that land was ceded to the United States in 1818. Other tribes that either visited or occupied smaller areas during this time included the historic Caddos, Tunicas, Shawnee, and Delaware.

Beginning immediately after the 1808 Osage cession and their removal to the region of present-day Oklahoma, the Arkansas River valley was occupied by the Cherokees, who had begun to be pushed from their traditional homelands in North and South Carolina. Known as the "Arkansas Cherokees" (Markham 1972; Davis 1987), the Cherokees occupied the Arkansas

River corridor from Little Rock on the east to Fort Smith on the west during the period from 1809 to 1828. During 1817, a reservation that includes the present Arkansas Nuclear One site was set aside for the Arkansas Cherokees on the north side of the river. Soon after, additional tribe members moved into the area from the Southern Appalachian region. With this migration, the population of Cherokees in the Arkansas River valley grew to between 4000 and 5000. Increasing pressure from white settlers brought about another land cession by the Arkansas Cherokees, and in 1828, they once again moved westward to the Oklahoma Territory, marking the end of Native American occupation in the vicinity of the project area.

Though relatively brief, the Cherokee occupation of the area that includes the present Arkansas Nuclear One site was fairly intense and left a lasting mark in the historic and archaeological records. The primary historic site associated with this period is the Dwight Mission, a Presbyterian mission to the Cherokees, established in 1820 on the west bank of Illinois Bayou, about 2.4 km (1.5 mi) east of the present Arkansas Nuclear One property line (Turrentine 1962). When the Cherokees were forced from the area a few years later, the mission relocated to Oklahoma as well. Lake Dardanelle inundated some of the original mission compound in the 1960s. The archaeological record from the Cherokee villages and home sites in the area outside the Arkansas Nuclear One property line is relatively unknown, but recent investigations indicate that the local archaeological remains hold great promise for significant research potential (Stewart-Abernathy 1998).

Following Cherokee removal, the area was immediately taken up by Euro-American settlers, including the May and Rye families, who settled the land in the immediate vicinity of the present Arkansas Nuclear One site in the 1830s (Anonymous 1975; Vance 1970). Although early Euro-American use of the land within the present Arkansas Nuclear One property was primarily agricultural, numerous important Historic era resources exist a short distance north of the site (Pope County Historical Association 1979, 1981; Vance 1970). Completed in 1823, a military road passed through the river valley just north of the site. This road connected Memphis, Little Rock, Fort Smith, and the Oklahoma Territory. In the late 1830s, this road was used as part of the final Cherokee removal from the Southern Appalachians and northern Georgia, along the infamous "Trail of Tears." The area just northwest of the present Arkansas Nuclear One site, which would eventually become the town of London, had a population of 65 people in 1832, although the town itself was not incorporated until 1882 with a population of 119. Three cotton gins were in the vicinity of London at one time. One was built in 1847 on the Rye farm, located just west of the present Arkansas Nuclear One property; the gin was torn down in 1902.

There were two routes of the 1838 Trail of Tears that passed by the present Arkansas Nuclear One site (DOI 1992). The first was the water route that in part followed the Arkansas River into Indian Territory. This route passed along the southern boundary of the present Arkansas Nuclear One site, using the now submerged Arkansas River waterway. The second route followed the land route along the north side of the Arkansas River and passed just to the north

along the military road. During the summer of 1838, three groups of Cherokees followed the water route to Fort Smith, west of Russellville, then on into their new homelands. At the same time, J. A. Bell led a detachment of 600 to 700 Cherokees along the second route.

The Trail of Tears was designated a National Historic Trail by Congress in 1987, and was granted additional protection under the National Trails System Act as amended through 2002. The legislatively designated historic trail includes only the water route in the vicinity of the present Arkansas Nuclear One site; Bell's Route was not formally included, although its designation as part of the national trail system is still under study.

Transportation and communication features soon followed. Just north of the Arkansas Nuclear One property, the Fort Smith and Little Rock Railroad was constructed in 1873; later, it was the Iron Mountain Railroad; and currently, it is the Union-Pacific line. Telephone service to the area began about 1900, and U.S. Highway 64 was constructed in 1921. The Arkansas-Louisiana gas main was completed in 1928, and electrical power became available in the late 1930s.

2.2.9.2 Prehistoric and Historic Resources at the Arkansas Nuclear One Site

Prehistoric. Construction of ANO-1 within the 471-ha (1164-ac) site began during 1968. During 1969, the Arkansas Archaeological Society conducted a reconnaissance field survey of the lands within the site that were not within the construction zone and that were not heavily vegetated (Cole 1969). From the report, it is not possible to define the actual acreage examined, although it is important to note that the goal of the fieldwork was to identify and record Native American archaeological properties.

Five prehistoric sites (3PP62-66) were recorded by the survey. All represented light surface scatters of archaeological materials with few age-diagnostic artifacts. No ceramics, which would be indicative of later Caddoan occupation, were located, and the sites probably represent pre-ceramic or Archaic Era campsites. Because each of the archaeological sites was located away from the construction area, Cole (1969) recommended that no further analysis was necessary at the time, although he stated that if any of the sites were to be impacted by project activities, further evaluation would be necessary. To date, none of these sites has been fully evaluated for potential significance for nomination to the National Register of Historic Places. Until these evaluations are completed, the Arkansas Historic Preservation Program considers these sites to be potentially eligible for inclusion in the National Register of Historic Places and, therefore, subject to consideration under the provisions of the National Historic Preservation Act of 1966 (16 USC 470) and its implementing regulations.

A search of the archaeological records maintained at the Arkansas Archaeological Society Research Station of Arkansas Tech University in Russellville revealed another 13 prehistoric archaeological sites that have been recorded within less than 1.6 km (1 mi) of the Arkansas

Nuclear One site boundary. These results, along with the reconnaissance-level survey methodology employed during the 1969 survey, indicate a potential for additional prehistoric Native American sites to exist on Arkansas Nuclear One property.

Cole (1972) conducted a search for five transmission line rights-of-way emanating from Arkansas Nuclear One that were either already constructed, under construction, or proposed for construction. Scant data of past archaeological surveys or known archaeological sites along any of the transmission line rights-of-way were available. There is no record that archaeological fieldwork was ever conducted along the ANO-2 transmission line right-of-way.

Historic. As noted above, the 1969 archaeological survey of the Arkansas Nuclear One site only focused on potential Native American properties, even though Historic Era Euro-American sites were present. Consequently, none of the Historic era properties has been recorded or evaluated for National Register of Historic Places eligibility.

Review of Historic era records and maps during the ANO-1 site visit (NRC 2001b) revealed that more than 35 Historic era properties existed within the Arkansas Nuclear One property boundaries, dating from approximately 1830 to 1967, when the property was acquired by Arkansas Power and Light Company. Although occupation of the area was continuous during the 1800s, specific information was not found on either the number of or precise locations of Historic era sites. It is known that the May farm was located south of the present Arkansas Nuclear One site and that the Rye farm, with its cotton gin, was located just west of the site.

No standing structures remain at any of these former historic sites except for a few storm shelter/storage cellars. They exist as unrecorded and unevaluated Historic era archaeological sites that exhibit house and outbuilding foundations, artifact scatters, trash dumps, and buried features, along with the historic roads and trails that linked the farming community.

A more recent search for Historic era properties at the Arkansas Nuclear One site revealed the presence of some 96 historic and archaeological sites at the Arkansas Nuclear One site (Historic Preservation Associates 2001). However, this survey counted individual historic structures as a single site, even though, in some cases, multiple structures may comprise a single historic farmstead. In any event, substantial data exist to indicate the presence of a significant number of unrecorded cultural resource properties at the Arkansas Nuclear One site.

Another recent field investigation of the Lake Dardanelle shoreline by Smith and Stewart-Abernathy (2003) further indicates the potential for the presence of both prehistoric and historic properties in the vicinity of the Arkansas Nuclear One site. One Historic era property (3PP598) located by this survey is on the Arkansas Nuclear One site. It consists of a scatter of early twentieth century artifacts along both sides of the mouth of the cooling water intake canal.

In addition to the farms, one Historic era cemetery, the May Cemetery, is located on Arkansas Nuclear One property, about 0.8 km (0.5 mi) south of the site. The cemetery is protected by a chain link fence and is well maintained. According to Lemley (1981), 106 marked and named graves are in the cemetery, along with a number of unnamed graves, both marked and unmarked. The cemetery was established during 1885. Because the site property was initially homesteaded about 55 years earlier, earlier interments were either buried elsewhere or are co-located with early farmsteads in unknown and unmarked graves. Two other historic cemeteries exist in proximity to the Arkansas Nuclear One site: the Swan (Finchum) Cemetery, located about 0.8 km (0.5 mi) west of the northwest corner of the Arkansas Nuclear One boundary, and the Crain Cemetery, situated immediately north of State Highway 333, between the site entrance and London, and about 183 m (200 yd) from the Arkansas Nuclear One property line (Lemley 1981). The Crain Cemetery does not appear on Arkansas Nuclear One or U.S. Geological Survey base maps, but includes some 32 marked graves dating back to 1865.

2.2.10 Related Federal Project Activities and Consultations

The staff reviewed the possibility that activities of other Federal agencies might impact the renewal of the operating license for ANO-2. Any such activities could result in cumulative environmental impacts and the possible need for the Federal agency to become a cooperating agency for preparation of this SEIS [10 CFR 51.10(b)(2)].

ANO-2 obtains its cooling water from Lake Dardanelle, which is formed by the Dardanelle Lock and Dam. The Dardanelle Lock and Dam was authorized by Congress. It was constructed and is now operated by ACE. The Dardanelle Lock and Dam produces hydroelectric power. Under the Federal Power Act of 1920, the Federal Energy Regulatory Commission does not license Federally owned hydroelectric facilities such as the Dardanelle Lock and Dam.

No Federal agencies participated in the scoping meetings or submitted written scoping comments concerning related Federal project activities. The staff determined that there were no Federal project activities directly related to renewal of the operating license for ANO-2 that could result in cumulative environmental impacts or that would make it desirable for another Federal agency to become a cooperating agency for preparation of this SEIS.

NRC is required under Section 102(C) of the National Environmental Policy Act of 1969 to consult with and obtain the comments of any Federal agency that has jurisdiction by law or special expertise with respect to any environmental impact involved. NRC consulted with the FWS and the National Marine Fisheries Service. Consultation correspondence is included in Appendix E.

2.3 References

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10 CFR Part 50. Code of Federal Regulations, Title 10, *Energy*, Part 50, "Domestic Licensing of Production and Utilization Facilities."

10 CFR Part 51. Code of Federal Regulations, Title 10, *Energy*, Part 51, "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions."

10 CFR 54. Code of Federal Regulations, Title 10, *Energy*, Part 54, "Requirements for Renewal of Operating Licenses for Nuclear Power Plants."

10 CFR Part 61. Code of Federal Regulations, Title 10, *Energy*, Part 61, "Licensing Requirements for Land Disposal of Radioactive Waste."

10 CFR Part 71. Code of Federal Regulations, Title 10, *Energy*, Part 71, "Packaging and Transportation of Radioactive Material."

40 CFR Part 58. Code of Federal Regulations, Title 40, *Protection of Environment*, Part 58, "Ambient Air Quality Surveillance."

40 CFR Part 81. Code of Federal Regulations, Title 40, *Protection of Environment*, Part 81, "Designation of Areas for Air Quality Planning Purposes."

40 CFR Part 190. Code of Federal Regulations, Title 40, *Protection of Environment*, Part 190, "Environmental Radiation Protection Standards for Nuclear Power Operations."

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3.0 Environmental Impacts of Refurbishment

Environmental issues associated with refurbishment activities are discussed in the *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (GEIS), NUREG-1437, Volumes 1 and 2 (NRC 1996, 1999).[a] The GEIS includes a determination of whether the analysis of the environmental issues could be applied to all plants and whether additional mitigation measures would be warranted. Issues are then assigned a Category 1 or a Category 2 designation. As set forth in the GEIS, Category 1 issues are those that meet all of the following criteria:

(1) 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 characteristics.

(2) A single significance level (i.e., SMALL, MODERATE, or LARGE) has been assigned to the impacts (except for collective off-site radiological impacts from the fuel cycle and from high-level waste and spent fuel disposal).

(3) 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 not to be sufficiently beneficial to warrant implementation.

For issues that meet the three Category 1 criteria, no additional plant-specific analysis is required in this supplemental environmental impact statement unless new and significant information is identified.

Category 2 issues are those that do not meet one or more of the criteria for Category 1 and, therefore, additional plant-specific review of these issues is required.

License renewal actions may require refurbishment activities for the extended plant life. These actions may have an impact on the environment that requires evaluation, depending on the type of action and the plant-specific design. Environmental issues associated with refurbishment that were determined to be Category 1 issues are listed in Table 3-1.

Environmental issues related to refurbishment considered in the GEIS for which these conclusions could not be reached for all plants, or for specific classes of plants, are Category 2 issues. These are listed in Table 3-2.

(a) The GEIS was originally issued in 1996. Addendum 1 to the GEIS was issued in 1999. Hereafter, all references to the "GEIS" include the GEIS and its Addendum 1.

Table 3-1. Category 1 Issues for Refurbishment Evaluation that are Applicable to Arkansas Nuclear One, Unit 2

ISSUE – 10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Sections
SURFACE-WATER QUALITY, HYDROLOGY, AND USE (FOR ALL PLANTS)	
Impacts of refurbishment on surface-water quality	3.4.1
Impacts of refurbishment on surface-water use	3.4.1
AQUATIC ECOLOGY (FOR ALL PLANTS)	
Refurbishment	3.5
GROUND-WATER USE AND QUALITY	
Impacts of refurbishment on ground-water use and quality	3.4.2
LAND USE	
Onsite land use	3.2
HUMAN HEALTH	
Radiation exposures to the public during refurbishment	3.8.1
Occupational radiation exposures during refurbishment	3.8.2
SOCIOECONOMICS	
Public services: public safety, social services, and tourism and recreation	3.7.4; 3.7.4.3; 3.7.4.4; 3.7.4.6
Aesthetic impacts (refurbishment)	3.7.8

The potential environmental effects of refurbishment actions would be identified, and the analysis would be summarized within this section, if such actions were planned. Entergy Operations, Inc. (Entergy) indicated that it has performed an evaluation of structures and components pursuant to 10 CFR 54.21 to identify activities that are necessary to continue operation of Arkansas Nuclear One, Unit 2 during the requested 20-year period of extended operation. These activities include replacement of certain components as well as new inspection activities and are described in the Entergy Environmental Report (Entergy 2003).

However, Entergy stated that the replacement of these components and the additional inspection activities are within the bounds of normal plant component replacement and inspections; therefore, they are not expected to affect the environment outside the bounds of plant operations as evaluated in the final environmental statement (AEC 1977). In addition, Entergy's evaluation of structures and components as required by 10 CFR 54.21 did not identify any major plant refurbishment activities or modifications necessary to support the continued

Table 3-2. Category 2 Issues for Refurbishment Evaluation that are Applicable to Arkansas Nuclear One, Unit 2

ISSUE – 10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Section	10 CFR 51.53 (c)(3)(ii) Subparagraph
TERRESTRIAL RESOURCES		
Refurbishment impacts	3.6	E
THREATENED OR ENDANGERED SPECIES (FOR ALL PLANTS)		
Threatened or endangered species	3.9	E
AIR QUALITY		
Air quality during refurbishment (nonattainment and maintenance areas)	3.3	F
SOCIOECONOMICS		
Housing impacts	3.7.2	I
Public services: public utilities	3.7.4.5	I
Public services: education (refurbishment)	3.7.4.1	I
Offsite land use (refurbishment)	3.7.5	I
Public services, transportation	3.7.4.2	J
Historic and archaeological resources	3.7.7	K
ENVIRONMENTAL JUSTICE		
Environmental justice	Not addressed[a]	Not addressed[a]

(a) Guidance related to environmental justice was not in place at the time the GEIS and the associated revision to 10 CFR Part 51 was prepared. If an applicant plans to undertake refurbishment activities for license renewal, environmental justice must be addressed in the applicant's environmental report and the staff's environmental impact statement.

operation of Arkansas Nuclear One, Unit 2 beyond the end of the existing operating license. Therefore, refurbishment is not considered in this supplemental environmental impact statement.

3.1 References

10 CFR Part 51. Code of Federal Regulations, Title 10, *Energy*, Part 51, "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions."

10 CFR Part 54. Code of Federal Regulations, Title 10, *Energy*, Part 54, "Requirements for Renewal of Operating Licenses for Nuclear Power Plants."

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4.0 Environmental Impacts of Operation

Environmental issues associated with operation of a nuclear power plant during the renewal term are discussed in the *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (GEIS), NUREG-1437, Volumes 1 and 2 (NRC 1996, 1999).[a] The GEIS includes a determination of whether the analysis of the environmental issues could be applied to all plants and whether additional mitigation measures would be warranted. Issues are then assigned a Category 1 or a Category 2 designation. As set forth in the GEIS, Category 1 issues are those that meet all of the following criteria:

(1) 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.

(2) A single significance level (i.e., SMALL, MODERATE, OR LARGE) has been assigned to the impacts (except for collective offsite radiological impacts from the fuel cycle and from high-level waste and spent fuel disposal).

(3) 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 not to be sufficiently beneficial to warrant implementation.

For issues that meet the three Category 1 criteria, no additional plant-specific analysis is required unless new and significant information is identified.

Category 2 issues are those that do not meet one or more of the criteria for Category 1, and therefore, additional plant-specific review of these issues is required.

This chapter addresses the issues related to operation during the renewal term that are listed in Table B-1 of Title 10 of the Code of Federal Regulations (CFR) Part 51, Subpart A, Appendix B, and are applicable to Arkansas Nuclear One, Unit 2 (ANO-2). Section 4.1 addresses issues applicable to the ANO-2 cooling system. Section 4.2 addresses issues related to transmission lines and onsite land use. Section 4.3 addresses the radiological impacts of normal operation, and Section 4.4 addresses issues related to the socioeconomic impacts of normal operation during the license renewal term. Section 4.5 addresses issues related to groundwater use and quality, while Section 4.6 discusses the impacts of license renewal-term operations on threatened and endangered species. Section 4.7 addresses potentially new information that was identified during the scoping period, and Section 4.8 discusses cumulative impacts. The

(a) The GEIS was originally issued in 1996. Addendum 1 to the GEIS was issued in 1999. Hereafter, all references to the "GEIS" include the GEIS and its Addendum 1.

results of the evaluation of environmental issues related to operation during the license renewal term are summarized in Section 4.9, and finally, the references cited are listed in Section 4.10. Category 1 and Category 2 issues that are not applicable to ANO-2 because they are related to plant design features or site characteristics not found at ANO-2 are listed in Appendix F.

4.1 Cooling System

Category 1 issues in Table B-1 of 10 CFR Part 51, Subpart A, Appendix B that are applicable to operation of the ANO-2 cooling system during the license renewal term are listed in Table 4-1. Entergy Operations, Inc. (Entergy) stated in its Environmental Report (ER) (Entergy 2003a) that it is not aware of any new and significant information associated with the renewal of the ANO-2 operating license (OL). The staff has not identified any new and significant information during its independent review of the ER, the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts related to these issues beyond those discussed in the GEIS. For all of the issues, the staff concluded in the GEIS that the impacts are SMALL, and additional plant-specific mitigation measures are not likely to be sufficiently beneficial to be warranted.

Table 4-1. Category 1 Issues Applicable to the Operation of the Arkansas Nuclear One, Unit 2 Cooling System During the License Renewal Term

ISSUE – 10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Sections
SURFACE WATER QUALITY, HYDROLOGY, AND USE (FOR ALL PLANTS)	
Altered current patterns at intake and discharge structures	4.2.1.2.1; 4.3.2.2; 4.4.2
Altered thermal stratification of lakes	4.2.1.2.2; 4.4.2.2
Temperature effects on sediment transport capacity	4.2.1.2.3; 4.4.2.2
Scouring caused by discharged cooling water	4.2.1.2.3; 4.4.2.2
Eutrophication	4.2.1.2.3; 4.4.2.2
Discharge of chlorine or other biocides	4.2.1.2.4; 4.4.2.2
Discharge of sanitary wastes and minor chemical spills	4.2.1.2.4; 4.4.2.2
Discharge of other metals in wastewater	4.2.1.2.4; 4.3.2.2; 4.4.2.2
AQUATIC ECOLOGY (FOR ALL PLANTS)	
Accumulation of contaminants in sediments or biota	4.2.1.2.4; 4.3.3; 4.4.3; 4.4.2.2
Entrainment of phytoplankton and zooplankton	4.2.2.1.1; 4.3.3; 4.4.3

Table 4-1. (contd)

ISSUE – 10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Sections
Cold shock	4.2.2.1.5; 4.3.3; 4.4.3
Thermal plume barrier to migrating fish	4.2.2.1.6; 4.4.3
Distribution of aquatic organisms	4.2.2.1.6; 4.4.3
Premature emergence of aquatic insects	4.2.2.1.7; 4.4.3
Gas supersaturation (gas bubble disease)	4.2.2.1.8; 4.4.3
Low dissolved oxygen in the discharge	4.2.2.1.9; 4.3.3; 4.4.3
Losses from predation, parasitism, and disease among organisms exposed to sublethal stresses	4.2.2.1.10; 4.4.3
Stimulation of nuisance organisms	4.2.2.1.11; 4.4.3
AQUATIC ECOLOGY (FOR PLANTS WITH COOLING-TOWER-BASED HEAT DISSIPATION SYSTEMS)	
Entrainment of fish and shellfish in early life stages	4.3.3
Impingement of fish and shellfish	4.3.3
Heat shock	4.3.3
TERRESTRIAL RESOURCES	
Cooling tower impacts on crops and ornamental vegetation	4.3.4
Cooling tower impacts on native plants	4.3.5.1
Bird collisions with cooling towers	4.3.5.2
HUMAN HEALTH	
Microbial organisms (occupational health)	4.3.6
Noise	4.3.7

A brief description of the staff's review and the GEIS conclusions, as codified in Table B-1, for each of these issues follows:

- Altered current patterns at intake and discharge structures. Based on information in the GEIS, the Commission found that

  > Altered current patterns have not been found to be a problem at operating nuclear power plants and are not expected to be a problem during the license renewal term.

  The staff has not identified any new and significant information during its independent review of the Entergy ER, the staff's site visit, the scoping process, or its evaluation of other

available information. Therefore, the staff concludes that there are no impacts of altered current patterns at intake and discharge structures during the license renewal term beyond those discussed in the GEIS.

- Altered thermal stratification of lakes. Based on information in the GEIS, the Commission found that

  > Generally, lake stratification has not been found to be a problem at operating nuclear power plants and is not expected to be a problem during the license renewal term.

  The staff has not identified any new and significant information during its independent review of the Entergy ER, the staff's site visit, the scoping process, its review of monitoring programs, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts of altered thermal stratification of lakes during the license renewal term beyond those discussed in the GEIS.

- Temperature effects on sediment transport capacity. Based on information in the GEIS, the Commission found that

  > These effects have not been found to be a problem at operating nuclear power plants and are not expected to be a problem during the license renewal term.

  The staff has not identified any new and significant information during its independent review of the Entergy ER, the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts of temperature effects on sediment transport capacity during the license renewal term beyond those discussed in the GEIS.

- Scouring caused by discharged cooling water. Based on information in the GEIS, the Commission found that

  > Scouring has not been found to be a problem at most operating nuclear power plants and has caused only localized effects at a few plants. It is not expected to be a problem during the license renewal term.

  The staff has not identified any new and significant information during its independent review of the Entergy ER, the staff's site visit, the scoping process, its review of monitoring programs, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts of scouring caused by discharged cooling water during the license renewal term beyond those discussed in the GEIS.

- Eutrophication. Based on information in the GEIS, the Commission found that

  > Eutrophication has not been found to be a problem at operating nuclear power plants and is not expected to be a problem during the license renewal term.

  The staff has not identified any new and significant information during its independent review of the Entergy ER, the staff's site visit, the scoping process, its review of monitoring programs, or its evaluation of other available information including plant monitoring data and technical reports. Therefore, the staff concludes that there are no impacts of eutrophication during the license renewal term beyond those discussed in the GEIS.

- Discharge of chlorine or other biocides. Based on information in the GEIS, the Commission found that

  > Effects are not a concern among regulatory and resource agencies, and are not expected to be a problem during the license renewal term.

  The staff has not identified any new and significant information during its independent review of the Entergy ER, the staff's site visit, the scoping process, or its evaluation of other available information including the National Pollutant Discharge Elimination System (NPDES) permit for ANO-2. Therefore, the staff concludes that there are no impacts of discharge of chlorine or other biocides during the license renewal term beyond those discussed in the GEIS.

- Discharge of sanitary wastes and minor chemical spills. Based on information in the GEIS, the Commission found that

  > Effects are readily controlled through NPDES permit and periodic modifications, if needed, and are not expected to be a problem during the license renewal term.

  The staff has not identified any new and significant information during its independent review of the Entergy ER, the staff's site visit, the scoping process, or its evaluation of other available information including the NPDES permit for ANO-2, or discussion with the NPDES compliance office (Arkansas Department of Environmental Quality [ADEQ]). Therefore, the staff concludes that there are no impacts of discharges of sanitary wastes and minor chemical spills during the license renewal term beyond those discussed in the GEIS.

- Discharge of other metals in wastewater. Based on information in the GEIS, the Commission found that

  > These discharges have not been found to be a problem at operating nuclear power plants with cooling-tower-based heat dissipation systems and have been satisfactorily mitigated at other plants. They are not expected to be a problem during the license renewal term.

  The staff has not identified any new and significant information during its independent review of the Entergy ER, the staff's site visit, the scoping process, or its evaluation of other available information including the NPDES permit for ANO-2, and discussions with the NPDES compliance office (ADEQ). Therefore, the staff concludes that there are no impacts of discharges of other metals in wastewater during the license renewal term beyond those discussed in the GEIS.

- Accumulation of contaminants in sediments or biota. Based on information in the GEIS, the Commission found that

  > Accumulation of contaminants has been a concern at a few nuclear power plants but has been satisfactorily mitigated by replacing copper alloy condenser tubes with those of another metal. It is not expected to be a problem during the license renewal term.

  The staff has not identified any new and significant information during its independent review of the Entergy ER, the staff's site visit, the scoping process, or its evaluation of available information. Therefore, the staff concludes that there are no impacts of accumulation of contaminants in sediments or biota during the license renewal term beyond those discussed in the GEIS.

- Entrainment of phytoplankton and zooplankton. Based on information in the GEIS, the Commission found that

  > Entrainment of phytoplankton and zooplankton has not been found to be a problem at operating nuclear power plants and is not expected to be a problem during the license renewal term.

  The staff has not identified any new and significant information during its independent review of the Entergy ER, the staff's site visit, the scoping process, its review of monitoring programs, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts of entrainment of phytoplankton and zooplankton during the license renewal term beyond those discussed in the GEIS.

- Cold shock. Based on information in the GEIS, the Commission found that

  > Cold shock has been satisfactorily mitigated at operating nuclear plants with once-through cooling systems, has not endangered fish populations or been found to be a problem at operating nuclear power plants with cooling towers or cooling ponds, and is not expected to be a problem during the license renewal term.

  The staff has not identified any new and significant information during its independent review of the Entergy ER, the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts of cold shock during the license renewal term beyond those discussed in the GEIS.

- Thermal plume barrier to migrating fish. Based on information in the GEIS, the Commission found that

  > Thermal plumes have not been found to be a problem at operating nuclear power plants and are not expected to be a problem during the license renewal term.

  The staff has not identified any new and significant information during its independent review of the Entergy ER, the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts of thermal plume barriers to migrating fish during the license renewal term beyond those discussed in the GEIS.

- Distribution of aquatic organisms. Based on information in the GEIS, the Commission found that

  > Thermal discharge may have localized effects but is not expected to effect the larger geographical distribution of aquatic organisms.

  The staff has not identified any new and significant information during its independent review of the Entergy ER, the staff's site visit, the scoping process, its review of monitoring programs, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts on distribution of aquatic organisms during the license renewal term beyond those discussed in the GEIS.

- Premature emergence of aquatic insects. Based on information in the GEIS, the Commission found that

  > Premature emergence has been found to be a localized effect at some operating nuclear power plants but has not been a problem and is not expected to be a problem during the license renewal term.

  The staff has not identified any new and significant information during its independent review of the Entergy ER, the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts of premature emergence of aquatic insects during the license renewal term beyond those discussed in the GEIS.

- Gas supersaturation (gas bubble disease). Based on information in the GEIS, the Commission found that

  > Gas supersaturation was a concern at a small number of operating nuclear power plants with once-through cooling systems but has been satisfactorily mitigated. It has not been found to be a problem at operating nuclear power plants with cooling towers or cooling ponds and is not expected to be a problem during the license renewal term.

  The staff has not identified any new and significant information during its independent review of the Entergy ER, the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts of gas supersaturation during the license renewal term beyond those discussed in the GEIS.

- Low dissolved oxygen in the discharge. Based on information in the GEIS, the Commission found that

  > Low dissolved oxygen has been a concern at one nuclear power plant with a once-through cooling system but has been effectively mitigated. It has not been found to be a problem at operating nuclear power plants with cooling towers or cooling ponds and is not expected to be a problem during the license renewal term.

  The staff has not identified any new and significant information during its independent review of the Entergy ER, the staff's site visit, the scoping process, its review of monitoring programs, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts of low dissolved oxygen during the license renewal term beyond those discussed in the GEIS.

- Losses from predation, parasitism, and disease among organisms exposed to sublethal stresses. Based on information in the GEIS, the Commission found that

  > These types of losses have not been found to be a problem at operating nuclear power plants and are not expected to be a problem during the license renewal term.

  The staff has not identified any new and significant information during its independent review of the Entergy ER, the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts of losses from predation, parasitism, and disease among organisms exposed to sublethal stresses during the license renewal term beyond those discussed in the GEIS.

- Stimulation of nuisance organisms. Based on information in the GEIS, the Commission found that

  > Stimulation of nuisance organisms has been satisfactorily mitigated at the single nuclear power plant with a once-through cooling system where previously it was a problem. It has not been found to be a problem at operating nuclear power plants with cooling towers or cooling ponds and is not expected to be a problem during the license renewal term.

  The staff has not identified any new and significant information during its independent review of the Entergy ER, the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts of stimulation of nuisance organisms during the license renewal term beyond those discussed in the GEIS.

- Entrainment of fish and shellfish in early life stages (cooling-tower-based systems). Based on information in the GEIS, the Commission found that

  > Entrainment of fish has not been found to be a problem at operating nuclear power plants with this type of cooling system and is not expected to be a problem during the license renewal term.

  The staff has not identified any new and significant information during its independent review of the Entergy ER, the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts of entrainment of fish and shellfish in early life stages for cooling-tower-based systems during the license renewal term beyond those discussed in the GEIS.

- Impingement of fish and shellfish (cooling-tower-based systems). Based on information in the GEIS, the Commission found that

  > The impingement has not been found to be a problem at operating nuclear power plants with this type of cooling system and is not expected to be a problem during the license renewal term.

  The staff has not identified any new and significant information during its independent review of the Entergy ER, the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts of impingement of fish and shellfish for cooling-tower-based systems during the license renewal term beyond those discussed in the GEIS.

- Heat shock (cooling-tower-based systems). Based on information in the GEIS, the Commission found that

  > Heat shock has not been found to be a problem at operating nuclear power plants with this type of cooling system and is not expected to be a problem during the license renewal term.

  The staff has not identified any new and significant information during its independent review of the Entergy ER, the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts of heat shock for cooling-tower-based systems during the license renewal term beyond those discussed in the GEIS.

- Cooling tower impacts on crops and ornamental vegetation. Based on information in the GEIS, the Commission found that

  > Impacts from salt drift, icing, fogging, or increased humidity associated with cooling tower operation have not been found to be a problem at operating nuclear power plants and are not expected to be a problem during the license renewal term.

  The staff has not identified any new and significant information during its independent review of the Entergy ER, the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no cooling tower impacts on crops and ornamental vegetation during the license renewal term beyond those discussed in the GEIS.

- Cooling tower impacts on native vegetation. Based on information in the GEIS, the Commission found that

  > Impacts from salt drift, icing, fogging, or increased humidity associated with cooling tower operation have not been found to be a problem at operating nuclear power plants and are not expected to be a problem during the license renewal term.

  The staff has not identified any new and significant information during its independent review of the Entergy ER, the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no cooling tower impacts on native vegetation during the license renewal term beyond those discussed in the GEIS.

- Bird collisions with cooling towers. Based on information in the GEIS, the Commission found that

  > These collisions have not been found to be a problem at operating nuclear power plants and are not expected to be a problem during the license renewal term.

  The staff has not identified any new and significant information during its independent review of the Entergy ER, the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts of bird collisions with cooling towers during the license renewal term beyond those discussed in the GEIS.

- Microbiological organisms (occupational health). Based on information in the GEIS, the Commission found that

  > Occupational health impacts are expected to be controlled by continued application of accepted industrial hygiene practices to minimize worker exposures.

  The staff has not identified any new and significant information during its independent review of the Entergy ER, the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts of microbiological organisms during the license renewal term beyond those discussed in the GEIS.

- Noise. Based on information in the GEIS, the Commission found that

  > Noise has not been found to be a problem at operating plants and is not expected to be a problem at any plant during the license renewal term.

  The staff has not identified any new and significant information during its independent review of the Entergy ER, the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts of noise during the license renewal term beyond those discussed in the GEIS.

The Category 2 issues related to cooling system operation during the license renewal term that are applicable to ANO-2 are listed in Table 4-2 and are discussed in Sections 4.1.1 and 4.1.2. Although the Entergy ER identified only microbiological organisms (public health) as an applicable Category 2 issue, the staff determined that all the Category 2 issues pertaining to plants with cooling towers are applicable to ANO-2.

Table 4-2. Category 2 Issues Applicable to the Operation of the Arkansas Nuclear One, Unit 2 Cooling System During the License Renewal Term

ISSUE – 10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Sections	10 CFR 51.53(c)(3)(ii) Subparagraph	SEIS Section
SURFACE WATER QUALITY, HYDROLOGY, AND USE (FOR ALL PLANTS)			
Water use conflicts (plants with cooling ponds or cooling towers using make-up water from a small river with low flow)	4.3.2.1; 4.4.2.1	A	4.1.1
HUMAN HEALTH			
Microbiological organisms (public health)(plants using lakes or canals, or cooling towers or cooling ponds that discharge to a small river)	4.3.6	G	4.1.5

4.1.1 Water Use Conflicts (Makeup Water from a Small River)

Consumptive water use can adversely impact riparian vegetation and associated animal communities by reducing the amount of water available for plant growth, maintenance, and reproduction. While changes, albeit small, in average annual stream flow downstream of Lake Dardanelle are inevitable because of the decrease in the total water supply, any changes that might occur in the pool elevation will be the result of other considerations in the operation of the Arkansas River system.

Because ANO-2 is located on a river impoundment and there are no water availability problems in Lake Dardanelle, the relatively small consumptive water loss from its operation does not have a significant adverse impact on instream ecological communities. Resource agencies have concurred with this assessment (AGFC 1995). Evaporative losses from the ANO-2 cooling tower are estimated to average 0.62 m^3/s (22 cfs) annually with the maximum annual average of 0.74 m^3/s (26 cfs). Under low-flow water conditions of 40 m^3/s (1400 cfs), the maximum evaporative losses only represent 2 percent reduction in the stream flow downstream. Consumptive use of water at ANO-2 is not expected to change during the period of the proposed license renewal. It is impossible to reliably predict the quantity of future withdrawals for all other users. However, State and Federal regulations are in place to ensure future withdrawals do not adversely impact the aquatic and riparian communities in Lake Dardanelle and downstream.

The staff has reviewed the impact of the consumptive use of water by ANO-2 on the aquatic communities in Lake Dardanelle. The staff has reviewed the available information, including that provided by the applicant, the staff's site visit, the scoping process, discussions with other agencies, and other public sources. Using this information, the staff evaluated the potential impacts from the consumptive use of water by ANO-2 on the aquatic communities in Lake Dardanelle during the license renewal term. It is the staff's conclusion that the potential impacts during the license renewal term are SMALL.

During the course of preparing this supplemental environmental impact statement (SEIS), the staff considered mitigation measures for the continued operation of ANO-2. When continued operation for an additional 20 years is considered as a whole, all of the specific effects on the environment (whether or not "significant") were considered. Based on this assessment, the staff expects that the measures in place at ANO-2 provide mitigation for all impacts related to the consumptive use of water by ANO-2 on the aquatic communities in Lake Dardanelle, and no new mitigation measures are warranted.

4.1.2 Microbiological Organisms (Public Health)

The Arkansas River, which was impounded to form Lake Dardanelle, has an annual average flow rate of 1070 m^3/s (37,800 cfs). ANO-2 uses a closed-cycle cooling system equipped with a natural-draft cooling tower to dissipate waste heat to the atmosphere. After moving through the condenser, circulating water rejects waste heat to the atmosphere through the natural-draft cooling tower. Evaporation in the cooling tower occurs at an average rate of approximately 0.62 m^3/s (22 cfs) with the maximum evaporation rate expected to be approximately 0.76 m^3/s (27 cfs). Remaining waste heat is discharged in the form of blowdown from the circulating water system to a 158-m (520-ft)-long canal discharging into Lake Dardanelle. This blowdown is mixed with the ANO-1 circulating water system discharge.

In 1981, 11 nuclear plants took part in a study to determine if thermophilic pathogens existed in cooling water systems. Arkansas Nuclear One was one of 10 plants in the study that had thermophilic free-living amoebae in cooling water samples. However, the amoebae were not pathogenic. *Naegleria* sp., which is pathogenic, was not detected in the water or sediment samples from the Arkansas Nuclear One intake canal or discharge embankment. *Legionella* sp. was detected in water samples collected in Lake Dardanelle at Arkansas Nuclear One, but the concentrations were similar to the concentrations in local surface water control sources (NRC 2001).

Studies on thermophilic pathogens at Arkansas Nuclear One have concluded that risk of infection from aerosols containing *Legionella* sp. is not a public health risk, but rather, a potential industrial hygiene concern that is managed through appropriate industrial hygiene practices (NRC 2001).

The Arkansas Department of Health was contacted to determine whether it had concerns regarding thermophilic pathogens in Lake Dardanelle or the Arkansas River. The Arkansas Department of Health had no information indicating that a human-health exposure problem exists with thermophilic pathogens in Lake Dardanelle or the Arkansas River (McGrew 2003; Meyers 2003).

There has been no known impact of ANO-2 operation on public health related to thermophilic microorganisms. Although there is a potential for deleterious thermophilic microorganisms associated with cooling systems, the actual hazard to public health from closed-cycle cooling systems at nuclear plants has not been documented or substantiated.

The staff has reviewed the available information, including that provided by Entergy, the staff's site visit, the scoping process, discussions with other agencies, and other public sources. Using this information, the staff evaluated the potential public health impacts resulting from operation of ANO-2 during the license renewal term. It is the staff's conclusion that the potential public health impacts during the license renewal term are SMALL.

While preparing this SEIS, the staff considered mitigation measures for the continued operation of ANO-2. When continued operation for an additional 20 years is considered as a whole, all of the specific effects on the environment (whether or not "significant") were considered. Based on this assessment, the staff expects that the measures in place at ANO-2 provide mitigation for all impacts related to public health, and no new mitigation measures are warranted.

4.2 Transmission Lines

One 500-kV, single-circuit transmission line, which is approximately 146 km (91 mi) long, connects ANO-2 to the power distribution grid. It extends from the existing ANO-2, 500-kV station switchyard southeasterly via the Mayflower substation (southwest of Mayflower) to the Mabelvale substation (southwest of Little Rock) (Entergy 2003a). Its right-of-way is 55 m (180 ft) wide (Entergy 2003a), encompasses 730 ha (1804 ac), and crosses lands that consist of rural property, forestland, and to a limited degree, agricultural and timber production operations. Vegetation management along the ANO-2 transmission line right-of-way involves mechanical and manual clearing only. No herbicides are used to manage vegetation along this right-of-way (Entergy 2003a).

Category 1 issues in 10 CFR Part 51, Subpart A, Appendix B, Table B-1 that are applicable to the ANO-2 transmission line are listed in Table 4-3. Entergy stated in its ER (Entergy 2003a) that it is not aware of any new and significant information concerning the transmission line or right-of-way maintenance for the Category 1 issues associated with the renewal of the ANO-2 OL. The staff conducted an independent review of the Entergy ER, a site visit, the scoping process, consultation with the U.S. Fish and Wildlife Service (FWS) and the Arkansas Natural Heritage Commission (ANHC), and an evaluation of other available information. As a result of this review, the staff concludes that there are no impacts related to these issues beyond those discussed in the GEIS (NRC 1996). For all those issues, the staff concluded that the impacts are SMALL, and additional plant-specific mitigation measures are not likely to be sufficiently beneficial to be warranted.

Table 4-3. Category 1 Issues Applicable to the Arkansas Nuclear One, Unit 2 Transmission Line During the License Renewal Term

ISSUE – 10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Sections
TERRESTRIAL RESOURCES	
Power line right-of-way management (cutting and herbicide application)	4.5.6.1
Bird collisions with power lines	4.5.6.2
Impacts of electromagnetic fields on flora and fauna (plants, agricultural crops, honeybees, wildlife, livestock)	4.5.6.3
Floodplains and wetland on power line right-of-way	4.5.7
AIR QUALITY	
Air quality effects of transmission lines	4.5.2
LAND USE	
Onsite land use	4.5.3
Power line right-of-way	4.5.3

A brief description of the staff's review and GEIS conclusions, as codified in 10 CFR Part 51, Subpart A, Appendix B, Table B-1, for each of these issues follows:

- Power line right-of-way management (cutting and herbicide application). Based on information in the GEIS, the Commission found that

  > The impacts of right-of-way maintenance on wildlife are expected to be of small significance at all sites.

  During the staff site visit, the staff observed several instances of erosion on moderate grades beneath the 500-kV power line. However, these were not sufficiently extensive to alter the conclusions in the GEIS. The staff has not identified any new and significant information during its independent review of the Entergy ER, the staff's site visit, the scoping process, or its evaluation of other information. Therefore, the staff concludes that there are no impacts of power line right-of-way management during the license renewal term beyond those discussed in the GEIS.

- Bird collisions with power lines. Based on information in the GEIS, the Commission found that

  > Impacts are expected to be of small significance at all sites.

  The staff has not identified any new and significant information during its independent review of the Entergy ER, the staff's site visit, the scoping process, consultation with the FWS, or its evaluation of other information. Therefore, the staff concludes that there are no impacts of bird collisions with power lines during the license renewal term beyond those discussed in the GEIS.

- Impacts of electromagnetic fields on flora and fauna (plants, agricultural crops, honeybees, wildlife, livestock). Based on information in the GEIS, the Commission found that

  > No significant impacts of electromagnetic fields on terrestrial flora and fauna have been identified. Such effects are not expected to be a problem during the license renewal term.

  The staff has not identified any new and significant information during its independent review of the Entergy ER, the staff's site visit, the scoping process, or its evaluation of other information. Therefore, the staff concludes that there are no impacts of electromagnetic fields on flora and fauna during the license renewal term beyond those discussed in the GEIS.

- Floodplains and wetlands on power line right-of-way. Based on information in the GEIS, the Commission found that

  > Periodic vegetation control is necessary in forested wetlands underneath power lines and can be achieved with minimal damage to the wetland. No significant impact is expected at any nuclear power plant during the license renewal term.

  On October 11 and 12, 2002, FTN Associates, Ltd. conducted biological field surveys where the ANO-2 transmission line right-of-way crosses Illinois Bayou, Cadron Creek, and Goose Pond Natural Area (three areas of concern to the ANHC [ANHC 2002]). FTN found no evidence that these areas had been previously impacted or would be impacted in the future by continued maintenance of the transmission line right-of-way (FTN 2004). The staff has not identified any new and significant information during its independent review of the Entergy ER, the staff's site visit, the scoping process, or its evaluation of other information. Therefore, the staff concludes that there are no impacts of the ANO-2 power line right-of-way on floodplains and wetlands during the license renewal term beyond those discussed in the GEIS.

- Air quality effects of transmission lines. Based on the information in the GEIS, the Commission found that

  > Production of ozone and oxides of nitrogen is insignificant and does not contribute measurably to ambient levels of these gases.

  The staff has not identified any new and significant information during its independent review of the Entergy ER, the staff's site visit, the scoping process, or its evaluation of other information. Therefore, the staff concludes that there are no air quality impacts of the ANO-2 transmission line during the license renewal term beyond those discussed in the GEIS.

- Onsite land use. Based on information in the GEIS, the Commission found that

  > Projected onsite land use changes required during ... the renewal period would be a small fraction of any nuclear power plant site and would involve land that is controlled by the applicant.

  The staff has not identified any new and significant information during its independent review of the Entergy ER, the staff's site visit, the scoping process, or its evaluation of other information. Therefore, the staff concludes that there are no onsite land-use impacts during the license renewal term beyond those discussed in the GEIS.

- Power line right-of-way. Based on information in the GEIS, the Commission found that

  > Ongoing use of power line right of ways would continue with no change in restrictions. The effects of these restrictions are of small significance.

  The staff has not identified any new and significant information during its independent review of the Entergy ER, the staff's site visit, the scoping process, or its evaluation of other information. Therefore, the staff concludes that there are no impacts of the ANO-2 power line right-of-way on land use during the license renewal term beyond those discussed in the GEIS.

Category 2 and uncategorized issues in 10 CFR Part 51, Subpart A, Appendix B, Table B-1, that are applicable to the ANO-2 transmission line are listed in Table 4-4 and are discussed in Sections 4.2.1 and 4.2.2.

Table 4-4. Category 2 and Uncategorized Issues Applicable to the Arkansas Nuclear One, Unit 2 Transmission Line During the License Renewal Term

ISSUE – 10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Sections	10 CFR 51.53(c)(3)(ii) Subparagraph	SEIS Section
HUMAN HEALTH			
Electromagnetic fields, acute effects (electric shock)	4.5.4.1	H	4.2.1
Electromagnetic fields, chronic effects	4.5.4.2	NA	4.2.2

4.2.1 Electromagnetic Fields – Acute Effects

In the GEIS (NRC 1996), the staff found that without a review of the conformance of each nuclear plant transmission line with National Electrical Safety Code (NESC) (NESC 1997) criteria, it was not possible to determine the significance of the electric shock potential. Evaluation of individual plant transmission lines is necessary because the issue of electric shock safety was not addressed in the licensing process for some plants. For other plants, land use in the vicinity of transmission lines may have changed, or power distribution companies may have chosen to upgrade line voltage. To comply with 10 CFR 51.53(c)(3)(ii)(H), Entergy must provide an assessment of the potential shock hazard if the transmission lines that were constructed for the specific purpose of connecting the plant to the transmission system do not meet the recommendations of the NESC for preventing electric shock from induced currents.

One 500-kV transmission line was constructed to connect ANO-2 to the power distribution grid. The onsite transmission line meets the 1997 NESC criteria. The offsite portion of the line runs

approximately 146 km (91 mi) from the ANO-2 switchyard to the Mayflower substation and then to the Mabelvale substation. This line, which has been operated at the same voltage since it was energized in 1973 (Entergy 2003a), meets the 1997 NESC clearance criterion of 8.64 m (28.35 ft) at a maximum operating temperature of 100°C (212°F). The ENVIRO code (EPRI 1992) was used to evaluate the electric field strength 1 m (3 ft) above ground level assuming that a large tractor-trailer truck was parked beneath the line at each of 16 major road crossings. The steady state current was calculated from these estimated field strengths. At two of the 16 crossings, the calculated steady state current exceeded the 5 mA NESC criterion. The two highway crossings were both where the transmission lines cross I-40. The highest current prediction, about 6.2 mA, was for the east-bound lanes of I-40 near Conway, Arkansas, and the other was near the Arkansas Nuclear One site. It is highly unlikely that a tractor-trailer truck would park under either of these transmission line spans because I-40 is a limited-access highway, so except for emergencies, parking on the highway is not allowed.

Additionally, state regulations limit large vehicles on minor and dirt roads. The largest steady state current for a large school bus on such roads or an agricultural combine in a field where the transmission line crosses was calculated to be less than 4 mA.

The staff has reviewed Entergy evaluation and computational results. Based on this review, the staff concludes that the impact of the potential for electric shock is SMALL and additional mitigation is not warranted.

4.2.2 Electromagnetic Fields – Chronic Effects

In the GEIS, the chronic effects of 60-Hz electromagnetic fields from transmission lines is not designated as a Category 1 or 2 issue, and will not be so designated until a scientific consensus is reached on the health implications of these fields.

The potential for chronic effects from these fields continues to be studied and is not known at this time. The National Institute of Environmental Health Sciences (NIEHS) directs related research through the U.S. Department of Energy. A recent report (NIEHS 1999) contains the following conclusion:

> The NIEHS concludes that ELF-EMF [extremely low frequency-electromagnetic field] exposure cannot be recognized as entirely safe because of weak scientific evidence that exposure may pose a leukemia hazard. In our opinion, this finding is insufficient to warrant aggressive regulatory concern. However, because virtually everyone in the United States uses electricity and therefore is routinely exposed to ELF-EMF, passive regulatory action is warranted such as a continued emphasis on educating both the public and the regulated community on means aimed at reducing exposures. The

> NIEHS does not believe that other cancers or non-cancer health outcomes provide sufficient evidence of a risk to currently warrant concern.

This statement is not sufficient to cause the staff to change its position with respect to the chronic effects of electromagnetic fields. The staff concludes that the GEIS finding of "not applicable" is still appropriate, and will continue to follow developments on this issue.

4.3 Radiological Impacts of Normal Operations

Category 1 issues in 10 CFR Part 51, Subpart A, Appendix B, Table B-1 that are applicable to ANO-2 in regard to radiological impacts are listed in Table 4-5. Entergy stated in its ER that it is not aware of any new and significant information associated with the renewal of the ANO-2 OL. The staff has not identified any new and significant information during its independent review of the Entergy ER, the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts related to these issues beyond those discussed in the GEIS. For these issues, the staff concluded in the GEIS that the impacts are SMALL, and additional plant-specific mitigation measures are not likely to be sufficiently beneficial to be warranted.

Table 4-5. Category 1 Issues Applicable to Radiological Impacts of Normal Operations at Arkansas Nuclear One, Unit 2 During the License Renewal Term

ISSUE – 10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Sections
HUMAN HEALTH	
Radiation exposures to public (license renewal term)	4.6.2
Occupational radiation exposures (license renewal term)	4.6.3

A brief description of the staff's review and the GEIS conclusions, as codified in Table B-1, for each of these issues follows:

- Radiation exposures to public (license renewal term). Based on information in the GEIS, the Commission found that

  > Radiation doses to the public will continue at current levels associated with normal operations.

  The staff has not identified any new and significant information during its independent review of the Entergy ER, the staff's site visit, the scoping process, or its evaluation of other

available information. Therefore, the staff concludes that there are no impacts of radiation exposures to the public during the license renewal term beyond those discussed in the GEIS.

- Occupational radiation exposures (license renewal term). Based on information in the GEIS, the Commission found that

  > Projected maximum occupational doses during the license renewal term are within the range of doses experienced during normal operations and normal maintenance outages, and would be well below regulatory limits.

  The staff has not identified any new and significant information during its independent review of the Entergy ER, the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts of occupational radiation exposures during the license renewal term beyond those discussed in the GEIS.

There are no Category 2 issues related to radiological impacts of routine operations.

4.4 Socioeconomic Impacts of Plant Operations During the License Renewal Term

Category 1 issues in 10 CFR Part 51, Subpart A, Appendix B, Table B-1 that are applicable to socioeconomic impacts during the license renewal term are listed in Table 4-6. Entergy stated in the its ER that it is not aware of any new and significant information associated with the renewal of the ANO-2 OL. The staff has not identified any new and significant information during

Table 4-6. Category 1 Issues Applicable to Socioeconomics for Arkansas Nuclear One, Unit 2 During the License Renewal Term

ISSUE – 10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Sections
SOCIOECONOMICS	
Public services: public safety, social services, and tourism and recreation	4.7.3; 4.7.3.3; 4.7.3.4; 4.7.3.6
Public services: education (license renewal term)	4.7.3.1
Aesthetic impacts (license renewal term)	4.7.6
Aesthetic impacts of transmission lines (license renewal term)	4.5.8

its independent review of the Entergy ER, the staff's site visit, the scoping process, discussions with other agencies, or its evaluation of other information. Therefore, the staff concludes that there are no impacts related to these issues beyond those discussed in the GEIS. For these issues, the staff concluded in the GEIS that the impacts are SMALL, and additional plant-specific mitigation measures are not likely to be sufficiently beneficial to be warranted.

A brief description of the staff's review and the GEIS conclusions, as codified in Table B-1, for each of these issues follows:

- Public services: public safety, social services, and tourism and recreation. Based on information in the GEIS, the Commission found that

  > Impacts to public safety, social services, and tourism and recreation are expected to be of small significance at all sites.

  The staff has not identified any new and significant information during its independent review of the Entergy ER, the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts on public safety, social services, and tourism and recreation during the license renewal term beyond those discussed in the GEIS.

- Public services: education (license renewal term). Based on information in the GEIS, the Commission found that

  > Only impacts of small significance are expected.

  The staff has not identified any new and significant information during its independent review of the Entergy ER, the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts on education during the license renewal term beyond those discussed in the GEIS.

- Aesthetic impacts (license renewal term). Based on information in the GEIS, the Commission found that

  > No significant impacts are expected during the license renewal term.

  The staff has not identified any new and significant information during its independent review of the Entergy ER, the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no aesthetic impacts during the license renewal term beyond those discussed in the GEIS.

- Aesthetic impacts of transmission lines (license renewal term). Based on information in the GEIS, the Commission found that

  No significant impacts are expected during the license renewal term.

The staff has not identified any new and significant information during its independent review of the Entergy ER, the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no aesthetic impacts of transmission lines during the license renewal term beyond those discussed in the GEIS.

Table 4-7 lists the Category 2 socioeconomic issues, which require plant-specific analysis, and environmental justice, which was not addressed in the GEIS. These issues are discussed in Sections 4.4.1 through 4.4.6.

Table 4-7. Environmental Justice and GEIS Category 2 Issues Applicable to Socioeconomics for Arkansas Nuclear One, Unit 2 During the License Renewal Term

ISSUE – 10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Sections	10 CFR 51.53(c)(3)(ii) Subparagraph	SEIS Section
	SOCIOECONOMICS		
Housing impacts	4.7.1	I	4.4.1
Public services: public utilities	4.7.3.5	I	4.4.2
Offsite land use (license renewal term)	4.7.4	I	4.4.3
Public services, transportation	4.7.3.2	J	4.4.4
Historic and archaeological resources	4.7.7	K	4.4.5
Environmental justice	Not addressed[a]	Not addressed[a]	4.4.6

(a) Guidance related to environmental justice was not in place at the time the GEIS and the associated revision to 10 CFR Part 51 was prepared. Therefore, environmental justice must be addressed in the licensee's ER and the staff's EIS.

4.4.1 Housing Impacts During Operations

Impacts on housing are considered SMALL when a small or not easily discernible change in housing availability occurs. Impacts are considered MODERATE when there is discernible but short-lived reduction in available housing units because of project-induced migration. Impacts are considered LARGE when project-related housing demands result in very limited housing availability and would increase rental rates and housing values well above normal inflation (NRC 1996).

In determining housing impacts, the applicant chose to follow Appendix C of the GEIS (NRC 1996), which presents a population characterization method that is based on two factors, "sparseness" and "proximity." Sparseness measures population density within 32 km (20 mi) of the site, and proximity measures population density and city size within 80 km (50 mi). Each factor has categories of density and size (NRC 1996), and a matrix is used to rank the population category as low, medium, or high (NRC 1996).

Entergy used 2000 census data from the Arkansas State Census Data Center (UALR 2002) and Geographical Information System software (ArcView,® Version 8.1) to determine the overall resident population and demographic characteristics in the vicinity of Arkansas Nuclear One. Entergy's analysis of the 2000 census data indicates that 87,468 people live within 32 km (20 mi) of Arkansas Nuclear One, which equates to a population density of 27 persons/km^2 (70 persons/mi^2). According to the GEIS sparseness index, the area around Arkansas Nuclear One is classified as Category 3 sparseness (having 60 to 120 persons per mi^2 within 20 miles).

Entergy's analysis of the 2000 census data shows that 267,664 people live within 80 km (50 mi) of Arkansas Nuclear One, which equates to a population density of 13 people/km^2 (34 people/mi^2). According to the GEIS proximity index, the Arkansas Nuclear One site is classified as Category 1 (no city with 100,000 or more people and fewer than 50 persons per mi^2 within 80 km [50 mi]). According to the GEIS sparseness and proximity matrix, the combination of Category 3 sparseness and Category 1 proximity leads to the conclusion that Arkansas Nuclear One is located in a medium population area.

The staff confirmed these analyses using an independently confirmed methodology (Section 2.2.8.5). During 2000, the population living within 32 km (20 mi) of ANO-2 was estimated to be 99,033 (USCB 2000a). This total converts to a population density of about 30 persons/km^2 (79 persons/mi^2) living on the land area within a 32-km (20-mi) radius of Arkansas Nuclear One. This concentration falls into the GEIS sparseness Category 3 (i.e., having fewer than or equal to 46 persons/km^2 [120 persons/mi^2]).

An estimated 311,904 people live within 80 km (50 mi) of the Arkansas Nuclear One site (USCB 2000a), equating to a population density of around 15 persons/km^2 (40 persons/mi^2) on the available land area. Applying the GEIS proximity measures (NRC 1996), the area around Arkansas Nuclear One is classified as Category 1 (i.e., having fewer than 19 persons/km^2 [50 persons/mi^2] within 80 km [50 mi] of the site). According to the GEIS criteria, these sparseness and proximity scores place Arkansas Nuclear One in a medium population area.

10 CFR Part 51, Subpart A, Appendix B, Table B-1 states that impacts on housing availability are expected to be of SMALL significance at plants located in a medium population area where

growth-control measures are not in effect. The ANO-2 site is located in a medium population area. Pope, Johnson, and Yell Counties are not subject to growth-control measures that would limit housing development.

SMALL impacts result when no discernible change in housing availability occurs, changes in rental rates and housing values are similar to those occurring statewide, and no housing construction or conversion is required to meet new demand (NRC 1996). The GEIS assumes that an additional staff of 60 permanent per-unit workers might be needed during the license renewal period to perform routine maintenance and other activities. Entergy assumes that no additional workers will be needed. Entergy does not plan any new refurbishment activity as part of the license renewal process; therefore, employment will not change in the area as result of license renewal. Thus, Entergy concludes that there are no impacts to housing from license renewal activities (Entergy 2003a). As a result, Entergy concludes that the impacts would be SMALL, and mitigation measures would not be necessary or effective (Entergy 2003a).

The staff has reviewed the available information, including that provided by Entergy, the staff's site visit, the scoping process, discussions with other agencies, and other public sources. Using this information, the staff evaluated the potential housing impacts resulting from operation of ANO-2 during the license renewal term. It is the staff's conclusion that the potential housing impacts during the license renewal term are SMALL.

During the course of this SEIS preparation, the staff considered mitigation measures for the continued operation of ANO-2. When continued operation for an additional 20 years is considered as a whole, all of the specific effects on the environment (whether or not "significant") were considered. Based on this assessment, it is the staff's conclusion that the measures in place at ANO-2 provide mitigation for all impacts related to housing, and no new mitigation measures are warranted.

4.4.2 Public Services: Public Utility Impacts During Operations

Impacts on public utility services are considered SMALL if there is little or no change in the ability of the system to respond to the level of demand, so there is no need to add capital facilities. Impacts are considered MODERATE if overtaxing of service capabilities occurs during periods of peak demand. Impacts are considered LARGE if existing levels of service (e.g., water or sewer services) are substantially degraded and additional capacity is needed to meet ongoing demands for services. The GEIS indicates that, in the absence of new and significant information to the contrary, the only impacts on public utilities that could be significant are impacts on public water supplies (NRC 1996).

Analysis of impacts on the public water supply system considered both plant demand and plant-related population growth. Section 2.2.2 describes the permitted withdrawal rate for

ANO-2 and actual use of water. Entergy plans no refurbishment at ANO-2, so plant water demand would not change beyond current demands (Entergy 2003a).

In its ER, Entergy stated that it does not anticipate a need for additional workers during the period of extended operation. Therefore, there will be no expected impact to public utilities from additional plant workers.

Plant operations during the period of extended operation were not projected to cause a noticeable effect on the local water supply. Sanitary sewage is treated in an onsite wastewater treatment plant (Entergy 2003a). There would be no effect on offsite sewage systems. In 1997, City Corporation water system (owned by the city of Russellville) completed construction of a new water supply source, the Huckleberry Creek Reservoir, which significantly increased the system capacity, and will provide residential and industrial customers in the area with a reliable supply of high-quality potable water in the future.

According to City Corporation water system, Arkansas Nuclear One does not cause capacity or flow concerns for the system, and the system should be able to meet the ANO-2 water demand in the foreseeable future (Church 2002). In addition, Entergy and City Corporation water system have worked together to upgrade the water system near the plant. A 3.8-million L (1-million gal) storage tank was installed just north of the facility. Eighty percent of the capacity of the tank is reserved for Arkansas Nuclear One with the remaining amount assigned to meet the needs of the city of London (Entergy 1999).

Current potable water usage by the site is approximately 0.1 percent of the maximum daily capacity of the city of Russellville water system.

The staff has reviewed the available information, including that provided by Entergy, the staff's site visit, the scoping process, discussions with other agencies, and other public sources. Using this information, the staff evaluated the potential impacts of increased water use resulting from the potential increase in employment. It is the staff's conclusion that the potential impacts of increased water use resulting from the potential increase in employment during the license renewal term are SMALL.

During the course of this SEIS preparation, the staff considered mitigation measures for the continued operation of ANO-2. When continued operation for an additional 20 years is considered as a whole, all of the specific effects on the environment (whether or not "significant") were considered. Based on this assessment, it is the staff's conclusion that the measures in place at ANO-2 provide mitigation for all impacts related to public services, and no new mitigation measures are warranted.

4.4.3 Offsite Land Use During Operations

Land use in the vicinity of a nuclear power plant may change as a result of plant-related population growth. Offsite land use during the license renewal term is a Category 2 issue (10 CFR Part 51, Subpart A, Appendix B, Table B-1). Table B-1 at 10 CFR Part 51, Subpart A, Appendix B, notes that "significant changes in land use may be associated with population and tax revenue changes resulting from license renewal." Entergy has not identified any increases in plant staffing related to license renewal; consequently, there are no corresponding increases in direct or indirect workers in Pope County.

Section 4.7.4 of the GEIS defines the magnitude of land-use changes as a result of plant operation during the license renewal term as follows:

SMALL – Little new development and minimal changes to an area's land-use pattern.

MODERATE – Considerable new development and some changes to the land-use pattern.

LARGE – Large-scale new development and major changes in the land-use pattern.

Section 4.7.4.1 of the GEIS (NRC 1996) states that the assessment of tax-driven, land-use impacts during the license renewal term should consider (1) the size of the plant's payments relative to the community's total revenues, (2) the nature of the community's existing land-use pattern, and (3) the extent to which the community already has public services in place to support and guide development. If the plant's tax payments are projected to be small relative to the community's total revenue, new tax-driven, land-use changes attributable to the plant during the plant's license renewal term would be SMALL, especially where the community has pre-established patterns of development and has provided adequate public services to support and guide development. If the plant's tax payments are projected to be medium-to-large relative to the community's total revenue, new tax-driven, land-use changes would be MODERATE. This is most likely to be true where the community has no pre-established patterns of development (i.e., land-use plans or controls) or has not provided adequate public services to support and guide development in the past, especially infrastructure that would allow industrial development. If the plant's tax payments are projected to be a dominant source of the community's total revenue, new tax-driven, land-use changes would be LARGE. This would be especially true where the community has no pre-established pattern of development or has not provided adequate public services to support and guide development in the past.

Pope County is the only jurisdiction that taxes Entergy directly for Arkansas Nuclear One, and it is the principal jurisdiction that receives direct tax revenue as a result of Arkansas Nuclear One's presence. Because there are no major refurbishment activities and no new construction as a result of the proposed license renewal, no new sources of plant-related tax payments are

expected that could significantly influence land use in Pope County. During the license renewal term, however, new land-use impacts could result from the use by local government entities of the tax revenue paid by Entergy for ANO-2. As discussed in Section 2.2.8.6, Entergy paid Pope County $8.5 million in property taxes for ANO-1 and ANO-2 in 2002. Taxes associated with Arkansas Nuclear One make up approximately 43 percent, 55 percent, and 43 percent of the locally generated property tax revenues for the county general, roads, and library budgets, respectively (Entergy 2003a). The majority of Entergy's property taxes for Arkansas Nuclear One are allocated to the Russellville School District. In 2002, Entergy's taxes made up about 49 percent of the locally generated property tax revenues for the school district (Entergy 2003a).

Residential development is expected to continue around Lake Dardanelle because of the availability of desirable lakefront property. Pope County has experienced moderate population growth and moderate land-use changes in the last 10 years. Although recent population growth is not directly related to the presence of Arkansas Nuclear One, future lakefront development would be facilitated by the presence of roads and water service, which are an indirect impact of Arkansas Nuclear One. Continuation of Pope County's tax receipts from Arkansas Nuclear One keeps tax rates below what they otherwise would have to be to fund the county government and also provides for a higher level of public infrastructure and services than otherwise would be possible. This enhances the county's attractiveness as a place to live and may tend to accelerate the conversion of open space to residential and commercial uses.

The Arkansas Nuclear One site was one of the case studies examined in the GEIS (NRC 1996). Section C.4.1.5.2 of the GEIS concluded that the indirect land-use impacts associated with the license renewal term are expected to be MODERATE. The GEIS case study finding, however, was for both ANO-1 and ANO-2 and also assumed a certain level of refurbishment activity. Entergy stated in its license renewal application that it will not conduct any refurbishment activities for ANO-2 beyond routine replacement of certain components (Entergy 2003b). Consequently, it is the staff's conclusion that the land-use impact during the license renewal term of ANO-2 will be SMALL. Additional mitigation for land-use impacts during the license renewal term does not appear to be warranted.

4.4.4 Public Services: Transportation Impacts During Operations

On October 4, 1999, 10 CFR 51.53(c)(3)(ii)(J) and 10 CFR Part 51, Subpart A, Appendix B, Table B-1, were revised to clearly state that "Public Services: Transportation Impacts During Operations" is a Category 2 issue (see NRC 1999 for more discussion of this clarification). The issue is treated as such in this SEIS.

The transportation infrastructure appears to adequately serve the residents living in the area around ANO-2. However, Entergy identified two current traffic issues from interviews with the

Arkansas Highway and Transportation Department and local law enforcement agencies. One issue is occasional congestion at the east intersection of State Highway 333 and U.S. Highway 64, which serves as a major ingress and egress point for traffic associated with Arkansas Nuclear One (see Section 2.1, Figure 2-2, and Section 2.2.8, Table 2-9). Congestion at this intersection has been reduced by using staggered work schedules and shift changes at ANO-1 and ANO-2. According to the Arkansas State Police, only one recorded accident occurred at this intersection in 2001 (ASP 2002). The other issue is the potential for construction of an I-40 east-bound on-ramp between London and Lake Dardanelle. There currently is only an east-bound off-ramp at this location. The addition of an eastbound on-ramp would reduce local traffic congestion caused by site workers on State Highway 7 and U.S. Highway 64 and local streets in Russellville.

Because there are no major refurbishment activities required for ANO-2 license renewal and there are no expected increases in the total number of employees that will be onsite during the period of extended operation, Entergy concluded that the impacts on transportation during the license renewal term would be SMALL, and no mitigative measures would be warranted (Entergy 2003a).

The staff has reviewed the available information, including that provided by Entergy, the staff's site visit, the scoping process, discussions with other agencies, and other public sources. Using this information, the staff evaluated the potential impacts to transportation service resulting from extended operation of ANO-2. It is the staff's conclusion that the potential impacts to transportation service degradation during the license renewal term are SMALL.

During the course of this SEIS preparation, the staff considered mitigation measures for the continued operation of ANO-2. When continued operation for an additional 20 years is considered as a whole, all of the specific effects on the environment (whether or not "significant") are considered. Based on this assessment, it is the staff's conclusion that measures in place at ANO-2 or identified above provide mitigation for all impacts related to transportation, and no additional mitigation measures are warranted.

4.4.5 Historic and Archaeological Resources

The National Historic Preservation Act of 1966, as amended (NHPA), requires that Federal agencies take into account the effects of their undertakings on historic properties. The historic preservation review process mandated by Section 106 of the NHPA is outlined in regulations issued by the Advisory Council on Historic Preservation at 36 CFR Part 800. Renewal of an OL is an undertaking that could potentially affect historic properties. Therefore, according to the NHPA, NRC is to make a reasonable effort to identify historic properties in the area of potential

effects.[a] If no historic properties are present or affected, the NRC is required to notify the State Historic Preservation Officer before proceeding. If it is determined that historic properties are present, the NRC is required to assess and resolve possible adverse effects of the undertaking.

Because the Entergy license renewal application (Entergy 2003b) covering an additional 20 years of operation of ANO-2 does not include plans for future land disturbances or structural modifications beyond routine maintenance activities at the plant, there would be no identifiable adverse effects to known historic and archaeological resources.

The staff initiated discussions with the Arkansas State Historic Preservation Officer and the Advisory Council on Historic Preservation (Appendix E). In addition, the staff initiated consultations with the following tribes: Caddo Nation, Seminole Nation of Oklahoma, Cherokee Nation of Oklahoma, Muscogee (Creek) Nation of Oklahoma, Osage Nation, Quapaw Tribe of Oklahoma, and the Choctaw Nation of Oklahoma. Based on the tribal consultations, no potential traditional cultural properties or other culturally sensitive areas/resources have been identified at the Arkansas Nuclear One site.

As discussed in Section 2.2.9.1, the water route of the 1838 Trail of Tears National Historic Trail near the plant has been inundated by earlier development of the McClellan-Kerr Navigation System, Lake Dardanelle in this case. Bell's Route of the Trail of Tears passes in the vicinity (within 0.9 km [0.5 mi]) of the northern property boundary of Arkansas Nuclear One site, close to the paths occupied today by U.S. Highway 64 and the Union Pacific Railroad. Based on separation distance from the site, the staff concludes that the potential for impacts to elements (e.g., campsites, ruts, middens) adjacent to the Trail of Tears from continued operation of ANO-2 is SMALL.

Entergy indicated in its application for license renewal (Entergy 2003b) that it has performed an evaluation of structures and components pursuant to 10 CFR 54.21 to identify activities that are necessary to continue operation of ANO-2 during the requested 20-year period of extended operation. These activities include replacement of certain components as well as new inspection activities. However, Entergy stated that the replacements of these components and

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(a) In accordance with the NHPA, the NRC staff has determined that the area of potential effects for a license renewal action is the area at the power plant site and its immediate environs that may be impacted by post-license renewal land-disturbing operations or projected refurbishment activities associated with the proposed action. The area of potential effects may extend beyond the immediate environs in those instances where post-license renewal land-disturbing operations or projected refurbishment activities, specifically related to license renewal, may potentially have an effect on known or proposed historic sites. This determination is made irrespective of ownership or control of the lands of interest.

the additional inspection activities are within the bounds of normal plant component replacement and inspections; therefore, they are not expected to affect the environment outside the bounds of plant operations as evaluated in the final environmental impact statement for Arkansas Nuclear One (AEC 1973). In addition, Entergy's evaluation of structures and components did not identify any major plant refurbishment activities beyond the period for which the existing OL was issued. Had Entergy anticipated the need for refurbishment activities and, if such refurbishment activities would have adverse effects on historic properties, then it would be expected that Entergy would seek ways to avoid or reduce the effects on such properties.

Additional care should be taken during normal operational or maintenance conditions to ensure that potential historic properties are not inadvertently impacted. These activities may include not only operation of the plant itself, but also land management-related actions such as recreation, wildlife habitat enhancement, or maintaining/upgrading access roads throughout the plant site. To assist in protecting known and unrecorded historic properties, Entergy has implemented administrative procedural controls. These procedural controls include steps to ensure that historic and archaeological sites/areas will not be inadvertently damaged during onsite activities that involve land disturbances.

Based on the finding that Entergy did not identify any major refurbishment activities related to the renewal of the ANO-2 OL and that operations will continue within the bounds of plant operations as evaluated in the final environmental impact statement for ANO-2 (AEC 1977), and the steps taken by Entergy to preclude adverse impacts to cultural resources in the future, it is the staff's conclusion that the potential impacts on historic and archeological resources are expected to be SMALL, and mitigation is not warranted.

4.4.6 Environmental Justice

Environmental justice refers to a Federal policy requiring that Federal agencies identify and address, as appropriate, disproportionately high and adverse human health or environmental effects of its actions on minority[a] or low-income populations. The memorandum accompanying Executive Order 12898 (59 FR 7629) directs Federal executive agencies to consider environmental justice under the National Environmental Policy Act of 1969. The Council on Environmental Quality has provided guidance for addressing environmental justice (CEQ 1997). Although the Executive Order is not mandatory for independent agencies, the NRC has voluntarily committed to undertake environmental justice reviews. Specific guidance is provided

(a) The NRC Guidance for performing environmental justice reviews defines "minority" as American Indian or Alaskan Native; Asian; Native Hawaiian or other Pacific Islander; Black races; or Hispanic ethnicity. "Other" races and multi-racial individuals may be considered as separate minorities (NRC 2004a).

in NRC Office of Nuclear Reactor Regulation Office Instruction LIC-203, Revision 1, Procedural Guidance for Preparing Environmental Assessments and Considering Environmental Issues (NRC 2004a).

The scope of the review as defined in NRC guidance (NRC 2004a) includes identification of impacts on minority and low-income populations, the location and significance of any environmental impacts during operations on populations that are particularly sensitive, and information pertaining to mitigation. It also includes evaluation of whether these impacts are likely to be disproportionately high and adverse.

The staff examined the geographic distribution of minority and low-income populations within 80 km (50 mi) of the ANO-2 site, employing the 2000 census for minority and low-income populations (USCB 2000a, b). The populations within an 80-km (50-mi) radius of ANO-2 encompassed parts of 19 counties. The staff supplemented its analysis by field inquiries to county planning departments and social service agencies in Pope, Johnson, and Yell Counties, and Pope County elected officials and staff.

For the purpose of the staff's review, a minority population is defined to exist if the percentage of each minority, or aggregated minority category within the census block groups[a] potentially affected by the license renewal of ANO-2, exceeds the corresponding percentage of minorities in the entire State of Arkansas by 20 percent, or if the corresponding percentage of minorities within the census block group is at least 50 percent. A low-income population is defined to exist if the percentage of low-income population within a census block group exceeds the corresponding percentage of low-income population in the entire State of Arkansas by 20 percent, or if the corresponding percentage of low-income population within a census block group is at least 50 percent.

Entergy used 2000 census data from the Arkansas State Census Data Center (UALR 2002) to identify minority populations within 80 km (50 mi) of ANO-2. ArcView® Geographical Information System software (Version 8.1) was used to identify 218 census block groups within the 80-km (50-mi) radius, compile the minority and low-income population data, and produce maps showing the geographic location of minority and low-income populations in relation to Arkansas Nuclear One. The information for these block groups was then reviewed with respect to the NRC criteria for minority and low-income populations. Overall, minority populations within

(a) A census block group is a combination of census blocks, which are statistical subdivisions of a census tract. A census block is the smallest geographic entity for which the U.S. Census Bureau collects and tabulates decennial census information. A census tract is a small, relatively permanent statistical subdivision of counties delineated by local committees of census data users in accordance with U.S. Census Bureau guidelines for the purpose of collecting and presenting decennial census data. Census block groups are subsets of census tracts (USCB 2001).

the 80-km (50-mi) radius impact site were small and well dispersed. Based on the "exceeds 50 percent" and "more than 20 percent greater" criteria, minority populations existed in only 4 of the 218 block groups. These block groups are located in the communities of Dardanelle, Morrilton, and Conway. The nearest minority population to ANO-2 was in census block group 952300-3 located approximately 13 km (8 mi) southeast of the plant.

The staff also followed the convention of employing 2000 census block group data to identify minority and low-income block groups within the 80-km (50-mi) radius of ANO-2 (USCB 2000a, b) and confirmed Entergy's findings by independent analysis.

Figure 4-1 from the Entergy ER (Entergy 2003a) shows the distribution of minority populations (shaded areas) within the 80-km (50-mi) radius. The NRC staff identified one additional minority block group (9525002-2 in Yell County, immediately east-southeast of the town of Danville, and 20 miles south-southwest of block group 952500-3 shown in Figure 4-1). Figure 4-2 shows the locations of the low-income populations within 80 km (50 mi) of ANO-2. There are only seven low-income census block groups within 80 km (50 mi). The majority of these block groups are located in the communities of Clarksville, Russellville, and Conway. The nearest low-income population to Arkansas Nuclear One was in census block group 951400-2, located approximately 8 km (5 mi) east of the site. One of the low-income block groups (census tract 030700, group 3) was also defined as a minority population block group. It is about 79 km (49 mi) from ANO-2.

With the locations of minority and low-income populations identified, the staff evaluated whether any of the environmental impacts of the proposed action could affect these populations in a disproportionately high and adverse manner. Based on staff guidance (NRC 2004a), air, land, and water resources within about 80 km (50 mi) of the ANO-2 site were examined. Within that area, a few potential environmental impacts could affect human populations as discussed throughout this report, but all of these impacts were considered SMALL for the general population.

The pathways through which the environmental impacts associated with ANO-2 license renewal can affect human populations are discussed throughout this report. During its review of the information, including that provided by Entergy, the staff's site visit, the scoping process, discussions with other agencies, and other public sources, the staff found no unusual resource dependencies or practices, such as subsistence agriculture, hunting, or fishing, through which minority and/or low-income populations could be disproportionately highly and adversely affected. In addition, the staff did not identify any location-dependent disproportionately high and adverse impacts that would affect these minority and low-income populations. Because the environmental impacts are considered SMALL for the general population, special circumstances would be necessary for there to be a disproportionate impact to minorities or low-income

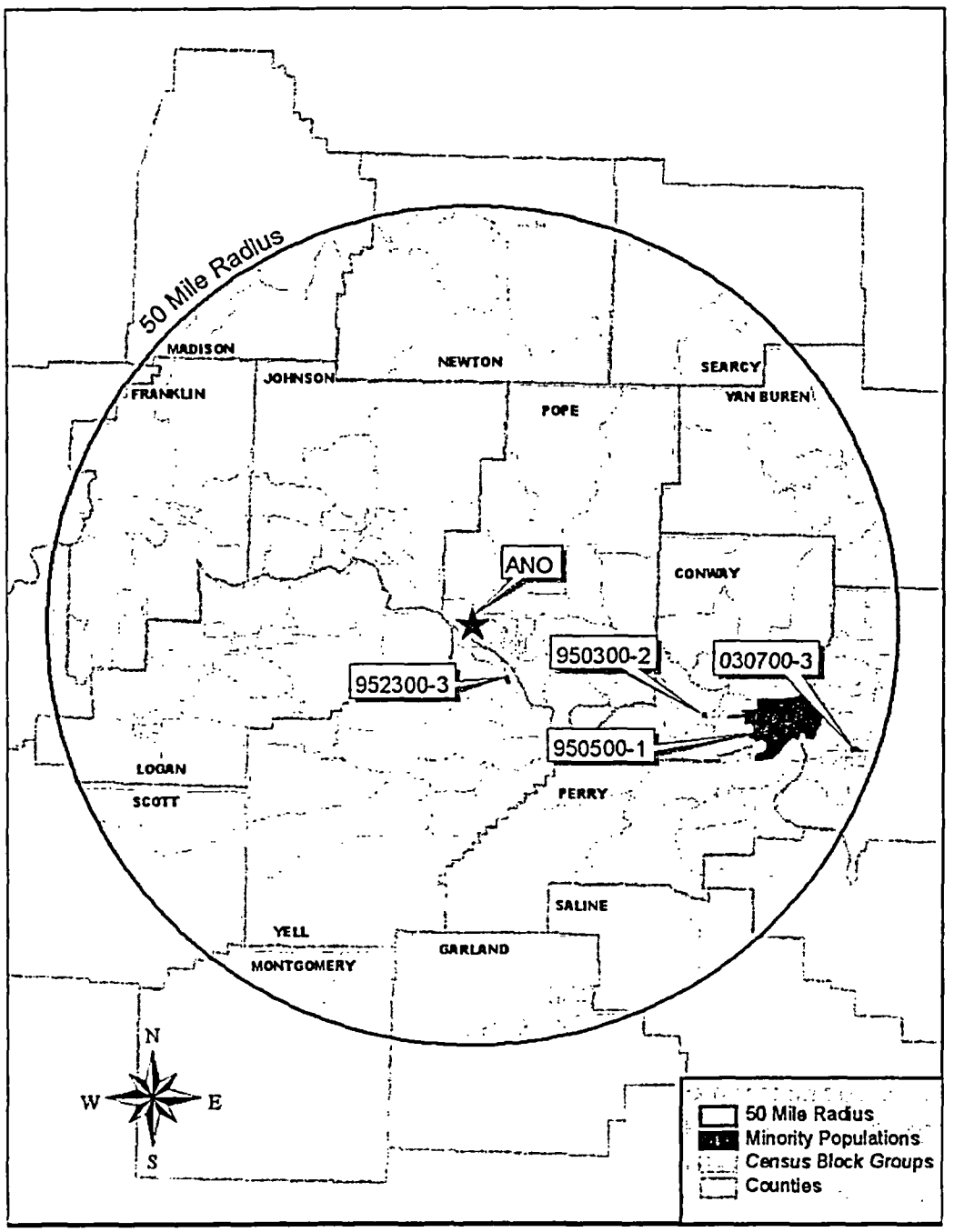

Figure 4-1. Geographic Distribution of Minority Populations (shown in shaded areas) Within an 80-km (50-mi) Radius of the Arkansas Nuclear One Site Based on Census Block Group Data

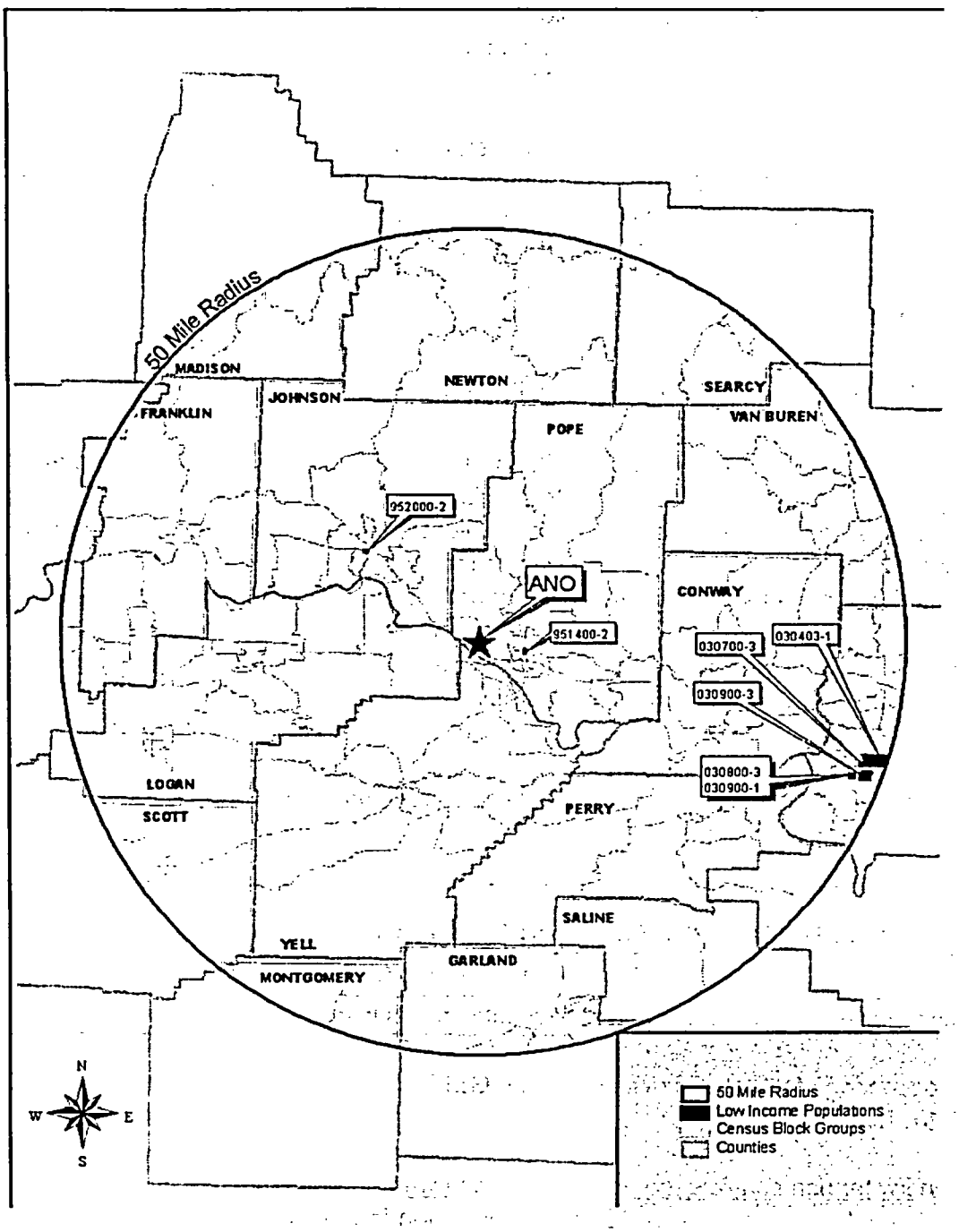

Figure 4-2. Geographic Distribution of Low-Income Populations (shown in shaded areas) Within an 80-km (50-mi) Radius of the Arkansas Nuclear One Site Based on Census Block Group Data

populations. During its review, the staff did not identify any such circumstances. Therefore, the staff concludes that the potential offsite impacts from ANO-2 to minority and low-income populations during the renewal term are SMALL

During the course of this SEIS preparation, the staff considered mitigation measures for the continued operation of ANO-2. When continued operation for an additional 20 years is considered as a whole, all of the specific effects on the environment (whether or not "significant") were considered. Based on the assessment above, the staff concludes that the measures in place at ANO-2 provide mitigation for all impacts related to environmental justice, and no new mitigation measures are warranted.

4.5 Groundwater Use and Quality

The Category 1 issue in 10 CFR Part 51, Subpart A, Appendix B, Table B-1 that is applicable to ANO-2 groundwater use and quality is listed in Table 4-8. Entergy stated in its ER that "no new information existed for the issues that would invalidate the GEIS conclusions" (Entergy 2003a). The staff has not identified any new and significant information during its independent review of the ANO-2 ER, the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts related to this issue beyond those discussed in the GEIS. For this issue, the GEIS concluded that the impacts are SMALL, and plant-specific mitigation measures are not likely to be sufficiently beneficial to be warranted.

Table 4-8. Category 1 Issues Applicable to Groundwater Use and Quality During the License Renewal Term

ISSUE – 10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Sections
GROUNDWATER USE AND QUALITY	
Groundwater use conflicts (potable and service water; plants that use <100 gpm).	4.8.1.1

A brief description of the staff's review and the GEIS conclusions, as codified in Table B-1, 10 CFR 51, follows.

- Groundwater use conflicts (potable and service water; plants that use <100 gpm). Based on information in the GEIS, the Commission found that

  > Plants using less than 100 gpm are not expected to cause any ground-water use conflicts.

As discussed in Section 2.2.2, there is no groundwater use at ANO-2. The staff has not identified any new and significant information during its independent review of the Entergy ER, the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no groundwater use conflicts during the license renewal term beyond those discussed in the GEIS.

The Category 2 issue related to groundwater use that is applicable to ANO-2 is listed in Table 4-9 and discussed in Section 4.5.1.

Table 4-9. Category 2 Issues Applicable to Groundwater Use and Quality During the License Renewal Term

ISSUE – 10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Sections	10 CFR 51.53(c)(3)(ii) Subparagraph	SEIS Section
GROUNDWATER USE AND QUALITY			
Groundwater use conflicts (plants using cooling towers withdrawing make-up water from a small river)	4.8.1.3 4.4.2.1	A	4.5.1

4.5.1 Groundwater Use Conflicts (Plants Using Cooling Towers Withdrawing Makeup Water from a Small River)

Reductions in the total surface water supply in Lake Dardanelle and the Arkansas River downstream could reduce the water available to groundwater users. In some regions, surface water is a significant source of recharge to groundwater aquifers. However, the consumptive use of water resulting from evaporation from the cooling towers is relatively small compared with the flow in the Arkansas River.

The Arkansas River is impounded behind Dardanelle Lock and Dam to form Lake Dardanelle. The lock and dam are operated by ACE as part of the Arkansas River Navigation Project, which provides for navigation, flood control, hydropower production, water supply, and recreation throughout the Arkansas River Basin. The average annual flow for the Arkansas River at Dardanelle is 1070 m^3/s (37,800 cfs). Monthly average stream flows of less than 40 m^3/s (1400 cfs) have been recorded in only 3 months since 1977. Currently, ACE has no plans to change the operation of Lake Dardanelle that might affect the water supply available to ANO-2.

Evaporative losses from the ANO-2 cooling tower are estimated to average 0.62 m^3/s (22 cfs) annually with the maximum annual average of 0.74 m^3/s (26 cfs). Under low flow water conditions of 40 m^3/s (1400 cfs), the maximum evaporative losses only represent 2 percent reduction in the stream flow downstream.

The consumptive use of surface water associated with evaporative losses at ANO-2 is not expected to change during the period of the proposed license renewal. It is impossible to reliably predict the quantity of future withdrawals and groundwater demands by other water users over the license renewal term. However, there are State and Federal regulations in place to ensure that future withdrawals do not adversely impact the groundwater resources around Lake Dardanelle and downstream. Furthermore, the consumptive use of less than 2 percent of the Arkansas River flow past the Arkansas Nuclear One site would not detectably alter the groundwater resource downstream of the facility. Therefore, it is the staff's conclusion that the impact of the consumptive use of surface water by ANO-2 on groundwater use is considered to be SMALL, and additional mitigation is not warranted.

4.6 Threatened or Endangered Species

Threatened or endangered species are listed as a Category 2 issue in 10 CFR Part 51, Subpart A, Appendix B, Table B-1. This issue is listed in Table 4-10.

Table 4-10. Category 2 Issue Applicable to Threatened or Endangered Species at Arkansas Nuclear One, Unit 2 During the License Renewal Term

ISSUE – 10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Section	10 CFR 51.53(c)(3)(ii) Subparagraph	SEIS Section
THREATENED OR ENDANGERED SPECIES (FOR ALL PLANTS)			
Threatened or endangered species	4.1	E	4.6

This issue requires consultation with appropriate agencies to determine whether threatened or endangered species listed under the Endangered Species Act are present and whether they would be adversely affected by continued operation of ANO-2 during the license renewal term. The presence of threatened or endangered species in the vicinity of the ANO-2 site and its transmission line right-of-way is discussed in this SEIS (Sections 2.2.5 and 2.2.6).

Entergy contacted FWS by letter on September 17, 2002, requesting information about the presence of Federally listed threatened or endangered species on and in the vicinity of the ANO-2 site and its transmission line right-of-way. FWS responded to Entergy on December 20, 2002, identifying the endangered interior population of the least tern (*Sterna antillarum*) as occurring along portions of the Arkansas River, and the threatened Arkansas River shiner (*Notropis girardi*) as having had an historic occurrence in the river (Entergy 2003a). FWS stated that no threatened or endangered species had been observed in the vicinity of the ANO-2 site and its transmission line (Entergy 2003a).

The NRC contacted FWS by letter on December 9, 2003, (NRC 2003) also requesting information about Federally protected species. FWS responded to the NRC on January 14, 2004, identifying the least tern and the threatened bald eagle (*Haliaeetus leucocephalus*) as present in the vicinity of the ANO-2 site and its transmission line (FWS 2004a). FWS also stated that no threatened or endangered species would be likely to be impacted by continued operation of ANO-2 during the license renewal term (FWS 2004a). National Oceanic and Atmospheric Administration (NOAA) Fisheries was contacted by NRC on December 11, 2003. NOAA Fisheries indicated that they had no listed species or critical habitat in their purview associated with ANO-2 (NOAA 2003).

In addition to the above Federally listed species, the Entergy ER identified the endangered gray bat (*Myotis grisescens*) as occurring in the vicinity of the ANO-2 site and its transmission line (Entergy 2003a). No critical habitat has been designated for any of the above Federally listed terrestrial species (FWS 2004b). Critical habitat has been designated for the Arkansas River shiner, but not in the State of Arkansas (FWS 2004b).

The staff has reviewed the available information, including that provided by Entergy, FWS, ANHC, AGFC, the scoping process, and other public information sources. Based on this review and its independent analysis, the staff prepared a Biological Assessment (Appendix E) that assesses the potential impact of license renewal on the Arkansas River shiner, the bald eagle, the least tern (interior population), and the gray bat. The Biological Assessment was transmitted to the FWS by letter dated June 8, 2004, and FWS responded to the NRC by letter on July 29, 2004, concurring with the findings in the Biological Assessment. The staff concludes that continued operation of ANO-2 and continued operation and maintenance of its transmission line right-of-way is likely to have no effect on any Federally listed threatened or endangered species.

4.7 Evaluation of Potential New and Significant Information on Impacts of Operations During the License Renewal Term

During the scoping period, comments related to a shad block net barrier and security barrier were received from FWS. In the January 14, 2004, letter from FWS to NRC, FWS commented that the use of the shad barrier, when necessary, will have limited effect on fisheries and recreation. Additionally, FWS recognized that the security barrier may result in a loss of recreational access. However, the barrier may also benefit fish by creating fisheries refugia. The staff has reviewed the potential impacts on the fish and the recreational fishery near the Arkansas Nuclear One site. The staff concludes that the impacts to fish or the recreational fishery from continued operation of ANO-2 are SMALL, as concluded in the GEIS, and that additional plant-specific mitigation measures are not warranted at this time.

The staff has not identified significant new information on environmental issues listed in 10 CFR Part 51, Subpart A, Appendix B, Table B-1, related to operation during the license renewal term. The staff reviewed Entergy's process and their conclusions related to new and significant information (NRC 2004b). The staff also reviewed the discussion of environmental impacts associated with operation during the license renewal term in this SEIS and has conducted its own independent review, including public scoping meetings, to identify new and significant information. Processes for identification and evaluation of new information are described in Section 1.2.2.

4.8 Cumulative Impacts

The staff considered potential cumulative impacts during the evaluation of information applicable to each of the potential impacts of operations during the license renewal term identified within the GEIS. For the purposes of this analysis, past actions were those related to the resources at the time of the 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. Therefore, the analysis considers potential impacts through the end of the current license term, as well as the 20-year license renewal term. The geographical area over which past, present, and future actions that could contribute to cumulative impacts is dependent on the type of action considered, and is described below for each impact area.

The impacts of the proposed action, as described in Section 4.0, are combined with other past, present, and reasonably foreseeable future actions at ANO-2 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.

4.8.1 Cumulative Impacts Resulting from Operation of the Plant Cooling System

For the purposes of this analysis, the geographic area considered is Lake Dardanelle. As described in Section 4.1, the staff found no new and significant information indicating that the conclusions regarding any of the cooling-system-related Category 1 issues applicable to ANO-2 are inconsistent with the conclusions in the GEIS. Additionally, the staff determined that none of the cooling-system-related Category 2 issues were likely to have greater than a SMALL impact on local water quality or aquatic resources.

The staff, while preparing this assessment, assumed that other industrial, commercial, or public installations will be located in the general vicinity of ANO-2 prior to the end of operation. Intake of water from and discharge of water to Lake Dardanelle for these facilities would be regulated by the Arkansas Department of Environmental Quality and other agencies, just as the Arkansas Nuclear One plant is presently regulated. The intake and discharge limits for each installation are set considering the overall or cumulative impact of all of the other regulated activities in the area. Therefore, the staff concludes that the potential cumulative impacts of continued operation of ANO-2 will be SMALL, and that no additional mitigation measures are warranted.

4.8.2 Cumulative Impacts Resulting from Continued Operation of Transmission Lines

The continued operation of the ANO-2 electrical transmission facilities was evaluated to determine if there is the potential for interactions with other past, present, and future actions that could result in adverse cumulative impacts to terrestrial resources such as wildlife populations, and the size and distribution of habitat areas; aquatic resources such as wetlands and floodplains; and both the acute and chronic effects of electromagnetic fields. For the purposes of this analysis, the geographic area encompassing past, present, and foreseeable future actions that could contribute to adverse cumulative effects is the area within the 146-km (91-mi)-long 500-kV, single-circuit transmission line that connects ANO-2 to the power distribution grid. This line extends from the existing ANO-2 500-kV station switchyard southeasterly via the Mayflower substation (southwest of Mayflower) to the Mabelvale substation (southwest of Little Rock) (Figure 2-4).

As described in Section 4.2, the staff found no new and significant information indicating that the conclusions regarding any of the transmission line-related Category 1 issues as related to ANO-2 are inconsistent with the conclusions within the GEIS. The applicant follows right-of-way management procedures (Entergy 2003a) that protect wildlife and habitat resources, including floodplains and wetlands. There are no State or Federally regulated wetlands at the ANO-2 site or within the transmission line right-of-way connecting the power plant to the power distribution grid. Therefore, continued operation and maintenance of this right-of-way is not likely to contribute to a regional decline in wetland or floodplain resources. The maintenance procedures ensure minimal disturbance to wildlife.

Therefore, the staff concludes that the cumulative impacts of the continued operation of the ANO-2 transmission line will be SMALL, and no additional mitigation is warranted.

4.8.3 Cumulative Radiological Impacts

The radiological exposure limits for protection of the public and for occupational exposures have been developed assuming long-term exposures, and therefore incorporate cumulative impacts. As described in Section 2.2.7, the public and occupational doses resulting from ANO-2 are well below regulatory limits, and as described in Section 4.3, the impacts of these exposures are SMALL. For the purposes of this analysis, the geographical area is the area included within an 80-km (50-mi) radius of the Arkansas Nuclear One site (Figure 2-1). NRC would regulate any reasonably foreseeable future actions that could contribute to cumulative radiological impacts.

Therefore, the staff determined that the cumulative radiological impacts of continued operation of ANO-2 will be SMALL, and that additional mitigation is not warranted.

4.8.4 Cumulative Socioeconomic Impacts

Much of the analyses of socioeconomic impacts presented in Section 4.4 of this SEIS incorporate cumulative impact analysis. For instance, the impact of the total number of additional housing units that may be needed can only be evaluated with respect to the total number that will be available in the impacted area. Therefore, the geographical area of the cumulative analysis varies depending on the particular impact considered, and may depend on specific boundaries, such as taxation jurisdictions or may be distance related, as in the case of environmental justice.

The continued operation of ANO-2 is not likely to add to any cumulative socioeconomic impacts beyond those already evaluated in Section 4.4. In other words, the impacts of issues such as transportation or offsite land use are likely to be nondetectable beyond the regions previously evaluated and will quickly decrease with increasing distance from the site. The staff determined that the impacts on housing, public utilities, public services, and environmental justice would all be SMALL. The staff determined that the impact on offsite land use is SMALL because, even though ANO-2 provides greater than 10 percent of the property tax revenue for the local jurisdictions, the tax-related, land-use changes are expected to be small, and there are no refurbishment actions planned at ANO-2 that would add either to the population or the tax base. There are no reasonably foreseeable scenarios that would alter these conclusions in regard to cumulative impacts.

Related to historic and archaeological resources, the continued operation of ANO-2 would not add to any cumulative impacts to these resources beyond those identified in Section 4.4.5. Entergy has implemented procedures to ensure that either known or potential historical and archaeological sites will not be inadvertently impacted during onsite activities that involve land

disturbances. Continued operation and maintenance of ANO-2 would not affect land use beyond the geographic area currently in use for these activities; therefore, additional cumulative impacts would be negligible.

Based on these considerations, the staff concludes that continued operation of ANO-2 is not likely to make a detectable contribution to the cumulative effects associated with any of the socioeconomic issues discussed in Section 4.4. Therefore, the cumulative impacts will be SMALL, and no additional mitigation measures are warranted.

4.8.5 Cumulative Impacts on Groundwater Use and Quality

There are no groundwater withdrawals at ANO-2, and Entergy imports less than 4 m^3/min (100 gpm) of potable water from local utilities for plant use. As noted previously, surface water is the primary source of potable water for local water utilities. The impact of current water usage has been determined in Section 4.5 to be SMALL. Because there are no groundwater withdrawals at ANO-2 and there are none anticipated in the future, Arkansas Nuclear One does not cause a detectable change in the regional groundwater usage. Therefore, the cumulative impact will be SMALL, and no mitigation measures are warranted.

4.8.6 Cumulative Impacts on Threatened or Endangered Species

The geographic area considered in the analysis of potential cumulative impacts to threatened or endangered species includes Pope County and the waters of Lake Dardanelle. As discussed in Sections 2.2.5 and 2.2.6, there are several threatened or endangered species that occur within this area. However, the Biological Assessment determined that continued operation of ANO-2 would have no effect on any of these species, because none are known to occur in the vicinity of ANO-2 or its transmission line right-of-way. Therefore, the continued operation of ANO-2 will not contribute to a regional cumulative impact on these species because ANO-2 is not adversely affecting any of these species. Furthermore, there are no species currently considered to be candidates for, or proposed for, listing as threatened or endangered known to occur in the vicinity of the site. Also, it is unlikely that any Federally or State-listed species will increase its known range to an extent that it would become adversely affected by continued plant operation.

Therefore, the staff has determined that the cumulative impacts to threatened or endangered species due to continued operation of ANO-2 and its associated transmission line will be SMALL, and no additional mitigation measures are warranted.

4.9 Summary of Impacts of Operations During the License Renewal Term

Neither Entergy nor the staff is aware of information that is both new and significant related to any of the applicable Category 1 issues associated with the ANO-2 operation during the license renewal term. Consequently, the staff concludes that the environmental impacts associated with these issues are bounded by the impacts described in the GEIS. For each of these issues, the GEIS concluded that the impacts would be SMALL and that additional plant-specific mitigation measures are not likely to be sufficiently beneficial to warrant implementation.

Plant-specific environmental evaluations were conducted for 10 Category 2 issues applicable to ANO-2 operation during the license renewal term and for environmental justice and chronic effects of electromagnetic fields. For 10 issues and environmental justice, the staff concluded that the potential environmental impact of license renewal term operations of ANO-2 would be of SMALL significance in the context of the standards set forth in the GEIS and that additional mitigation is not warranted. In addition, the staff determined that a consensus has not been reached by appropriate Federal health agencies regarding chronic adverse effects from electromagnetic fields. Therefore, no evaluation of this issue is required. Cumulative impacts of past, present, and reasonably foreseeable future actions were considered, regardless of what agency (Federal or non-Federal) or person undertakes such other actions. For purposes of this analysis, where ANO-2 license renewal impacts are deemed to be SMALL, the staff concludes that these impacts would not result in significant cumulative impacts on potentially affected resources.

4.10 References

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10 CFR Part 54. Code of Federal Regulations, Title 10, *Energy,* Part 54, "Requirements for Renewal of Operating Licenses for Nuclear Power Plants."

36 CFR Part 800. Code of Federal Regulations, Title 36, *Parks, Forests, and Public Property,* Part 800, "Protection of Historic Properties."

40 CFR Part 1508.7. Code of Federal Regulations. Title 40, *Protection of Environment,* Part 1508, "Terminology and Index, Section."

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5.0 Environmental Impacts of Postulated Accidents

Environmental issues associated with postulated accidents are discussed in the *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (GEIS), NUREG-1437, Volumes 1 and 2 (NRC 1996, 1999).[a] The GEIS includes a determination of whether the analysis of the environmental issue could be applied to all plants and whether additional mitigation measures would be warranted. Issues are then assigned a Category 1 or a Category 2 designation. As set forth in the GEIS, Category 1 issues are those that meet all of the following criteria:

(1) 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.

(2) Single significance level (i.e., SMALL, MODERATE, or LARGE) has been assigned to the impacts (except for collective offsite radiological impacts from the fuel cycle and from high-level waste and spent fuel disposal).

(3) 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 not to be sufficiently beneficial to warrant implementation.

For issues that meet the three Category 1 criteria, no additional plant-specific analysis is required unless new and significant information is identified.

Category 2 issues are those that do not meet one or more of the criteria for Category 1, and therefore, additional plant-specific review of these issues is required.

This chapter describes the environmental impacts from postulated accidents that might occur during the license renewal term.

5.1 Postulated Plant Accidents

Two classes of accidents are evaluated in the GEIS. These are design-basis accidents (DBAs) and severe accidents, as discussed below.

(a) The GEIS was originally issued in 1996. Addendum 1 to the GEIS was issued in 1999. Hereafter, all references to the "GEIS" include the GEIS and Addendum 1.

5.1.1 Design-Basis Accidents

In order to receive NRC approval to operate a nuclear power facility, an applicant must submit a safety analysis report (SAR) as part of its application. The SAR presents the design criteria and design information for the proposed reactor and comprehensive data on the proposed site. The SAR also discusses various hypothetical accident situations and the safety features that are provided to prevent and mitigate accidents. The NRC staff reviews the application to determine whether the plant design meets the Commission's regulations and requirements and includes, in part, the nuclear plant design and its anticipated response to an accident.

DBAs are those accidents that both the licensee and the NRC staff evaluate to ensure that the plant can withstand normal and abnormal transients and a broad spectrum of postulated accidents without undue hazard to the health and safety of the public. A number of these postulated accidents are not expected to occur during the life of the plant but are evaluated to establish the design basis for the preventive and mitigative safety systems of the facility. The acceptance criteria for DBAs are described in Title 10 of the Code of Federal Regulations (CFR) Part 50 and 10 CFR Part 100.

The environmental impacts of DBAs are evaluated during the initial licensing process, and the ability of the plant to withstand these accidents is demonstrated to be acceptable before issuance of the operating license (OL). The results of these evaluations are found in license documentation such as the staff's safety evaluation report (SER), the final environmental statement (FES), the licensee's updated final safety analysis report (UFSAR), and Section 5.1 of this supplemental environmental impact statement (SEIS). The licensee is required to maintain the acceptable design and performance criteria throughout the life of the plant, including any extended-life operation. The consequences for these events are evaluated for the hypothetical maximally exposed individual; as such, changes in the plant environment will not affect these evaluations. Because of the requirements that continuous acceptability of the consequences and aging management programs be in effect for license renewal, the environmental impacts as calculated for DBAs should not differ significantly from initial licensing assessments over the life of the plant, including the license renewal term. Accordingly, the design of the plant relative to DBAs during the extended period is considered to remain acceptable, and the environmental impacts of those accidents were not examined further in the GEIS.

The Commission has determined that the environmental impacts of DBAs are of SMALL significance for all plants because the plants were designed to successfully withstand these accidents.

Therefore, for the purposes of license renewal, DBAs are designated as a Category 1 issue in 10 CFR Part 51, Subpart A, Appendix B, Table B-1. The early resolution of the DBAs makes them a part of the current licensing basis of the plant; the current licensing basis of the plant is to be maintained by the licensee under its current license and, therefore, under the provisions of 10 CFR 54.30, is not subject to review under license renewal. This issue, applicable to ANO-2, is listed in Table 5-1.

Table 5-1. Category 1 Issue Applicable to Postulated Accidents During the License Renewal Term

ISSUE – 10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Section
POSTULATED ACCIDENTS	
Design-basis accidents	5.3.2; 5.5.1

Based on information in the GEIS, the Commission found that

> The NRC staff has concluded that the environmental impacts of design-basis accidents are of small significance for all plants.

Entergy Operations, Inc. (Entergy) stated in its Environmental Report (ER) (Entergy 2003) that it is not aware of any new and significant information associated with the renewal of the Arkansas Nuclear One, Unit 2 (ANO-2) OL. The staff has not identified any new and significant information during the staff's independent review of the ANO-2 ER (Entergy 2003), the scoping process, the staff's site visit, the staff's evaluation of other available information, and public comments. Therefore, the staff concludes that there are no impacts of DBAs during the license renewal term beyond those discussed in the GEIS.

5.1.2 Severe Accidents

Severe nuclear accidents are those that are more severe than DBAs because they could result in substantial damage to the reactor core, whether or not there are serious offsite consequences. The GEIS assessed the impacts of severe accidents during the license renewal term, using the results of existing analyses and site-specific information to conservatively predict the environmental impacts of severe accidents for each plant during the renewal period.

Based on information in the GEIS, the Commission found that

> The probability weighted consequences of atmospheric releases, fallout onto open bodies of water, releases to ground water, and societal and economic impacts from severe accidents are small for all plants. However, alternatives to mitigate severe accidents must be considered for all plants that have not considered such alternatives.

Therefore, the Commission has designated mitigation of severe accidents as a Category 2 issue in 10 CFR Part 51, Subpart A, Appendix B, Table B-1. This issue, applicable to ANO-2, is listed in Table 5-2.

Table 5-2. Category 2 Issue Applicable to Postulated Accidents During the License Renewal Term

ISSUE – 10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Sections	10 CFR 51.53(c)(3)(ii) Subparagraph	SEIS Section
	POSTULATED ACCIDENTS		
Severe Accidents	5.3.3; 5.3.3.2; 5.3.3.3; 5.3.3.4; 5.3.3.5; 5.4; 5.5.2	L	5.2

The staff has not identified any new and significant information during the staff's independent review of the Entergy ER (Entergy 2003), the scoping process, the staff's site visit, the staff's evaluation of other available information, and public comments. Therefore, the staff concludes that there are no impacts of severe accidents beyond those discussed in the GEIS. However, in accordance with 10 CFR 51.53(c)(3)(ii)(L), the staff has reviewed severe accident mitigation alternatives (SAMAs) for ANO-2. The results of the staff's review are discussed in Section 5.2.

5.2 Severe Accident Mitigation Alternatives

10 CFR 51.53(c)(3)(ii)(L) requires that license renewal applicants consider alternatives to mitigate severe accidents if the staff has not previously evaluated severe accident mitigation alternatives (SAMAs) for the applicant's plant in an environmental impact statement (EIS) or related supplement or in an environmental assessment. The purpose of this consideration is to ensure that plant changes (i.e., hardware, procedures, and training) with the potential for improving severe accident safety performance are identified and evaluated. SAMAs have not been previously considered for ANO-2; therefore, the remainder of Chapter 5 addresses those alternatives.

5.2.1 Introduction

This section presents a summary of the SAMA evaluation for ANO-2 conducted by Entergy and described in its ER (Entergy 2003) and of the NRC's review of that evaluation. The details of the review are described in the NRC staff evaluation prepared by the staff with contract assistance from Information Systems Laboratories, Inc. The entire evaluation is presented in Appendix G.

The SAMA evaluation for ANO-2 was a four-step process. In the first step, Entergy quantified the level of risk associated with potential reactor accidents using the plant-specific probabilistic risk assessment and other risk models.

The second step was the examination of the major risk contributors to identify areas where plant improvements might have the greatest chance to reduce risk. Then possible ways of reducing those risks were identified. Common ways of reducing risk are changes to components, systems, procedures, and training. Entergy identified 192 potential SAMAs. Using a set of screening criteria, the number of SAMAs requiring further consideration was reduced to 93. Preliminary cost estimates were made for these 93 SAMAs, and any SAMAs costing more than the maximum attainable benefit were removed from further consideration.

In the third step, the benefits and costs for the remaining candidate SAMAs were estimated. Estimates were made of how much each proposed SAMA could reduce risk. Those estimates were developed in terms of dollars in accordance with NRC guidance for performing regulatory analyses (NRC 1997). The costs of implementing the proposed SAMAs were also estimated.

Finally in the fourth step, the costs and benefits of each of the remaining SAMAs were compared to determine whether the SAMA was cost-beneficial, meaning the benefits of the SAMA were greater than the costs (a positive cost-benefit). In the final analysis, Entergy concluded that none of these 192 SAMAs were cost-beneficial for ANO-2. However, the staff concluded that two of the SAMAs may be cost-beneficial, and two other SAMAs may be cost-beneficial when uncertainties are taken into account.

Each of these four steps is discussed in more detail in the sections that follow.

5.2.2 Estimate of Risk

Entergy submitted an assessment of SAMAs for ANO-2 as part of its ER (Entergy 2003). This assessment was based on the most recent ANO-2 Probabilistic Safety Assessment (PSA) available at that time, a plant-specific offsite consequence analysis performed using the MELCOR Accident Consequence Code System 2 (MACCS2) computer program, and insights from the ANO-2 Individual Plant Examination (IPE) (Entergy 1992) and Individual Plant

Examination of External Events (IPEEE) (Entergy 1996). The SAMA analysis is based on the most recent PSA model available (referred to as Revision 3p2) when the ER was prepared. The scope of the ANO-2 PSA does not include external events. The baseline core damage frequency (CDF) for ANO-2 is approximately 7.2×10^{-6} per year, based on internally initiated events. Entergy did not include the contribution to CDF from external events in these estimates; however, it did account for the potential risk reduction benefits associated with external events by doubling the estimated benefits for internal events. The breakdown of CDF by initiating event/accident class is summarized in Table 5-3. Transients and small break loss-of-coolant accidents (LOCAs) are dominant contributors to the CDF.

Table 5-3. Estimated Core Damage Frequencies for Arkansas Nuclear One, Unit 2

Initiating Event/Accident Class	CDF (per year)	% Contribution to CDF
Transients	4.2×10^{-6}	58
Small break LOCA	1.7×10^{-6}	24
Interfacing system LOCA (ISLOCA)	3.3×10^{-7}	5
Vessel rupture	2.7×10^{-7}	4
Medium break LOCA	1.9×10^{-7}	3
Large break LOCA	2.8×10^{-7}	4
Steam generator tube rupture (SGTR)	1.5×10^{-7}	2
Total CDF (from internal events)	**7.2×10^{-6}**	**100**

Entergy estimated the dose from all postulated accidents to the population within 80 km (50 mi) of the ANO-2 site to be approximately 0.0172 person-Sv (1.72 person-rem). The breakdown of the population dose by containment release mode is summarized in Table 5-4. Steam generator tube rupture and late containment failures dominate the population dose.

The staff reviewed Entergy's data and evaluation methods and concludes that the quality of the risk analyses is adequate to support an assessment of the risk reduction potential for the candidate SAMAs. Accordingly, the staff based its assessment of offsite risk on the CDF and offsite doses provided by Entergy.

Table 5-4. Breakdown of Population Dose by Containment Release Mode

Containment Release Mode	Population Dose (person-Sv per year [person-rem per year])	% Contribution
SGTR	0.0074 (0.74)	43
ISLOCA	0.00006 (0.006)	<1
Early containment failure	0.0025 (0.25)	15
Late containment failure	0.0073 (0.73)	42
No containment failure	0 (0)	0
Total Population Dose	**0.0172 (1.72)**	**100**

5.2.3 Potential Plant Improvements

Once the most risk significant parts of the plant design and operation were identified, Entergy searched for ways to reduce those risks. To identify potential plant improvements, Entergy reviewed improvements identified in the ANO-2 IPE and IPEEE and subsequent PSA revision processes, SAMA analyses submitted for other nuclear power plants, and NRC and industry documents discussing potential plant improvements. Entergy identified 192 potential risk-reducing improvements to plant components, systems, procedures, and training (SAMAs).

All but 93 of these SAMAs were removed from further consideration because (1) the SAMA was not applicable at ANO-2 because of design differences, (2) the SAMA had already been implemented at ANO-2, or (3) the SAMA was sufficiently similar to and combined with other SAMA candidates. A preliminary cost estimate was prepared for each of the remaining 93 SAMAs.

The staff reviewed Entergy's process for identifying and screening potential SAMAs, and concluded that the process was systematic and comprehensive.

5.2.4 Evaluation of Risk Reduction and Costs of Improvements

Entergy evaluated the risk reduction potential of the remaining 93 SAMAs. The majority of the SAMA evaluations were performed in a bounding fashion in that the SAMA was assumed to completely eliminate the risk associated with the proposed enhancement. Such bounding calculations overestimate the benefit and are conservative. The benefits (i.e., the estimated dollar value of these risk reductions) were developed by calculating and adding the averted public exposure, offsite property damage, occupational exposure, and onsite costs associated with each SAMA (Entergy 2003).

The staff reviewed Entergy's bases for calculating the risk reduction for the various plant improvements and concluded that the rationale and assumptions for estimating risk reduction were reasonable and generally conservative. Therefore, the staff based its estimates of averted risk for the various SAMAs on Entergy's risk reduction estimates. However, the staff concluded that the benefit estimates should be increased by a factor of five to account for the potential impacts of external events.

The staff reviewed the cost estimates and concluded that the cost ranges provided by Entergy were reasonable and appropriate for use in the SAMA evaluation.

5.2.5 Cost-Benefit Comparison

For the 93 candidate SAMAs identified through the screening process, a more detailed assessment and cost estimate were developed. Entergy applied a multiplier of two to the averted cost estimates (for internal events) for each SAMA to account for external events. As a result of this assessment, the cost-benefit analysis showed that none of the candidate SAMAs were cost-beneficial. Therefore, Entergy concluded that there were no cost-beneficial SAMAs (Entergy 2004).

The staff reviewed Entergy's calculation methods and logic arguments in the final cost-benefit comparisons and concluded that Entergy's original benefit estimates should be increased by a factor of five to account for the potential impact of external events. Based on this evaluation, and the use of more realistic estimates of risk reduction and/or implementation costs, two of the SAMAs appear to be cost-beneficial: SAMA AC/DC-16, which involves development of procedures to emphasize the steps in plant recovery following station blackout, and SAMA CW-06, which involves procedural changes to shed component cooling water (CCW) loads to extend the CCW heat-up time in the event of a loss of essential raw cooling water. Additionally, two SAMAs could be cost-beneficial when uncertainties are taken into account. These SAMAs involve (1) installing backwash filters in place of the existing raw cooling water system strainers (SAMA CW-27) and (2) replacing either containment sump valve 2CV-5649-1 or 2CV-5650-2 with an air-operated valve (SAMA CC-20).

5.2.6 Conclusions

The staff reviewed the Entergy SAMA analysis and concluded that the methods used and the implementation of those methods were sound. The treatment of SAMA benefits and costs, the generally large negative net benefits, and the inherently small baseline risks support the general conclusion that the SAMA evaluations performed by Entergy are reasonable and sufficient for the license renewal submittal. However, the staff concluded that two SAMAs appear to be cost-beneficial: SAMA AC/DC-16, development of procedures to emphasize the steps in plant recovery following station blackout; and SAMA CW-06, procedural changes to

shed CCW loads to extend the CCW heat-up time in the event of a loss of essential raw cooling water. Additionally, two SAMAs could be cost-beneficial when uncertainties are taken into account: (1) SAMA CW-27, installation of backwash filters in place of the existing raw cooling water system strainers, and (2) SAMA CC-20, replacing either containment sump valve 2CV-5649-1 or 2CV-5650-2 with an air-operated valve. However, these SAMAs do not relate to adequately managing the effects of aging during the period of extended operation. Therefore, they need not be implemented as part of license renewal pursuant to 10 CFR Part 54. Entergy has not made any commitment to implement these SAMAs.

The staff concludes that none of the other candidate SAMAs are cost-beneficial. This conclusion is consistent with the low residual level of risk indicated in the ANO-2 PSA and the fact that ANO-2 has already implemented many plant improvements identified from the IPE and IPEEE process.

5.3 References

10 CFR Part 50. Code of Federal Regulations, Title 10, *Energy*, Part 50, "Domestic Licensing of Production and Utilization Facilities."

10 CFR Part 51. Code of Federal Regulations, Title 10, *Energy*, Part 51, "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions."

10 CFR Part 54. Code of Federal Regulations, Title 10, *Energy*, Part 54, "Requirements for Renewal of Operating Licenses for Nuclear Power Plants."

10 CFR Part 100. Code of Federal Regulations, Title 10, *Energy*, Part 100, "Reactor Site Criteria."

Entergy Operations, Inc. (Entergy). 1992. Letter from Entergy to NRC Document Control Desk. Subject: Arkansas Nuclear One, Units 1 and 2, Results of Individual Plant Examination for Severe Accident Vulnerabilities (Generic Letter 88-20), August 1992.

Entergy Operations, Inc. (Entergy). 1996. Letter from Entergy to NRC Document Control Desk. Subject: Arkansas Nuclear One, Units 1 and 2, Generic Letter 88-20, Supplement 4, "Individual Plant Examination for External Events for Severe Accident Vulnerabilities," May 31, 1996.

Entergy Operations, Inc. (Entergy). 2003. *Applicant's Environmental Report – Operating License Renewal Stage, Arkansas Nuclear One, Unit 2.* Russellville, Arkansas. October 2003.

Entergy Operations, Inc. (Entergy). 2004. Letter from T. G. Mitchell, Entergy to NRC Document Control Desk. Subject: Clarification of a Request for Additional Information Response for Environmental Report TAC No. MB8405, Arkansas Nuclear One – Unit 2, Docket No. 50-368, License No. NPF-6, July 15, 2004.

U.S. Nuclear Regulatory Commission (NRC). 1996. *Generic Environmental Impact Statement for License Renewal of Nuclear Plants*. NUREG-1437, Volumes 1 and 2, Washington, D.C.

U.S. Nuclear Regulatory Commission (NRC). 1997. *Regulatory Analysis Technical Evaluation Handbook*. NUREG/BR-0184, Washington, D.C.

U.S. Nuclear Regulatory Commission (NRC). 1999. *Generic Environmental Impact Statement for License Renewal of Nuclear Plants, Main Report*, "Section 6.3 – Transportation, Table 9.1, Summary of findings on NEPA issues for license renewal of nuclear power plants, Final Report." NUREG-1437, Volume 1, Addendum 1, Washington, D.C.

6.0 Environmental Impacts of the Uranium Fuel Cycle and Solid Waste Management

Environmental issues associated with the uranium fuel cycle and solid waste management are discussed in the *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (GEIS), NUREG-1437, Volumes 1 and 2 (NRC 1996, 1999).[a] The GEIS includes a determination of whether the analysis of the environmental issue could be applied to all plants and whether additional mitigation measures would be warranted. Issues are then assigned a Category 1 or a Category 2 designation. As set forth in the GEIS, Category 1 issues are those that meet all of the following criteria:

(1) 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.

(2) A single significance level (i.e., SMALL, MODERATE, or LARGE) has been assigned to the impacts (except for collective offsite radiological impacts from the fuel cycle and from high-level waste [HLW] and spent fuel disposal).

(3) 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 not to be sufficiently beneficial to warrant implementation.

For issues that meet the three Category 1 criteria, no additional plant-specific analysis is required unless new and significant information is identified.

Category 2 issues are those that do not meet one or more of the criteria for Category 1, and therefore, additional plant-specific review of these issues is required.

This chapter addresses the issues that are related to the uranium fuel cycle and solid waste management during the license renewal term that are listed in Table B-1 of Title 10 of the Code of Federal Regulations (CFR) Part 51, Subpart A, Appendix B, and are applicable to Arkansas Nuclear One, Unit 2 (ANO-2). The generic potential impacts of the radiological and non-radiological environmental impacts of the uranium fuel cycle and transportation of nuclear fuel and wastes are described in detail in the GEIS. This description is based, in part, on the generic impacts provided in 10 CFR 51.51(b), Table S-3, "Table of Uranium Fuel Cycle Environmental Data," and in 10 CFR 51.52(c), Table S-4, "Environmental Impact of

(a) The GEIS was originally issued in 1996. Addendum 1 to the GEIS was issued in 1999. Hereafter, all references to the "GEIS" include the GEIS and its Addendum 1.

Transportation of Fuel and Waste to and from One Light-Water-Cooled Nuclear Power Reactor." The staff also addresses the impacts from radon-222 and technetium-99 in the GEIS.

6.1 The Uranium Fuel Cycle

Category 1 issues in 10 CFR Part 51, Subpart A, Appendix B, Table B-1, that are applicable to ANO-2 from the uranium fuel cycle and solid waste management are listed in Table 6-1.

Table 6-1. Category 1 Issues Applicable to the Uranium Fuel Cycle and Solid Waste Management at Arkansas Nuclear One, Unit 2 During the License Renewal Term

ISSUE – 10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Section
URANIUM FUEL CYCLE AND WASTE MANAGEMENT	
Offsite radiological impacts (individual effects from other than the disposal of spent fuel and high level waste)	6.1; 6.2.1; 6.2.2.1; 6.2.2.3; 6.2.3; 6.2.4; 6.6
Offsite radiological impacts (collective effects)	6.1; 6.2.2.1; 6.2.3; 6.2.4; 6.6
Offsite radiological impacts (spent fuel and high level waste disposal)	6.1; 6.2.2.1; 6.2.3; 6.2.4; 6.6
Nonradiological impacts of the uranium fuel cycle	6.1; 6.2.2.6; 6.2.2.7; 6.2.2.8; 6.2.2.9; 6.2.3; 6.2.4; 6.6
Low-level waste storage and disposal	6.1; 6.2.2.2;6.4.2; 6.4.3; 6.4.3.1; 6.4.3.2; 6.4.3.3; 6.4.4; 6.4.4.1; 6.4.4.2; 6.4.4.3; 6.4.4.4; 6.4.4.5; 6.4.4.5.1; 6.4.4.5.2; 6.4.4.5.3; 6.4.4.5.4; 6.4.4.6;6.6
Mixed waste storage and disposal	6.4.5.1; 6.4.5.2; 6.4.5.3; 6.4.5.4; 6.4.5.5; 6.4.5.6; 6.4.5.6.1; 6.4.5.6.2; 6.4.5.6.3; 6.4.5.6.4; 6.6
On-site spent fuel	6.1; 6.4.6; 6.4.6.1; 6.4.6.2; 6.4.6.3; 6.4.6.4; 6.4.6.5; 6.4.6.6; 6.4.6.7; 6.6
Nonradiological waste	6.1; 6.5; 6.5.1; 6.5.2; 6.5.3; 6.6
Transportation	6.1; 6.3.1; 6.3.2.3; 6.3.3; 6.3.4; 6.6, Addendum 1

Entergy Operations Inc. (Entergy) stated in its Environmental Report (ER) (Entergy 2003) that it is not aware of any new and significant information associated with the renewal of the ANO-2 operating license. The staff has not identified any new and significant information during its independent review of the Entergy ER, the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts related to these issues beyond those discussed in the GEIS. For these issues, the staff concluded in the GEIS that the impacts are SMALL except for the collective offsite radiological impacts from the fuel cycle and from HLW and spent fuel disposal, as discussed below, and that additional plant-specific mitigation measures are not likely to be sufficiently beneficial to be warranted.

A brief description of the staff review and the GEIS conclusions, as codified in Table B-1, 10 CFR Part 51, Subpart A, Appendix B, Table B-1, for each of these issues follows:

- Offsite radiological impacts (individual effects from other than the disposal of spent fuel and high level waste). Based on information in the GEIS, the Commission found that

  > Off-site impacts of the uranium fuel cycle have been considered by the Commission in Table S-3 of this part [10 CFR 51.51(b)]. Based on information in the GEIS, impacts on individuals from radioactive gaseous and liquid releases including radon-222 and technetium-99 are small.

  The staff has not identified any new and significant information during its independent review of the Entergy ER, the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no offsite radiological impacts of the uranium fuel cycle during the license renewal term beyond those discussed in the GEIS.

- Offsite radiological impacts (collective effects). Based on information in the GEIS, the Commission found that

  > The 100 year environmental dose commitment to the U.S. population from the fuel cycle, high level waste and spent fuel disposal excepted, is calculated to be about 14,800 person rem [148 person Sv], or 12 cancer fatalities, for each additional 20-year power reactor operating term. Much of this, especially the contribution of radon releases from mines and tailing piles, consists of tiny doses summed over large populations. This same dose calculation can theoretically be extended to include many tiny doses over additional thousands of years as well as doses outside the U.S. The result of such a calculation would be thousands of cancer fatalities from the fuel cycle, but this result assumes that even tiny doses have some statistical adverse health effect which will not ever be mitigated (for

example no cancer cure in the next thousand years), and that these doses projected over thousands of years are meaningful. However, these assumptions are questionable. In particular, science cannot rule out the possibility that there will be no cancer fatalities from these tiny doses. For perspective, the doses are very small fractions of regulatory limits and even smaller fractions of natural background exposure to the same populations.

Nevertheless, despite all the uncertainty, some judgement as to the regulatory NEPA [National Environmental Policy Act] implications of these matters should be made and it makes no sense to repeat the same judgement in every case. Even taking the uncertainties into account, the Commission concludes that these impacts 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. Accordingly, while the Commission has not assigned a single level of significance for the collective effects of the fuel cycle, this issue is considered Category 1.

The staff has not identified any new and significant information during its independent review of the Entergy ER, the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no offsite radiological impacts (collective effects) from the uranium fuel cycle during the license renewal term beyond those discussed in the GEIS.

- Offsite radiological impacts (spent fuel and high level waste disposal). Based on information in the GEIS, the Commission found that

  For the high level waste and spent fuel disposal component of the fuel cycle, there are no current regulatory limits for offsite releases of radionuclides for the current candidate repository site. However, if we assume that limits are developed along the lines of the 1995 National Academy of Sciences (NAS) report, "Technical Bases for Yucca Mountain Standards," and that in accordance with the Commission's Waste Confidence Decision, 10 CFR 51.23, a repository can and likely will be developed at some site which will comply with such limits, peak doses to virtually all individuals will be 100 millirem [1 mSv] per year or less. However, while the Commission has reasonable confidence that these assumptions will prove correct, there is considerable uncertainty since the limits are yet to be developed, no repository application has been completed or reviewed, and uncertainty is inherent in the models used to evaluate possible pathways to the human environment. The NAS report indicated that 100 millirem [1 mSv] per year should be considered as a starting point for limits for individual

doses, but notes that some measure of consensus exists among national and international bodies that the limits should be a fraction of the 100 millirem [1 mSv] per year. The lifetime individual risk from 100 millirem [1 mSv] annual dose limit is about is about 3×10^{-3}.

Estimating cumulative doses to populations over thousands of years is more problematic. The likelihood and consequences of events that could seriously compromise the integrity of a deep geologic repository were evaluated by the Department of Energy in the "Final Environmental Impact Statement: Management of Commercially Generated Radioactive Waste," October 1980 [DOE 1980]. The evaluation estimated the 70-year whole-body dose commitment to the maximum individual and to the regional population resulting from several modes of breaching a reference repository in the year of closure, after 1,000 years, after 100,000 years, and after 100,000,000 years. Subsequently, the NRC and other federal agencies have expended considerable effort to develop models for the design and for the licensing of a high level waste repository, especially for the candidate repository at Yucca Mountain. More meaningful estimates of doses to population may be possible in the future as more is understood about the performance of the proposed Yucca Mountain repository. Such estimates would involve very great uncertainty, especially with respect to cumulative population doses over thousands of years. The standard proposed by the NAS is a limit on maximum individual dose. The relationship of potential new regulatory requirements, based on the NAS report, and cumulative population impacts has not been determined, although the report articulates the view that protection of individuals will adequately protect the population for a repository at Yucca Mountain. However, EPA's generic repository standards in 40 CFR part 191 generally provide an indication of the order of magnitude of cumulative risk to population that could result from the licensing of a Yucca Mountain repository, assuming the ultimate standards will be within the range of standards now under consideration. The standards in 40 CFR part 191 protect the population by imposing "containment requirements" that limit the cumulative amount of radioactive material released over 10,000 years. Reporting performance standards that will be required by EPA are expected to result in releases and associated health consequences in the range between 10 and 100 premature cancer deaths with an upper limit of 1,000 premature cancer deaths world-wide for a 100,000 metric tonne (MTHM) repository.

Nevertheless, despite all the uncertainty, some judgement as to the regulatory NEPA implications of these matters should be made and it makes no sense to repeat the same judgement in every case. Even taking the uncertainties into account, the Commission concludes that these impacts 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. 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.

On February 15, 2002, based on a recommendation by the Secretary of the Department of Energy, the President recommended the Yucca Mountain site for the development of a repository for the geologic disposal of spent nuclear fuel and high-level nuclear waste. The U.S. Congress approved this recommendation on July 9, 2002, in Joint Resolution 87, which designated Yucca Mountain as the repository for spent nuclear waste. On July 23, 2002, the President signed Joint Resolution 87 into law; Public Law 107-200, 116 Stat. 735 (2002) designates Yucca Mountain as the repository for spent nuclear waste. This development does not represent new and significant information with respect to the offsite radiological impacts from license renewal related to disposal of spent nuclear fuel and high-level nuclear waste.

EPA developed Yucca Mountain-specific repository standards, which were subsequently adopted by the NRC in 10 CFR Part 63. In an opinion, issued July 9, 2004, the U.S. Court of Appeals for the District of Columbia Circuit (the Court) vacated EPA's radiation protection standards for the candidate repository, which required compliance with certain dose limits over a 10,000 year period. The Court's decision also vacated the compliance period in NRC's licensing criteria for the candidate repository in 10 CFR Part 63.

Therefore, for the high-level waste and spent fuel disposal component of the fuel cycle, there is some uncertainty with respect to regulatory limits for offsite releases of radioactive nuclides for the current candidate repository site. However, prior to promulgation of the affected provisions of the Commission's regulations, we assumed that limits would be developed along the lines of the 1995 National Academy of Sciences report, "Technical Bases for Yucca Mountain Standards," and that in accordance with the Commission's Waste Confidence Decision, 10 CFR 51.23, a repository that would comply with such limits could and likely would be developed at some site. Peak doses to virtually all individuals will be 1mSv (100 mrem) per year or less.

Despite the current uncertainty with respect to these rules, some judgment as to the regulatory NEPA implications of offsite radiological impacts of spent fuel and high-level waste disposal should be made. The staff concludes that these impacts are acceptable in that the impacts would not be sufficiently large to require the NEPA conclusion that the option of extended operation under 10 CFR Part 54 should be eliminated.

The staff has not identified any new and significant information during its independent review of the Entergy ER, the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no offsite radiological impacts related to spent fuel and HLW disposal during the renewal term beyond those discussed in the GEIS.

- Nonradiological impacts of the uranium fuel cycle. Based on information in the GEIS, the Commission found that

  > The nonradiological impacts of the uranium fuel cycle resulting from the renewal of an operating license for any plant are found to be small.

  The staff has not identified any new and significant information during its independent review of the Entergy ER, the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no nonradiological impacts of the uranium fuel cycle during the license renewal term beyond those discussed in the GEIS.

- Low-level waste storage and disposal. Based on information in the GEIS, the Commission found that

  > 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 will remain small during the term of a renewed license. The maximum additional on-site land that may be required for low-level waste storage during the term of a renewed license and associated impacts will be small. Nonradiological impacts on air and water will be negligible. The radiological and nonradiological environmental impacts of long-term disposal of low-level waste from any individual plant at licensed sites are small. In addition, the Commission concludes that there is reasonable assurance that sufficient low-level waste disposal capacity will be made available when needed for facilities to be decommissioned consistent with NRC decommissioning requirements.

  The staff has not identified any new and significant information during its independent review of the Entergy ER, the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts of low-level waste storage and disposal associated with the license renewal term beyond those discussed in the GEIS.

- Mixed waste storage and disposal. Based on information in the GEIS, the Commission found that

  > 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 will not increase the small, continuing risk to human health and the environment posed by mixed waste at all plants. The radiological and non-radiological environmental impacts of long-term disposal of mixed waste from any individual plant at licensed sites are small. In addition, the Commission concludes that there is reasonable assurance that sufficient mixed waste disposal capacity will be made available when needed for facilities to be decommissioned consistent with NRC decommissioning requirements.

  The staff has not identified any new and significant information during its independent review of the Entergy ER, the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts of mixed waste storage and disposal associated with the license renewal term beyond those discussed in the GEIS.

- On-site spent fuel. Based on information in the GEIS, the Commission found that

  > The expected increase in the volume of spent fuel from an additional 20 years of operation can be safely accommodated on site with small environmental effects through dry or pool storage at all plants if a permanent repository or monitored retrievable storage is not available.

  The staff has not identified any new and significant information during its independent review of the Entergy ER, the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts of onsite spent fuel associated with license renewal beyond those discussed in the GEIS.

- Nonradiological waste. Based on information in the GEIS, the Commission found that

  > No changes to generating systems are anticipated for license renewal. Facilities and procedures are in place to ensure continued proper handling and disposal at all plants.

  The staff has not identified any new and significant information during its independent review of the Entergy ER, the staff's site visit, the scoping process, or its evaluation of other

available information. Therefore, the staff concludes that there are no nonradiological waste impacts during the license renewal term beyond those discussed in the GEIS.

- Transportation. Based on information contained in the GEIS, the Commission found that

> The impacts of transporting spent fuel enriched up to 5 percent uranium-235 with average burnup for the peak rod to current levels approved by NRC up to 62,000 MWd/MTU and the cumulative impacts of transporting high-level waste to a single repository, such as Yucca Mountain, Nevada are found to be consistent with the impact values contained in 10 CFR 51.52(c), Summary Table S-4—Environmental Impact of Transportation of Fuel and Waste to and from One Light-Water-Cooled Nuclear Power Reactor. If fuel enrichment or burnup conditions are not met, the applicant must submit an assessment of the implications for the environmental impact values reported in § 51.52.

ANO-2 meets the fuel-enrichment and burnup conditions set forth in Addendum 1 to the GEIS (NRC 1999). The staff has not identified any new and significant information during its independent review of the Entergy ER, the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts of transportation of spent fuel associated with license renewal beyond those discussed in the GEIS.

There are no Category 2 issues for the uranium fuel cycle and solid waste management.

6.2 References

10 CFR Part 51. Code of Federal Regulations, Title 10, *Energy,* Part 51, "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions."

10 CFR Part 54. Code of Federal Regulations, Title 10, *Energy,* Part 54, "Requirements for Renewal of Operating Licenses for Nuclear Power Plants."

10 CFR Part 63. Code of Federal Regulations, Title 10, *Energy,* Part 63, "Disposal of High-Level Radioactive Wastes in a Geologic Repository at Yucca Mountain, Nevada."

40 CFR Part 191. Code of Federal Regulations, Title 40, *Protection of Environment*, Part 191, "Environmental Radiation Protection Standards for Management and Disposal of Spent Nuclear Fuel, High-Level and Transuranic Radioactive Waste."

Entergy Operations, Inc. (Entergy). 2003. *Applicant's Environmental Report – Operating License Renewal Stage Arkansas Nuclear One - Unit 2.* Russellville, Arkansas.

National Environmental Policy Act (NEPA) of 1969, as amended, 42 USC 4321, et. seq.

U.S. Department of Energy (DOE). 1980. *Final Environmental Impact Statement: Management of Commercially Generated Radioactive Waste.* DOE/EIS-0046F, Washington, D.C.

U.S. Nuclear Regulatory Commission (NRC). 1996. *Generic Environmental Impact Statement for License Renewal of Nuclear Plants.* NUREG-1437, Volumes 1 and 2, Washington, D.C.

U.S. Nuclear Regulatory Commission (NRC). 1999. *Generic Environmental Impact Statement for License Renewal of Nuclear Plants, Main Report, Section 6.3 – Transportation, Table 9.1, Summary of findings on NEPA issues for license renewal of nuclear power plants.* NUREG-1437, Volume 1, Addendum 1, Washington, D.C.

7.0 Environmental Impacts of Decommissioning

Environmental impacts from the activities associated with the decommissioning of any reactor before or at the end of an initial or renewed license are evaluated in the *Generic Environmental Impact Statement for Decommissioning of Nuclear Facilities: Regarding the Decommissioning of Nuclear Power Reactors*, NUREG-0586, Supplement 1 (NRC 2002). The staff's evaluation of the environmental impacts of decommissioning presented in Supplement 1 resulted in a range of impacts for each environmental issue. These results may be used by licensees as a starting point for a plant-specific evaluation of the decommissioning impacts at their facilities.

The incremental environmental impacts associated with decommissioning activities resulting from continued plant operation during the license renewal term are evaluated in the *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (GEIS), NUREG-1437, Volumes 1 and 2 (NRC 1996, 1999).[a] The evaluation in NUREG-1437 includes a determination of whether the analysis of the environmental issue could be applied to all plants and whether additional mitigation measures would be warranted. Issues are then assigned a Category 1 or a Category 2 designation. As set forth in the GEIS, Category 1 issues are those that meet all of the following criteria:

(1) 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.

(2) A single significance level (i.e., SMALL, MODERATE, or LARGE) has been assigned to the impacts (except for collective off-site radiological impacts from the fuel cycle and from high level waste and spent fuel disposal).

(3) 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 not to be sufficiently beneficial to warrant implementation. For issues that meet the three Category 1 criteria, no additional plant-specific analysis is required unless new and significant information is identified.

Category 2 issues are those that do not meet one or more of the criteria for Category 1, and therefore, additional plant-specific review of these issues is required. There are no Category 2 issues related to decommissioning.

(a) The GEIS was originally issued in 1996. Addendum 1 to the GEIS was issued in 1999. Hereafter, all references to the "GEIS" include the GEIS and its Addendum 1.

7.1 Decommissioning

Category 1 issues in Table B-1 of Title 10 of the Code of Federal Regulations (CFR) Part 51, Subpart A, Appendix B that are applicable to Arkansas Nuclear One, Unit 2 (ANO-2) decommissioning following the license renewal term are listed in Table 7-1. Entergy Operations, Inc. (Entergy) stated in its Environmental Report (ER) (Entergy 2003) that it is aware of no new and significant information regarding the environmental impacts of ANO-2 license renewal. The staff has not identified any new and significant information during its independent review of the Entergy ER, the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts related to these issues beyond those discussed in the GEIS. For all of these issues, the staff concluded in the GEIS that the impacts are SMALL, and additional plant-specific mitigation measures are not likely to be sufficiently beneficial to be warranted.

Table 7-1. Category 1 Issues Applicable to the Decommissioning of Arkansas Nuclear One, Unit 2 Following the License Renewal Term

ISSUE – 10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Section
DECOMMISSIONING	
Radiation Doses	7.3.1; 7.4
Waste Management	7.3.2; 7.4
Air Quality	7.3.3; 7.4
Water Quality	7.3.4; 7.4
Ecological Resources	7.3.5; 7.4
Socioeconomic Impacts	7.3.7; 7.4

A brief description of the staff's review and the GEIS conclusions, as codified in Table B-1, for each of the issues follows:

- Radiation doses. Based on information in the GEIS, the Commission found that

  > Doses to the public will be well below applicable regulatory standards regardless of which decommissioning method is used. Occupational doses would increase no more than 1 man-rem [0.01 person-Sv] caused by buildup of long-lived radionuclides during the license renewal term.

  The staff has not identified any new and significant information during its independent review of the Entergy ER, the staff's site visit, the scoping process, or its evaluation of other

available information. Therefore, the staff concludes that there are no radiation dose impacts associated with decommissioning following the license renewal term beyond those discussed in the GEIS.

- Waste management. Based on information in the GEIS, the Commission found that

  > Decommissioning at the end of a 20-year license renewal period would generate no more solid wastes than at the end of the current license term. No increase in the quantities of Class C or greater than Class C wastes would be expected.

  The staff has not identified any new and significant information during its independent review of the Entergy ER, the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts from solid waste associated with decommissioning following the license renewal term beyond those discussed in the GEIS.

- Air quality. Based on information in the GEIS, the Commission found that

  > Air quality impacts of decommissioning are expected to be negligible either at the end of the current operating term or at the end of the license renewal term.

  The staff has not identified any new and significant information during its independent review of the Entergy ER, the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts on air quality associated with decommissioning following the license renewal term beyond those discussed in the GEIS.

- Water quality. Based on information in the GEIS, the Commission found that

  > The potential for significant water quality impacts from erosion or spills is no greater whether decommissioning occurs after a 20-year license renewal period or after the original 40-year operation period, and measures are readily available to avoid such impacts.

  The staff has not identified any new and significant information during its independent review of the Entergy ER, the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts on water quality associated with decommissioning following the license renewal term beyond those discussed in the GEIS.

- Ecological resources. Based on information in the GEIS, the Commission found that

  > Decommissioning after either the initial operating period or after a 20-year license renewal period is not expected to have any direct ecological impacts.

  The staff has not identified any new and significant information during its independent review of the Entergy ER, the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no impacts on ecological resources associated with decommissioning following the license renewal term beyond those discussed in the GEIS.

- Socioeconomic Impacts. Based on information in the GEIS, the Commission found that

  > Decommissioning would have some short-term socioeconomic impacts. The impacts would not be increased by delaying decommissioning until the end of a 20-year relicense period, but they might be decreased by population and economic growth.

  The staff has not identified any new and significant information during its independent review of the Entergy ER, the staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the staff concludes that there are no socioeconomic impacts associated with decommissioning following the license renewal term beyond those discussed in the GEIS.

7.2 References

10 CFR Part 51. Code of Federal Regulations, Title 10, *Energy,* Part 51, "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions."

Entergy Operations, Inc. (Entergy). 2003. *Applicant's Environmental Report – Operating License Renewal Stage Arkansas Nuclear One, Unit 2.* Russellville, Arkansas.

U.S. Nuclear Regulatory Commission (NRC). 1996. *Generic Environmental Impact Statement for License Renewal of Nuclear Plants.* NUREG-1437, Volumes 1 and 2, Washington, D.C.

U.S. Nuclear Regulatory Commission (NRC). 1999. *Generic Environmental Impact Statement for License Renewal of Nuclear Plants, Main Report, Section 6.3 – Transportation, Table 9.1, Summary of findings on NEPA issues for license renewal of nuclear power plants.* NUREG-1437, Volume 1, Addendum 1, Washington, D.C.

U.S. Nuclear Regulatory Commission (NRC). 2002. *Generic Environmental Impact Statement for Decommissioning of Nuclear Facilities: Regarding the Decommissioning of Nuclear Power Reactors.* NUREG-0586, Supplement 1, Volumes 1 and 2, Washington, D.C.

8.0 Environmental Impacts of Alternatives to License Renewal

This chapter examines the potential environmental impacts associated with denying the renewal of the operating license (OL) (i.e., the no-action alternative); the potential environmental impacts from power generating sources other than Arkansas Nuclear One, Unit 2 (ANO-2); the possibility of purchasing electric power from other sources to replace power generated by ANO-2 and the associated environmental impacts; the potential environmental impacts from a combination of generating and conservation measures; and other generation alternatives that were deemed unsuitable for replacement of power generated by ANO-2. The environmental impacts are evaluated using the U.S. Nuclear Regulatory Commission's (NRC's) three-level standard of significance – SMALL, MODERATE, or LARGE – developed using Council on Environmental Quality (CEQ) guidelines and set forth in the footnotes to Table B-1 of Title 10 of the Code of Federal Regulations (CFR) Part 51, Subpart A, Appendix B:

SMALL – Environmental effects are not detectable or are so minor that they will neither destabilize nor noticeably alter any important attribute of the resource.

MODERATE – Environmental effects are sufficient to alter noticeably, but not to destabilize important attributes of the resource.

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

The impact categories evaluated in this chapter are the same as those used in the *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (GEIS) NUREG-1437, Volumes 1 and 2 (NRC 1996, 1999)[(a)] with the additional impact category of environmental justice.

The impact assessments discussed for these alternatives for ANO-2 are, in some cases, different from those assessments discussed in the Arkansas Nuclear One, Unit 1 (ANO-1) final supplemental environmental impact statement, Supplement 3 to NUREG-1437. These differences result from changes in the time both units could be operating (i.e., ANO-1 can now continue operating until 2034), comparisons between facilities using cooling towers or once-through cooling systems, updated information obtained since the review of ANO-1 (i.e., census data), or revisions in methodology and considerations that have resulted from the staff's

(a) The GEIS was originally issued in 1996. Addendum 1 to the GEIS was issued in 1999. Hereafter, all references to the "GEIS" include the GEIS and its Addendum 1.

experience with license renewal at other facilities. Where appropriate, the staff identified the reasons for any differences in these assessments.

8.1 No-Action Alternative

The NRC's regulations implementing the National Environmental Policy Act of 1969 (NEPA) specify that the no-action alternative be discussed in an NRC environmental impact statement (EIS) (10 CFR Part 51, Subpart A, Appendix A(4)). For license renewal, the no-action alternative refers to a scenario in which NRC would not renew the ANO-2 OL, and Entergy Operations, Inc. (Entergy) would then cease operations at the plant and initiate decommissioning no later than July 17, 2018.

Entergy will be required to comply with NRC decommissioning requirements whether or not the OL is renewed. If the ANO-2 OL is renewed, shutdown of the unit and decommissioning activities will not be avoided but may be postponed for up to an additional 20 years. If the OL is not renewed, Entergy would conduct decommissioning activities according to the requirements in 10 CFR 50.82.

The environmental impacts associated with decommissioning following a license renewal term of up to 20 years or following the no-action alternative would be bounded by the discussion of impacts in Chapter 7 of the GEIS (NRC 1996), Chapter 7 of this SEIS, and the *Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities*, NUREG-0586, Supplement 1 (NRC 2002). The impacts of decommissioning after 60 years of operation are not expected to be significantly different from those occurring after 40 years of operation.

Impacts from the decision to permanently cease operations are not considered in NUREG-0586, Supplement 1.[a] Therefore, immediate impacts that occur between plant shutdown and the beginning of decommissioning are considered here. These impacts, which will occur when the unit shuts down regardless of whether the license is renewed or not, are discussed below, with the results presented in Table 8-1. Plant shutdown will result in a net reduction in power production capacity. The power not generated by ANO-2 during the license renewal term would likely be replaced by (1) power purchased from other electricity providers, (2) generating alternatives other than ANO-2, (3) demand-side management (DSM) and energy conservation, or (4) some combination of these options. The environmental impacts of these options are discussed in Section 8.2.

(a) Appendix J of NUREG-0586, Supplement 1, discusses the socioeconomic impacts of plant closure, but the results of the analysis in Appendix J are not incorporated in the analysis presented in the main body of the NUREG.

Table 8-1. Summary of Environmental Impacts of the No-Action Alternative and Decommissioning Related to Renewal of the Arkansas Nuclear One, Unit 2 Operating License

Impact Category	Impact	Comments
Land Use	SMALL	Closure will result in decreased land use. Decommissioning onsite impacts expected to be temporary. No offsite impacts expected from plant closure or decommissioning.
Ecology	SMALL	Plant closure will immediately reduce impacts to terrestrial and aquatic ecology. Decommissioning impacts to ecology are expected to be temporary and will be mitigated by using best management practices. Some increased impacts would occur in the immediate vicinity of the plant where local population may have become adapted to life in the cooling ponds and the warm effluent streams. However, these effects would be similar whether the license period is extended or not.
Water Use and Quality	SMALL	Water use will decrease. Water quality unlikely to be adversely affected.
Air Quality	SMALL	All emissions will decrease following shutdown. During decommissioning, the greatest impact is likely to be from fugitive dust; impact can be mitigated by using best management practices.
Waste	SMALL	Low-level radioactive waste will be disposed of in licensed facilities. A permanent disposal facility for high-level waste (HLW) is not currently available; however, the Yucca Mountain repository for these wastes is under consideration.
Human Health	SMALL	Radiological doses to workers and members of the public are expected to be within regulatory limits and comparable to, or lower than, doses from operating plants. Occupational injuries, during decommissioning, are possible, but injury rates at nuclear power plants are below the U.S. average industrial rate.
Socioeconomics	SMALL to MODERATE	Following plant closure there will be a decrease in employment in Pope County and the surrounding counties, and a decrease in tax revenues for Pope County. Some temporary increases in employment will be created during decommissioning. Reduced employment would mean reduced traffic following plant shutdown. There will be some offsetting employment and traffic increases during decommissioning.
Aesthetics	SMALL	Positive impact from eventual removal of buildings and structures. Some noise impact during decommissioning operations.
Historic and Archaeological Resources	SMALL	Use of the properties will decrease following plant closure, and access will be controlled during decommissioning.
Environmental Justice	SMALL to MODERATE	Some loss of employment opportunities and social programs is expected.

The staff's assessments of the impacts of the no-action alternative on each impact category are provided in the following sections. The assessment of each impact category is supplemented with information about the potential impacts of decommissioning.

- **Land Use**

Cessation of ANO-2 operations would result in a reduced use of the Arkansas Nuclear One site. Land use on and off the site will be reduced and eventually eliminated. During decommissioning, some temporary changes in onsite land use could occur. These changes may include additional or expanded staging and laydown areas or construction of temporary buildings and parking areas. No offsite land-use changes are expected as a result of decommissioning. After cessation of operations and following decommissioning, the ANO-2 site would likely be retained by Entergy for other corporate purposes. Eventual sale or transfer of the site, however, could result in changes to land use. Notwithstanding this possibility, the impacts of the no-action alternative and decommissioning on land use are considered SMALL.

- **Ecology**

In Chapter 4 of this SEIS, the NRC staff concluded that the ecological impacts of plant operation were SMALL. Impacts on aquatic ecology would be reduced immediately following cessation of plant operations. Water withdrawal and cooling tower blowdown will end when the reactor is shut down. Some increased impacts may occur in the immediate vicinity of the plant where local populations may have become adapted to life in the cooling ponds and the warm effluent streams. However, these effects would be similar whether the license period is extended or not. Decommissioning activities may have some short-term impacts to site ecology. Impacts on aquatic ecology could result from removal of in-water pipes and structures or the filling of the discharge canal. Impacts to aquatic ecology would likely be short term and could be mitigated. The environmental impacts to aquatic species, including threatened and endangered species associated with these changes, are generally positive. The impact of plant closure on the terrestrial ecosystem will be negligible because the transmission lines to the plant will remain energized. Impacts on terrestrial ecology, related to decommissioning activities, could occur as a result of land disturbance for additional laydown yards, stockpiles, and support facilities. Land disturbance is expected to be minimal and would result in relatively short-term impacts that can be mitigated using best management practices. The land is expected to recover naturally. Overall, the impacts associated with the no-action alternative and decommissioning on terrestrial and aquatic ecology are considered SMALL.

- **Water Use and Quality**

In Chapter 4 of this SEIS, the NRC staff concluded that impacts of plant operation on surface water and groundwater use and quality were SMALL. The impact to aquatic resources resulting from cessation of ANO-2 operation would be elimination of consumptive water losses (e.g., evaporation associated with the cooling system) because reactor cooling will no longer be required. As plant staff size decreases, the demand for potable water is expected to also decrease. Water use during decommissioning is expected to be less than during operation.

The water quality is unlikely to be adversely affected. Overall, water use and quality impacts of the no-action alternative and decommissioning are considered SMALL.

- **Air Quality**

In Chapter 4 of this SEIS, the staff found the impacts of plant operations on air quality to be SMALL. When the plant stops operating, there will be a reduction in emissions from activities related to plant operation such as use of diesel generators and workers' transportation. Emission from diesel generators, boilers, and other activities associated with ANO-2 operations will cease or be greatly reduced. Decommissioning activities that can adversely affect air quality include dismantlement of systems and equipment, demolition of buildings and structures, and the operation of internal combustion engines. The most likely adverse impact would be the generation of fugitive dust. Best management practices, such as seeding and wetting, could be used to minimize the generation of fugitive dust. Air quality impacts associated with the no-action alternative and decommissioning are considered SMALL.

- **Waste**

The impacts of waste generated by plant operations are discussed in Chapter 6. Liquid, gaseous, and solid radioactive wastes are by-products of reactor operations. Liquid wastes are generated primarily by plant maintenance and service operations. Gaseous waste displaced from the chemical and volume control system tanks that are used to store liquids is the primary source of the waste form. Solid wastes include dry active waste, sludge, oil, bead resin, and filters. These wastes will be eliminated or greatly reduced by the cessation of operations. Decommissioning activities would result in the generation of radioactive and non-radioactive waste; however, when the plant stops operating, the plant will stop generating spent nuclear fuel, and generation of low-level waste (LLW) and mixed waste associated with plant operation and maintenance will be reduced. Therefore, the staff concludes that the impact of waste generated after shutdown of the plant would be SMALL.

The staff concluded that the volume of LLW generated during decommissioning could vary greatly depending on the type and size of the plant, the length of time it operated, the decommissioning option chosen, and the waste treatment and volume reduction procedures used (NRC 2002). LLW must be disposed of in a facility licensed by NRC or a state with authority delegated by NRC. Recent advances in volume reduction and waste processing have significantly reduced waste volumes. A permanent repository for HLW is not currently available, but is under consideration at Yucca Mountain, Nevada. The NRC has made a generic determination that, if necessary, spent fuel generated in any reactor can be stored safely and without significant environmental impacts for at least 30 years beyond the licensed life for operation (which may include the term of a revised or renewed license) of that reactor at its spent fuel storage basin or at either onsite or offsite independent spent fuel storage

installations (10 CFR 51.23(a)). Onsite and offsite licensed disposal facilities would be used for disposal of nonradioactive waste. Overall, waste impacts associated with the no-action alternative and decommissioning are considered SMALL.

- **Human Health**

In Chapter 4 of this SEIS, the NRC staff concluded that the impacts of plant operation on human health were SMALL. During ANO-2 operations, the doses to maximally exposed individuals in the vicinity of ANO-2 have been a small fraction of the limits specified to meet U.S. Environmental Protection Agency (EPA) standards. The assessment of radiation dose to the general public from effluents indicates the dose is only a fraction of the regulatory limit. These potential exposures will be reduced following cessation of plant operations. Radiological doses to occupational workers during decommissioning activities are estimated to average approximately 5 percent of the dose limits in 10 CFR Part 20, and to be similar to or lower than the doses experienced by workers in operating nuclear power plants. Effluent releases from decommissioning activities are estimated to be well below the limits in 10 CFR Part 20, and to be similar to or lower than effluent releases from operating nuclear power plants. These effluent releases will result in doses to the public well below 10 CFR Part 20 requirements.

Occupational injuries to workers engaged in decommissioning activities are possible. However, historical injury and fatality rates at nuclear power plants have been lower than the average U.S. industrial rates. For years, the commercial nuclear energy industry has ranked among the safest employment sectors in the United States. In 2001, its industrial safety accident rate, which tracks the number of accidents that result in lost work time, restricted work, or fatalities, was 0.24 per 200,000 worker-hours (NEI 2002). This is lower than the accident rate for the U.S. manufacturing industry (i.e., 4.0 per 200,000 worker-hours), and even lower than the accident rate for the workplaces of the U.S. finance, insurance, and real estate industries (i.e., 0.7 per 200,000 worker-hours) (BLS 2001). In addition, the variety of potential accidents at the plant will be reduced to a limited set associated with shutdown events and fuel handling. Overall, the human health impacts associated with the no-action alternative and decommissioning are considered SMALL.

- **Socioeconomics**

In Chapter 4 of this SEIS, the NRC staff concluded that the socioeconomic impacts of continued plant operation would be SMALL to MODERATE. There would be immediate socioeconomic impacts associated with the shutdown of the plant because of the reduction in the staff at the plant. In the GEIS, the NRC staff concludes that the socioeconomic impacts of plant shutdown could range from SMALL to LARGE. Some of these impacts could be offset if new power-generating facilities are built at or near the current site. Appendix J of

NUREG-0586, Supplement 1, provides additional discussion of the potential impacts of plant shutdown (NRC 2002).

The no-action alternative would result in the loss of the taxes attributable to ANO-2 as well as the loss of plant payrolls 20 years earlier than if the OL was renewed. There would also be an adverse impact on housing values and the local nearby economy if ANO-2 ceased operations.

Both Chapter 7 of the GEIS (NRC 1996) and Supplement 1 to NUREG-0586 (NRC 2002) note that socioeconomic impacts would be expected as a result of the decision to close a nuclear power plant, and that the direction and magnitude of the overall impacts would depend on the state of the economy, the net change in workforce at the plant, and the changes in local government tax receipts. The socioeconomic impacts of decommissioning activities are expected to be SMALL. Appendix J of NUREG-0586, Supplement 1, shows that the overall socioeconomic impact of plant closure plus decommissioning could be SMALL to MODERATE.

The workforce employed at ANO-2 resides primarily in the adjacent counties. The impacts associated with the loss of these jobs would be concentrated in Pope, Johnson, and Yell Counties. The loss of these jobs would be an adverse impact to the economies of these counties. Employees at ANO-2 constitute approximately 2 percent of total employment in Pope County, but are among the highest-paid employees in the county. Loss of these jobs is considered to have a SMALL to MODERATE socioeconomic impact.

ANO-2 employees also contribute time and resources to community activities, such as schools, churches, community groups, and civic activities. The loss of jobs would have an adverse impact on involvement with these activities.

There would also be an immediate reduction in property tax revenues for Pope County. As discussed in Section 2.2.8, the property taxes paid by Entergy for both units at Arkansas Nuclear One represented approximately 43 percent, 55 percent, and 43 percent of the locally generated tax revenues for the 2002 Pope County General, County Roads, and County Library budgets, respectively. The majority of Entergy's property taxes are allocated to the Russellville School District. In 2002, tax payment from Entergy made up about 49 percent of the locally generated property tax revenues for the school district. The loss of about half of the tax revenues would be an adverse impact to the economies of these counties.

In Chapter 4 of this SEIS, the NRC staff concluded that the impacts of continued plant operation on transportation would be SMALL. Cessation of operations would be accompanied by a reduction in traffic in the vicinity of the plant. There would be some offsetting employment and traffic increases during decommissioning. Most of the reduction would be associated with a reduction in the plant workforce, but there will also be a reduction in shipment of material to

and from the plant. Therefore, the staff concludes that the impacts of plant closure on transportation would be SMALL.

Overall, the staff concludes that the socioeconomic impacts associated with the no-action alternative are considered SMALL to MODERATE, and the impacts of decommissioning are considered SMALL.

- **Aesthetics**

Recognizing that ANO-1 will still be operating, cessation of ANO-2 plant operations would probably result in the dismantlement of some buildings and structures at the site, particularly the natural draft cooling tower used exclusively by ANO-2. Removal of the ANO-2 cooling tower would result in a lower plant visual profile and a positive aesthetic impact. Some operational noise also would be reduced or eliminated. Decommissioning would result in the eventual dismantlement of buildings and structures at the site resulting in a positive aesthetic impact. Noise generated during decommissioning operations may be detectable offsite; however, the impact is unlikely to be of large significance and can normally be mitigated. Thus, the aesthetic impacts associated with the no-action alternative and decommissioning are considered SMALL.

- **Historic and Archaeological Resources**

Use of land resources at the site would be reduced following ANO-2 closure. Because ANO-1 would still be operating, the site would be retained by Entergy for nuclear energy production.

In Chapter 4 of this SEIS, the NRC staff concluded that the impacts of continued plant operation on historic and archaeological resources would be SMALL. Onsite land use will not be affected immediately by the cessation of operations. Plant structures and other facilities are likely to remain in place until decommissioning, and access will be controlled during decommissioning. The transmission line associated with ANO-2 is expected to remain in service after plant shutdown. As a result, maintenance activities on the transmission line right-of-way will continue as before. Therefore, the staff concludes that the impacts on historic and archaeological resources from plant shutdown would be SMALL.

- **Environmental Justice**

In Chapter 4 of this SEIS, the NRC staff concluded that the environmental justice impact of continued operation of the plant would be SMALL because continued operation of the plant would not have a disproportionately high and adverse impact on minority and low-income populations. No environmental pathways have been identified that would cause disproportionate impacts if the no-action alternative is implemented. Closure of ANO-2 would

result in decreased employment opportunities and tax revenue in Pope County and surrounding counties, with possible negative and disproportionate impacts on minority or low-income populations ranging from SMALL to MODERATE. Plant closure may have an indirect negative effect on minority and low-income populations due to loss of tax revenues and community services, but the most direct effects would be on plant workers who lose their jobs. As noted earlier, plant workers tend to be on the higher end of the income scale; therefore, it is not clear that effects on the minority and low-income populations would be disproportionate relative to those on displaced plant workers. Decommissioning activities are not expected to adversely impact the minority and low-income populations of Pope County and surrounding counties. Thus, the environmental justice impacts under the no-action alternative and decommissioning are considered SMALL to MODERATE.

- **Summary of the No-Action Alternative**

The environmental impacts associated with the no-action alternative are summarized in Table 8-1. Implementation of the no-action alternative would also have certain positive impacts because adverse environmental impacts associated with current operation of ANO-2 (i.e., solid waste generation) would be eliminated.

8.2 Alternative Energy Sources

This section describes the environmental impacts associated with alternative sources of electric power to replace the power generated by ANO-2, assuming that the OL is not renewed. The order of presentation of these alternative energy sources does not imply which alternative would be most likely to occur or to have the least environmental impact.

The following generation alternatives are considered in detail:

- coal-fired generation at an alternate site (Section 8.2.1)
- natural-gas-fired generation at the existing ANO-2 site or at an alternate site (Section 8.2.2)
- nuclear generation at the existing ANO-2 site or at an alternate site (Section 8.2.3).

The alternative of purchasing power from other sources to replace power generated by ANO-2 is discussed in Section 8.2.4. Other power generation alternatives and conservation alternatives considered by the staff and found not to be reasonable replacements for ANO-2 are discussed in Section 8.2.5. The environmental impacts of a combination of generation and conservation alternatives are discussed in Section 8.2.6.

The entire Arkansas Nuclear One site encompasses 471 ha (1164 ac). Of this total land area, 73 ha (180 ac) are developed (Entergy 2003). Some types of replacement power plant could be located at this site and could therefore use existing infrastructure (e.g., cooling water system, transmission lines, roads, and technical and administrative support facilities). However, a conventional coal-fired power plant and coal pile requires about 700 ha (1700 ac) (NRC 1996), so it could not be accommodated on the existing site.

Each year the Energy Information Administration (EIA), a component of the U.S. Department of Energy (DOE), issues an Annual Energy Outlook. In its Annual Energy Outlook 2002 with Projections to 2025, EIA projects that natural-gas-fired combined-cycle[a] or combustion turbine technology (including distributed generation capacity) will make up 63 percent of new electric-generating capacity through the year 2025 (DOE/EIA 2003a). Both technologies are designed primarily to supply peak and intermediate capacity, but combined-cycle technology can also be used to meet base-load requirements. Coal-fired plants are projected by EIA to account for approximately 31 percent of new capacity during this period. Coal-fired plants are generally used to meet base-load requirements. Renewable energy sources, primarily wind, geothermal, and municipal solid waste units, are projected by EIA to account for the remaining 5 percent of capacity additions. The EIA projections are based on the assumption that providers of new generating capacity will seek to minimize cost while meeting applicable environmental requirements. Combined-cycle plants are projected by EIA to have the lowest generation cost in 2010 and 2025. These costs are about equal to coal-fired plants and less than the cost of generation at wind farms (DOE/EIA 2004a).

EIA projects that oil-fired plants will account for very little new generation capacity in the United States through the year 2025 because of higher fuel costs and lower efficiencies (DOE/EIA 2004a).

EIA also projects that new nuclear power plants will not account for any new generation capacity in the United States through the year 2025 because natural-gas-fired and coal-fired plants are projected to be more economical (DOE/EIA 2004a). In spite of this projection, a new nuclear plant alternative for replacing power generated by ANO-2 is considered for reasons stated in Section 8.2.3. NRC established a New Reactor Licensing Project Office in 2001 to prepare for and manage future reactor and site licensing applications (NRC 2001a).

If an alternative generating technology were selected to replace power generated by ANO-2, the plant would be decommissioned. Environmental impacts associated with decommissioning are discussed in Section 8.1 and are not otherwise addressed in Section 8.2.

(a) In a combined-cycle unit, hot combustion gas in a combustion turbine rotates the turbine to generate electricity. The hot exhaust from the combustion turbine is routed through a heat-recovery boiler to make steam to generate additional electricity.

8.2.1 Coal-Fired Generation

Environmental impact information for a replacement coal-fired power plant using closed-cycle cooling with cooling towers is presented in Section 8.2.1.1 and using once-through cooling in Section 8.2.1.2.

The staff and Entergy assumed that it would take about 1000 megawatts electric (MW[e]) of coal-fired generation capacity to replace the approximately 1023 MW(e) output of ANO-2. The typical capacity (in MW[e]) and configuration used by the electric power industry in the application of coal-fired generation technology vary. For evaluation of the coal-fired generation alternative, Entergy used information from evaluations already conducted in the ANO-1 SEIS (NRC 2001b). Therefore, the coal-fired evaluation is based on information about the Delmarva Power and Light Company's Dorchester Power Plant and the South Carolina Electric and Gas Company's Cope Power Plant, with estimates adjusted appropriately to develop a representative alternative coal-fired plant (NRC 2001b).

Unless otherwise indicated, the assumptions and numerical values used in Section 8.2.1 are from the Entergy Environmental Report (ER) (Entergy 2003). The staff reviewed this information and compared it to environmental impact information in the GEIS. Although the OL renewal period is only 20 years, the impact of operating the coal-fired alternative for 40 years is considered (as a reasonable projection of the operating life of a coal-fired plant).

8.2.1.1 Closed-Cycle Cooling System

The overall impacts at an alternate greenfield site of the coal-fired generating system using a closed-cycle cooling system with cooling towers are discussed in the following sections. The magnitude of impacts for the alternate site will depend on the location of the particular site selected. ANO-2 currently uses a closed-cycle cooling system. For the purposes of comparison with an alternative site, it is assumed that the replacement coal-fired plant sited at an alternate site also would use a closed-cycle cooling system.

- **Land Use**

The GEIS estimates that approximately 700 ha (1700 ac) would be needed for a 1000-MW(e) coal-fired plant, which would amount to a considerable loss of natural habitat or agricultural land for the plant site alone, excluding that required for mining and other fuel-cycle impacts. Additional land might also be needed for transmission lines and rail lines, depending on the location of the site relative to the nearest intertie connection and rail spur. Entergy estimates that it would require 200 to 800 ha (500 to 2000 ac) of land. The staff's assessment is based on the 700 ha (1700 ac) that is defined in the GEIS, which is encompassed by Entergy's

estimate. Depending on the transmission line routing and nearest rail line, these alternatives could result in MODERATE to LARGE land-use impacts.

To supply cool for the plant, land-use changes would occur at a mining site of undetermined location. In the GEIS, the staff estimated that approximately 8900 ha (22,000 ac) would be affected for mining the coal and disposing of the waste to support a 1000-MW(e) coal-fired plant during its operational life (NRC 1996). Partially offsetting this offsite land use would be the elimination of the need for uranium mining and processing to supply fuel for ANO-2. In the GEIS, the staff estimated that approximately 400 ha (1000 ac) would be affected for mining and processing the uranium during the operating life of a 1000-MW(e) nuclear power plant (NRC 1996).

The impact of a coal-fired generating unit with a closed-cycle cooling system on land use located at an alternate site is considered as MODERATE to LARGE.

- **Ecology**

Constructing a coal-fired plant at an alternate site would alter ecological resources because of the need to convert roughly 700 ha (1700 ac) of land at the site to industrial use for plant, coal storage, and ash and scrubber sludge disposal. However, some of this land might have been previously disturbed.

Coal-fired generation at an alternative site would introduce construction impacts and new incremental operational impacts. Even assuming siting at a previously disturbed area, the impacts would alter the ecology. Impacts could include wildlife habitat loss, reduced productivity, habitat fragmentation, and a local reduction in biological diversity. Use of cooling makeup water from a nearby surface water body could have adverse impacts on aquatic resources. If needed, construction and maintenance of power transmission line and a rail spur would have ecological impacts. There would be some impact on terrestrial ecology from water drift from the cooling towers. Overall, the ecological impacts of constructing a coal-fired plant with a closed-cycle cooling system at an alternate site are considered to be MODERATE to LARGE and would be greater than renewal of the ANO-2 OL.

- **Water Use and Quality**

Surface water. Cooling water at an alternate site would likely be withdrawn from a surface water body and would be regulated by permit. Depending on the water source, the impacts of water use for cooling system makeup water and the effects on water quality caused by cooling tower blowdown could have noticeable impacts. Therefore, the staff considers the impacts of a new coal-fired plant utilizing a closed-cycle cooling system at an alternate site to be SMALL to MODERATE.

Groundwater. Impacts of groundwater withdrawal would be SMALL if only used for potable water. If groundwater is used to supply makeup water, then the impacts could be MODERATE to LARGE. Therefore, groundwater impacts from a coal-fired plant on the aquifer would be site-specific and dependent on aquifer recharge and other withdrawals. The overall impacts would be SMALL to LARGE.

- **Air Quality**

The air-quality impacts of coal-fired generation differ considerably from those of nuclear generation due to emissions of sulfur oxides (SO_x), nitrogen oxides (NO_x), particulates, carbon monoxide, hazardous air pollutants such as mercury, and naturally occurring radioactive materials.

A new coal-fired generating plant would likely need a prevention of significant deterioration permit and an operating permit under the Clean Air Act (42 USC 7401). The plant would need to comply with the new source performance standards for such plants set forth in 40 CFR Part 60, Subpart Da. The standards establish emission limits for particulate matter and opacity (40 CFR 60.42a), sulfur dioxide (SO_2) (40 CFR 60.43a), and NO_x (40 CFR 60.44a). The facility would be designed to meet Best Available Control Technology or Lowest Achievable Emissions Rate standards, as applicable, for control of criteria air emissions.

EPA has various regulatory requirements for visibility protection in 40 CFR Part 51, Subpart P, including a specific requirement for review of any new major stationary source in an area designated as attainment or unclassified for criteria pollutants under the Clean Air Act. All of the potential alternative power plant sites most likely will be located in areas that are designated as attainment or unclassified for criteria pollutants.

Section 169A of the Clean Air Act (42 USC 7401) establishes a national goal of preventing future, and remedying existing, impairment of visibility in mandatory Class I Federal areas when impairment is caused by air pollution that results from human activities. In addition, EPA regulations provide that, for each mandatory Class I Federal area located within a state, the state must establish goals that provide for reasonable progress toward achieving natural visibility conditions. The reasonable progress goals must provide for an improvement in visibility for the most-impaired days over the period of the implementation plan and ensure no degradation in visibility for the least-impaired days over the same period (40 CFR 51.308(d)(1)).

If a new coal-fired power station were located close to a mandatory Class 1 Federal area, additional air pollution control requirements could be imposed. The Caney Creek and Upper Buffalo Wilderness areas are the closest wilderness areas to Arkansas Nuclear One. These areas are designated in 40 CFR 81.404 as mandatory Class 1 Federal areas in which visibility is an important value. The Caney Creek Wilderness area is more than 161 km (100 mi) from

the Arkansas Nuclear One site and the Upper Buffalo Wilderness area is within 80 km (50 mi) of the site (NRC 2001b).

Filters and electrostatic precipitators (99.9 percent particulate removal efficiency), a wet lime/limestone flue gas desulfurization system (95 percent scrubber removal efficiency), and an operating factor of 83.9 percent would result in annual emissions of 120 MT of filterable particulates, 30 MT of particulate matter having a diameter of 10 microns or less (PM_{10}), and 1820 MT of SO_x. Carbon monoxide emissions would be approximately 580 MT per year (NRC 2001b).

Impacts for specific pollutants are as follows:

Sulfur oxides. A new coal-fired power plant would be subject to the requirements in Title IV of the Clean Air Act. Title IV was enacted to reduce emissions of SO_2 and NO_x, the two principal precursors of acid rain, by restricting emissions of these pollutants from power plants. Title IV caps aggregate annual power plant SO_2 emissions and imposes controls on SO_2 emissions through a system of marketable allowances. EPA issues one allowance for each ton of SO_2 that a unit is allowed to emit. New units do not receive allowances, but are required to have allowances to cover their SO_2 emissions. Owners of new units must therefore either acquire allowances from owners of other power plants by purchase or reduce SO_2 emissions at other power plants they own. Allowances can be banked for use in future years. Thus, a new coal-fired power plant would not add to net regional SO_2 emissions, although it might do so locally. Regardless, SO_2 emissions would be greater for the coal alternative than the OL renewal alternative because a nuclear power plant releases almost no SO_2 during normal operations.

Entergy estimates that using current SO_x emissions control technology, the total annual stack emissions would include approximately 1820 MT of SO_x, most of which would be SO_2. Additional reductions could become necessary. The acid rain provision of the Clean Air Act (Sections 403 and 404) capped the nation's SO_2 emissions from power plants. Under the Clean Air Act, affected fossil-fired steam units are allocated a number of SO_2 emission allowances. To achieve compliance, each utility must hold enough allowances to cover its SO_2 emissions annually or be subject to certain penalties. If the utility's SO_2 emissions are less than its annually allocated emission allowances, then the utility may bank the surplus allowances for future use. An SO_2 allowances market has been established for the buying and selling of allowances. Entergy may have to purchase additional allowances to operate a coal-fired alternative. Because of allowances, a major new combustion facility in Arkansas would not add SO_2 impacts on a regional basis, though it might do so locally (Entergy 2003).

Nitrogen oxides emissions. Section 407 of the Clean Air Act establishes technology-based emission limitations for NO_x emissions. The market-based allowance system used for SO_2

emissions is not used for NO_x emissions. A new coal-fired power plant would be subject to the new source performance standard for such plants at 40 CFR 60.44a(d)(1), which limits the discharge of any gases that contain NO_x (expressed as NO_2) to 200 ng/J of gross energy output (1.6 lb/MWh), based on a 30-day rolling average.

Entergy assumed that the coal-fired unit could be tangentially fired with dry-bottom boilers. This firing configuration was chosen because it would have moderate uncontrolled emissions of NO_x compared with other configurations. The NO_x emission controls would include low-NO_x burners, overfire air, and post-combustion selective catalytic reduction. The combination of low-NO_x burners and overfire air would achieve a NO_x reduction of 40 to 60 percent from uncontrolled levels. The combustion controls, along with selective catalytic reduction, can achieve the current upper limit of NO_x control (95 percent reduction). Based on an operating capacity factor of 83.9 percent, the resulting annual NO_x emissions would be approximately 850 MT (Entergy 2003). Regardless of the control technology, this level of NO_x emissions would be greater than the OL renewal alternative, because a nuclear power plant releases almost no NO_x during normal operations.

Particulate emissions. Entergy estimates that the total annual stack emissions would include 120 MT of filterable particulate matter and 30 MT of PM_{10}. In addition, coal-handling equipment would introduce fugitive particulate emissions (Entergy 2003). Particulate emissions would be greater under the coal alternative than the OL renewal alternative because a nuclear plant releases few particles during normal operations. During the construction of a coal-fired plant, fugitive dust would be generated. In addition, exhaust emissions would come from vehicles and motorized equipment used during construction. Emissions would be greater for the coal alternative than the OL renewal alternative because a nuclear power plant releases almost no particulates during normal operations.

Carbon monoxide emissions. Entergy estimates that total carbon monoxide emissions would be approximately 580 MT per year (Entergy 2003). This level of emissions is greater than the OL renewal alternative.

Hazardous air pollutants including mercury. In December 2000, EPA issued regulatory findings on emissions of hazardous air pollutants from electric utility steam-generating units (65 FR 79825). EPA determined that coal-fired and oil-fired electric utility steam-generating units are significant emitters of hazardous air pollutants. Coal-fired power plants were found by EPA to emit arsenic, beryllium, cadmium, chromium, dioxins, hydrogen chloride, hydrogen fluoride, lead, manganese, selenium, and mercury (65 FR 79825). EPA concluded that mercury is the hazardous air pollutant of greatest concern. EPA found that (1) there is a link between coal consumption and mercury emissions, (2) electric utility steam-generating units are the largest domestic source of mercury emissions, and (3) certain segments of the U.S. population (e.g., the developing fetus and subsistence fish-eating populations) are believed to

be at potential risk of adverse health effects due to mercury exposures resulting from consumption of contaminated fish (65 FR 79825). Accordingly, EPA added coal-fired and oil-fired electric utility steam-generating units to the list of source categories under Section 112(c) of the Clean Air Act for which emission standards for hazardous air pollutants will be issued (65 FR 79825).

Uranium and thorium. Coal contains uranium and thorium. Uranium concentrations are generally in the range of 1 to 10 parts per million. Thorium concentrations are generally about 2.5 times greater than uranium concentrations (Gabbard 1993). One estimate is that a typical coal-fired plant had an annual release of approximately 4.7 MT (5.2 tons) of uranium and 11.6 MT (12.8 tons) of thorium in 1982 (Gabbard 1993). The population dose equivalent from the uranium and thorium releases and daughter products produced by the decay of these isotopes has been calculated to be significantly higher than that from nuclear power plants (Gabbard 1993).

Carbon dioxide. A coal-fired plant would have unregulated carbon dioxide emissions that could contribute to global warming.

Summary. The GEIS analysis did not quantify emissions from coal-fired power plants but implied that air impacts would be substantial. The GEIS also mentioned global warming from unregulated carbon dioxide emissions and acid rain from SO_x and NO_x emissions as potential impacts (NRC 1996). Adverse human health effects such as cancer and emphysema have been associated with the products of coal combustion. There have been a number of studies showing cardiovascular and respiratory effects from air pollution caused by fossil fuel combustion as well. Although local air quality would noticeably be reduced from the presence of a coal plant, equivalent regional allowances for SO_2 emissions would have to be obtained, and credits to more than offset NO_x emissions by a ratio of 1.15:1.00 would also have to be obtained. Air-quality impacts from coal-fired generation at an alternate site are considered to be MODERATE. The impacts would be clearly noticeable, but would not destabilize air quality.

- **Waste**

Coal combustion generates waste in the form of ash, and equipment for controlling air pollution generates additional ash, spent catalyst used for NO_x reduction, and scrubber sludge. Total waste volume would be about 800,000 MT/yr of ash and scrubber sludge. Spent catalyst used for NO_x reduction would be regenerated or disposed of offsite. Construction-related debris would be generated during construction activities. Waste impacts to groundwater and surface water could extend beyond the operating life of the plant if leachate and runoff from the waste storage area occurs. Disposal of the waste could noticeably affect land use and groundwater quality, but with appropriate management and monitoring, it would not destabilize any

resources. After closure of the waste site and revegetation, the land could be available for some other uses.

In May 2000, EPA issued a "Notice of Regulatory Determination on Wastes from the Combustion of Fossil Fuels" (65 FR 32214). EPA concluded that some form of national regulation is warranted to address coal combustion waste products because (1) the composition of these wastes could present danger to human health and the environment under certain conditions, (2) EPA has identified 11 documented cases of proven damage to human health and the environment by improper management of these wastes in landfills and surface impoundments, (3) present disposal practices are such that, in 1995, these wastes were being managed in 40 percent to 70 percent of landfills and surface impoundments without reasonable controls in place, particularly in the area of groundwater monitoring, and (4) EPA identified gaps in state oversight of coal combustion wastes. Accordingly, EPA announced its intention to issue regulations for disposal of coal combustion waste under subtitle D of the Resource Conservation and Recovery Act (42 USC 6901).

For all of the preceding reasons, the impacts from waste generated by a coal-fired plant using once-through cooling at an alternate site are considered to be MODERATE; the impacts would be clearly noticeable but would not destabilize any important resource.

- **Human Health**

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

The staff stated in the GEIS that there could be human health impacts (cancer and emphysema) from inhalation of toxins and particulates from a coal-fired plant, but the GEIS does not identify the significance of these impacts (NRC 1996). In addition, the discharges of uranium and thorium from coal-fired plants can potentially produce radiological doses in excess of those arising from nuclear power plant operations (Gabbard 1993).

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

more quantitative data, human health impacts from radiological doses and inhaling toxins and particulates generated by a coal-fired plant at an alternate site are considered to be SMALL.

- **Socioeconomics**

If a coal-fired power plant were built at an alternate site to replace power produced by ANO-2, the communities around the site would experience the impact of ANO-2 operational job losses, and the Russellville School District and Pope County would lose the ANO-2 tax base. These losses would have MODERATE to LARGE socioeconomic impacts, because ANO-2, which is roughly half the tax base of the Arkansas Nuclear One site, provides more than 20 percent of the total revenue in Pope County and slightly over 25 percent of the total revenue in Russellville School District.

During construction of the new coal-fired plant, communities near the construction site would experience demands on housing and public services that could have a MODERATE to LARGE impact at an alternative site. After construction, the nearby communities would be impacted by the loss of construction jobs. Construction of the coal-fired alternative would take approximately 5 years. The peak workforce is estimated to range from 1200 to 2500 additional workers during the 5-year construction period, based on estimates given in the GEIS. Communities around the new site would have to absorb the impacts of a large, temporary workforce (up to 2500 workers at the peak of construction) and a permanent workforce of approximately 200 workers. The coal-fired plant would provide a new tax base for the local jurisdiction at an alternate site. The staff stated in the GEIS that socioeconomic impacts at a rural site would be larger than at an urban site because more of the peak construction workforce would need to move to the area to work (NRC 1996). Socioeconomic impacts at a rural site could be MODERATE to LARGE.

Transportation-related impacts associated with commuting construction workers at an alternate site are site-dependent but could be MODERATE to LARGE. Transportation impacts related to commuting of plant operating personnel would also be site-dependent, but can be characterized as SMALL to MODERATE, because by the end of construction, the local road network likely would have expanded to accommodate the much larger construction workforce.

Coal and lime/limestone would likely be delivered to the alternate site by rail or barge. Socioeconomic impacts associated with rail transportation would likely be SMALL to MODERATE. For example, there would be delays to highway traffic as trains pass, and there could be negative impacts on the value of property close to the train tracks. Barge delivery of coal and lime/limestone would likely have SMALL socioeconomic impacts.

Overall, the socioeconomic impacts of constructing and operating a coal-fired generating plant at an alternate site are considered to be MODERATE to LARGE depending on the alternate site location.

- **Aesthetics**

The two coal-fired power block units could be as much as 61 m (200 ft) high and be visible offsite during daylight hours. The exhaust stacks could be as much as 152 m (500 ft) high. The stacks would likely be highly visible in daylight hours for distances greater than 16 km (10 mi). Cooling towers and associated plumes would also have an aesthetic impact. Natural-draft cooling towers could be as much as 160 m (520 ft) high, and mechanical draft towers could be as much as 30 m (100 ft) high. The stacks would be visible from parks, other recreational areas, and wildlife refuges in the vicinity of the plant. The power block units and associated stacks and cooling towers would also be visible at night because of outside lighting. The Federal Aviation Administration (FAA) generally requires that all structures exceeding an overall height of 61 m (200 ft) above ground level have markings and/or lighting so as not to impair aviation safety (FAA 2000). Visual impacts of a new coal-fired plant could be mitigated by landscaping and color selection for buildings that is consistent with the environment. Visual impact at night could be mitigated by using the minimum level of lighting that meets FAA requirements and appropriate shielding. Overall, the coal-fired units and the associated exhaust stacks and cooling towers would likely have a MODERATE to LARGE aesthetic impact. There would also be an aesthetic impact that could be LARGE if construction of a new electric power transmission line is needed.

Coal-fired generation would introduce mechanical sources of noise that would be audible offsite. Sources contributing to the noise produced by plant operation are classified as continuous or intermittent. Continuous sources include the mechanical equipment associated with normal plant operations and mechanical draft cooling towers. Intermittent sources include the equipment related to coal handling, solid waste disposal, and transportation related to coal and lime/limestone delivery; use of outside loudspeakers; and traffic during commuting times. Noise impacts associated with rail delivery of coal and lime/limestone would be most significant for residents living in the vicinity of the facility and along the rail route. Although sounds from passing trains significantly increases noise levels near the rail corridor, the short duration of the noise reduces the impact. Nevertheless, given the frequency of train transport and the fact that many people are likely to be within hearing distance of the rail route, the impacts of noise on residents in the vicinity of the facility and the rail line is considered MODERATE. Noise associated with barge transportation of coal and lime/limestone would not be significant. Noise and light from the plant would be detectable offsite. Aesthetic impacts at the plant site would be mitigated if the plant were located in an industrial area or adjacent to other power plants.

Overall, the aesthetic impacts associated with locating a coal-fired plant with a closed-cycle cooling system at an alternate site are considered to be MODERATE to LARGE.

- **Historic and Archaeological Resources**

An inventory of historic and archaeological resources would likely be needed for any onsite property that has not been previously surveyed. Other lands, if any, that are acquired to support the plant would also likely need an inventory of field cultural resources, identification and recording of existing historic and archaeological resources, and possible mitigation of adverse effects from subsequent ground-disturbing actions related to physical expansion of the plant site.

Before construction, studies would likely be needed to identify, evaluate, and address mitigation of the potential impacts of new plant construction on historic and archaeological resources. The studies would likely be needed for all areas of potential disturbance at the proposed plant site and along associated rights-of-way where new construction would occur (e.g., roads, transmission lines, rail lines, or other rights-of-way). Historic and archaeological resource impacts can generally be effectively managed or mitigated to some extent. Therefore, the impacts of a new coal-fired plant at an alternate site would be SMALL.

- **Environmental Justice**

Closure of ANO-2 would result in the loss of approximately 630 operating jobs (half of the total number of jobs at the Arkansas Nuclear One site). Resulting economic conditions could reduce employment prospects for minority or low-income populations. Pope County would also experience a loss of property tax revenue, which could affect its ability to provide services and programs. However, these losses would likely have SMALL to MODERATE environmental justice impacts given the large proportion of the tax base in Pope County attributable to ANO-2 (Section 2.2.8.6).

Environmental impacts on minority and low-income populations associated with a replacement coal-fired plant built at an alternate site would depend upon the site chosen and the nearby population distribution. Some impacts on housing availability and prices during construction might occur, and this could disproportionately affect minority and low-income populations. Therefore, impacts of a new coal-fired plant at an alternate site are considered to be SMALL to LARGE because of the potential for disproportional impacts on minority or low-income populations, depending on the site.

- **Summary**

The potential impacts of replacing the power produced by ANO-2 with a coal-fired generating plant with a closed-cycle cooling system are summarized in Table 8-2.

Table 8-2. Summary of Environmental Impacts of Coal-Fired Generation Using Closed-Cycle Cooling at an Alternate Greenfield Site in the Entergy Service Area

Impact Category	Impact	Comments
Land Use	MODERATE to LARGE	Approximately 200 to 800 ha (500 to 2000 ac), including transmission lines and rail line for coal delivery (Entergy estimate).
Ecology	MODERATE to LARGE	Impact will depend on ecology of site.
Water Use and Quality		
Surface Water	SMALL to MODERATE	Impact will depend on volume and other characteristics of the water source.
Groundwater	SMALL to LARGE	Impact will depend on site characteristics and availability of groundwater.
Air Quality	MODERATE	Sulfur oxides • 1820 MT/yr • allowances required Nitrogen oxides • 850 MT/yr • allowances required Particulate • 120 MT/yr (filterable) • 30 MT/yr (unfilterable) Carbon monoxide • 580 MT/yr Trace amounts of mercury, arsenic, chromium, beryllium, and selenium
Waste	MODERATE	Total waste volume would be about 800,000 MT/yr of ash and scrubber sludge.
Human Health	SMALL	Impacts considered minor.
Socioeconomics	MODERATE to LARGE	Communities would have to absorb impacts of a large, temporary workforce (up to 2500 workers at the peak of construction) and a permanent workforce of approximately 200 workers. Impacts at a rural site would be larger. Pope County would lose part of Arkansas Nuclear One site employment and tax base. Transportation-related impacts associated with commuting construction workers would be site-specific.

Table 8-2. (contd)

Impact Category	Impact	Comments
Aesthetics	MODERATE to LARGE	Could reduce aesthetic impact if siting is in an industrial area; impact would be LARGE if siting is largely in an undeveloped area.
Historic and Archaeological Resources	SMALL	Alternate location would necessitate cultural resource studies. Impacts can generally be managed or mitigated.
Environmental Justice	SMALL to LARGE	Impacts at alternate site vary depending on population distribution and characteristics at site. Pope County would lose tax revenue and jobs, with SMALL to MODERATE impacts on minority and low-income populations.

8.2.1.2 Once-Through Cooling System

The environmental impacts of constructing a coal-fired generation system at an alternate greenfield site using once-through cooling are similar to the impacts for a coal-fired plant using a closed-cycle cooling system. However, there are some environmental differences between the closed-cycle and once-through cooling systems. Table 8-3 summarizes the incremental differences.

Table 8-3. Summary of Environmental Impacts of Coal-Fired Generation with Once-Through Cooling at an Alternate Greenfield Site in the Entergy Service Area

Impact Category	Impact	Comments
Land Use	MODERATE to LARGE	Compared with a closed-cycle cooling system, 10 to 12 ha (25 to 30 ac) less land would be required because cooling towers and associated infrastructure are not needed.
Ecology	MODERATE to LARGE	Slightly reduced environmental impacts because there are no cooling towers; however, increased water withdrawal may impact aquatic resources.
Water Use and Quality		
Surface Water	SMALL to MODERATE	Impact would depend on the characteristics of the surface water body, volume of water withdrawn, and characteristics of the discharge.

Table 8-3. (contd)

Impact Category	Impact	Comments
Groundwater	SMALL to LARGE	Impact would depend on site characteristics and availability of groundwater. It is unlikely that groundwater would be used for once-through cooling, but could be used for sanitary water.
Air Quality	MODERATE	No change
Waste	MODERATE	No change
Human Health	SMALL	No change
Socioeconomics	MODERATE to LARGE	No change
Aesthetics	SMALL to MODERATE	Reduced aesthetic impact because cooling towers would not be used.
Historic and Archaeological Resources	SMALL	Less land impacted
Environmental Justice	SMALL to LARGE	No change

8.2.2 Natural-Gas-Fired Generation

Entergy assumed that a replacement natural-gas-fired plant would use combined-cycle technology. In the combined-cycle unit, hot combustion gases in a combustion turbine rotate the turbine to generate electricity. Waste combustion heat from the combustion turbine is routed through a heat-recovery steam generator to generate additional electricity. The sizes, types, and configurations of natural-gas-fired generation units currently operational in the United States vary and include single-cycle combustion and combined-cycle units that range in size from 25 to 600 MW(e). As with coal-fired technology, multiple units may be configured and combined at one location to produce the desired amount of megawatts, and construction can be phased to meet electrical power needs (NRC 2001b).

Providing 1000 MW(e) of replacement power with a combined-cycle system would require 45 ha (110 ac) of land. Natural gas typically has an average heating value of 3.7×10^7 Joules/cubic meter (J/m^3) (1000 British thermal units/cubic foot [Btu/ft^3]), and it would be the primary fuel; the natural-gas-fired alternative plant would burn approximately 1.24 $J/m^3/s$ (100 billion ft^3/yr) (NRC 2001b).

As a surrogate for a similar-sized natural-gas-fired alternative plant, Entergy used Baltimore Gas and Electric's Perryman Power Plant and Polk Power Plant described in the ANO-1 SEIS (NRC 2001b). The ANO-1 SEIS assumed that each unit would be less than 30 m (100 ft) high

and would be designed with dry, low-NO_x combustors, water injection, and selective catalytic reduction. Each unit would exhaust through a 70-m (230-ft) stack after passing through heat-recovery steam generators. This stack height is consistent with EPA regulations (40 CFR 51.100), which address requirements for determining the stack height of new emission sources (NRC 2001b).

The surrogate natural-gas-fired generation plant described in the ANO-1 SEIS was used to measure the impacts of replacing the 1023-MW(e) generating capacity of ANO-2. Natural gas would have to be delivered via pipeline. Reliant and Ozark are the two nearest natural gas pipelines, located approximately 8 km (5 mi) from the ANO-2 site. Construction cost of installing a gas line has been estimated to be an average of approximately $1 million per mile. To the degree the existing right-of-way could be used, the level of impact could be reduced (NRC 2001b).

Unless otherwise indicated, the assumptions and numerical values used throughout this section are from the Entergy ER. The staff reviewed this information and compared it to environmental impact information in the GEIS. Although the license renewal term is only 20 years, the impact of operating the natural-gas-fired alternative for 40 years is considered a reasonable projection of the operating life of a natural-gas-fired plant.

The impacts of a plant with a closed-cycle cooling system with cooling towers are discussed in Section 8.2.2.1, and the impacts of a plant with once-through cooling are discussed in Section 8.2.2.2.

8.2.2.1 Closed-Cycle Cooling System

The overall impacts of the natural-gas-generating system with a closed-cycle cooling system located at the Arkansas Nuclear One site or an alternate site are summarized in Table 8-4 and discussed in the following sections. The magnitude of impacts at an alternate site will depend on the location of the particular site selected.

- **Land Use**

Natural-gas-fired generation at the ANO-2 site would require converting the existing industrial site to a gas plant. Almost all the converted land would be used for the power block. Additional land would be disturbed during pipeline construction. Some additional land would also be required for backup oil storage tanks. Natural-gas-fired generation land-use impacts at the existing ANO-2 site are SMALL to MODERATE; the impacts could noticeably alter the habitat but would not destabilize important attributes of the resource. The difficulties of operating a

Table 8-4. Summary of Environmental Impacts of Natural-Gas-Fired Generation Using Closed-Cycle Cooling at the Existing Arkansas Nuclear One, Unit 2 Site or at an Alternate Greenfield Site in the Entergy Service Area

	Existing ANO-2 Site		Alternate Site	
Impact Category	**Impact**	**Comments**	**Impact**	**Comments**
Land Use	SMALL to MODERATE	Approximately 24 ha (60 ac) required for power block. 60 ha (150 ac) would be disturbed for pipeline construction. Additional land needed for backup oil storage tanks.	SMALL to MODERATE	Up to 200 ha (500 ac) required for site, pipelines, transmission line connection; additional land needed for backup oil storage tanks.
Ecology	MODERATE	Constructed on land within the existing site. Possible significant habitat loss because of pipeline construction.	SMALL to MODERATE	Impact depends on location and ecology of site; potential habitat loss and fragmentation; reduced productivity and biological diversity.
Water Use and Quality				
Surface Water	SMALL	Uses existing intake and discharge structures and cooling system.	SMALL to MODERATE	Impact depends on volume and characteristics of receiving water body.
Groundwater	SMALL	ANO-2 does not use groundwater, nor is a replacement facility expected to use groundwater during license renewal period.	SMALL to LARGE	Groundwater impacts would depend on uses and available supply.
Air Quality	MODERATE	Primarily NO_x. Impacts could be noticeable but not destabilizing. Plant would emit SO_x, NO_x, carbon monoxide, PM_{10} particulates, and some hazardous air pollutants.	MODERATE	Same impacts as existing site
Waste	SMALL	Small amount of ash produced	SMALL	Same impacts as existing site
Human Health	SMALL	Impacts considered minor	SMALL	Same impacts as existing site
Socioeconomics	SMALL to MODERATE	500 to 700 additional workers needed during 3-year construction period, followed by reduction from current Arkansas Nuclear One workforce. Tax base partially preserved. Daily commuting by 500 to 700 additional workers during 3-year construction period (MODERATE impact), followed by reduction from current workforce to 100 workers (SMALL during operations).	MODERATE to LARGE	Construction impacts would be relocated. Community near Arkansas Nuclear One would still experience workforce reduction. Pope County would lose ANO-2 tax base. Daily commuting by 500 to 700 additional workers during 3-year construction period (MODERATE impact), followed by reduction from current workforce to 100 workers (SMALL during operations).

Table 8-4. (contd)

	Existing ANO-2 Site		Alternate Site	
Impact Category	**Impact**	**Comments**	**Impact**	**Comments**
Aesthetics	SMALL to MODERATE	Visual impact of stacks and equipment would be noticeable, but not as significant as coal option.	SMALL to LARGE	Alternate location could reduce aesthetic impact if siting is in an industrial area.
Historic and Archaeological Resources	SMALL	Only previously disturbed and adjacent areas would be affected.	SMALL	Alternate location would necessitate cultural resource studies.
Environmental Justice	SMALL to MODERATE	Pope County would lose tax revenue and jobs, with SMALL to MODERATE impacts on minority and low-income populations.	SMALL to MODERATE	Impacts at alternate site vary depending on population distribution and makeup at site. Pope County would lose tax revenue and jobs, with SMALL to MODERATE impacts on minority and low-income populations.

natural-gas-fired plant and the remaining nuclear unit (ANO-1) at the same site are expected to be less than with a coal-fired plant because of the much smaller "footprint" of a natural-gas-fired plant (NRC 2001b).

In addition to the land required for the natural-gas-fired plant, construction at a greenfield site would impact approximately 8 to 20 ha (20 to 50 ac) for offices, roads, parking areas, and a switchyard. The Entergy ER assumed that the power block would require 24 ha (60 ac). Some additional land would also be required for backup oil storage. In addition, Entergy assumed that another 172 ha (424 ac) would be necessary for transmission lines (assuming the plant is sited 16 km (10 mi) from the nearest intertie connection) although this would depend on the actual plant location. Plants of this type are usually built very close to existing natural gas pipelines. Including the land required for pipeline construction, an alternate site would require approximately 200 ha (500 ac). Depending on the transmission line routing, the alternate site could result in SMALL to MODERATE land-use impacts (NRC 2001b).

The GEIS estimated that land-use requirements for a 1000-MW natural-gas-fired plant (which would be just 2 percent smaller than required to replace ANO-2) at an alternate site would be SMALL (approximately 45 ha [110 ac] for the plant site), and that co-locating with a retired nuclear plant would reduce these impacts. Therefore, the impacts would be SMALL to MODERATE, depending on the length and routing of required pipelines and transmission lines (NRC 2001b).

Partially offsetting these offsite land requirements would be the elimination of the need for uranium mining and processing to supply fuel for ANO-2. NRC staff stated in the GEIS (NRC 1996) that approximately 400 ha (1000 ac) would be affected for mining and processing the uranium during the operating life of a 1000-MW(e) nuclear power plant. However, there would be some impacts associated with developing new natural gas generating capacity.

Overall, land-use impacts for a natural-gas-fired plant with a closed-cycle cooling system at the ANO-2 site are considered SMALL to MODERATE, and the impacts to land use of a new natural-gas-fired plant with a closed-cycle cooling system located at an alternate site are considered to be SMALL to MODERATE.

- **Ecology**

Siting natural-gas-fired generation at the existing ANO-2 site would have MODERATE ecological impacts because the facility would be constructed partly on previously disturbed areas and would disturb relatively little acreage at the site. However, significant habitat would be disturbed by approximately 8 km (5 mi) of pipeline construction. Ecological impacts could be reduced by using the existing intake and discharge system. Past operational monitoring of the effects of closed-cycle cooling at ANO-2 has not shown significant negative impacts to the ecology of Lake Dardanelle, and this would be expected to remain unchanged (NRC 2001b).

The GEIS noted that land-dependent ecological impacts from construction would be SMALL unless site-specific factors indicate a particular sensitivity and that operational impact would be smaller than for other fossil fuel technologies of equal capacity. The ANO-1 SEIS (NRC 2001b) identified the gas pipeline as a site-specific factor that would make the natural-gas-fired alternative's ecological impacts larger than those of license renewal. Therefore, in this case, the appropriate characterization of natural-gas-fired-generation ecological impacts at the existing Arkansas Nuclear One site is MODERATE (NRC 2001b).

Construction at an alternate site could alter the ecology of the site and could impact threatened and endangered species and result in wildlife habitat loss and reduced productivity, habitat fragmentation, and a local reduction in biological diversity. Intake and discharge of cooling system makeup water could impact aquatic resources. There would be ecological impacts related to habitat loss and cooling tower drift associated with siting of the natural-gas-fired plant. If a new underground gas pipeline and/or power transmission line to the site were needed, there would also be temporary ecological impacts associated with bringing them to the site. Ecological impacts would depend on the amount and nature of the land converted for the plant. These ecological impacts could be SMALL to MODERATE (NRC 2001b).

Because it would use existing site land areas and infrastructure but would require a new branch pipeline, a new natural-gas-fired plant with closed-cycle cooling at the ANO-2 site is considered

to have a MODERATE impact on ecological resources. A new natural-gas-fired plant with closed-cycle cooling at an alternate site will have SMALL to MODERATE impacts on ecological resources.

- **Water Use and Quality**

Surface Water. A replacement natural-gas-fired plant would use the existing ANO-2 intake and discharge structures as part of a closed-cycle cooling system; therefore, water quality impacts would continue to be SMALL. Plant discharges would consist mostly of cooling tower blowdown, characterized primarily by an increased temperature and concentration of dissolved solids relative to the receiving water body and intermittent low concentrations of biocides (e.g., chlorine). Treated process waste streams and sanitary waste water may also be discharged. All discharges would be regulated by the State of Arkansas through a National Pollutant Discharge Elimination System permit. There would be a consumptive use of water resulting from evaporation from the cooling towers. Some erosion and sedimentation would likely occur during construction (NRC 1996). The GEIS categorized water-quality impacts from sedimentation as SMALL. The GEIS also noted that operational water-quality impacts would be similar to, or less than, those from other centralized generating technologies. The NRC concluded that water-quality impacts from coal-fired generation would be SMALL and water use at a natural-gas-fired alternative would be less than that for coal-fired generation. Surface water impacts would remain SMALL; the impacts would not be detectable or would be so minor that they would not noticeably alter important attributes of the resource (NRC 2001b).

For alternate sites, the impact on surface water would depend on the volume and other characteristics of the receiving body of water. Cooling water at an alternate site would likely be withdrawn from a surface water body and would be regulated by permit. Depending on the source water body, the impacts of water use for cooling system makeup water and the effects on water quality due to cooling tower blowdown could have noticeable impacts. The impacts would be SMALL to MODERATE (NRC 2001b).

Groundwater. ANO-2 does not use groundwater, and it is unlikely that a replacement natural-gas-fired plant would do so. Therefore, groundwater impacts at the Arkansas Nuclear One site would be SMALL; the impacts would be so minor that they would not noticeably alter any important attribute of the groundwater resource. For alternate sites, the impact to the groundwater would depend on the volume of groundwater withdrawn and the site characteristics, including the amount of groundwater available. Groundwater withdrawal could require a permit. The impacts would be SMALL to LARGE (NRC 2001b).

- **Air Quality**

Natural gas is a relatively clean-burning fuel. The natural-gas-fired alternative would release similar types of emissions but in lesser quantities than the coal-fired alternative. Because ANO-2 is not in a nonattainment area for ozone, air quality impacts of natural-gas-fired generation would not be of concern. The GEIS noted that air quality impacts resulting from the alternative natural-gas-fired power plant would be less than other fossil technologies because fewer pollutants are emitted and SO_2 is not emitted. Emission levels from the natural-gas-fired alternative would be less than emission levels from the coal-fired alternative. However, the natural-gas-fired alternative would contribute NO_x emissions to an area that in the future may become a nonattainment area for ozone. Because NO_x contributes to ozone formation, the NO_x emissions are still of future concern, and low NO_x combustors, water injection, and spent catalyst reduction could be mitigation measures required by regulatory agencies (NRC 2001b).

A new natural-gas-fired generating plant would likely need a prevention of significant deterioration permit and an operating permit under the Clean Air Act. A new combined-cycle, natural-gas-fired power plant would also be subject to the new source performance standards for such units specified in 40 CFR Part 60, Subparts Da and GG. These regulations establish emission limits for particulates, opacity, SO_2, and NO_x. The facility would be designed to meet Best Available Control Technology or Lowest Achievable Emissions Rate standards, as applicable, for control of criteria air emissions.

Section 169A of the Clean Air Act establishes a national goal of preventing future impairment of visibility and remedying existing impairment of visibility in mandatory Class I Federal areas when impairment results from air pollution created by human activities. In addition, EPA regulations provide that for each mandatory Class I Federal area located within a state, the state must establish goals that provide for reasonable progress towards achieving natural visibility conditions. The reasonable progress goals must provide for an improvement in visibility for the most-impaired days over the period of the implementation plan and ensure no degradation in visibility for the least-impaired days over the same period (40 CFR 51.308(d)(1)). There is a Class 1 Federal area located within 80 km (50 mi) of the Arkansas Nuclear One site and an additional area more than 161 km (100 mi) away.

Entergy did not provide quantitative estimates of air emissions from a natural-gas-fired plant equipped with appropriate pollution control technology. However, it is known from the GEIS that such emissions are generally much less than from an equivalent-capacity coal-fired plant. A natural-gas-fired power plant would emit SO_x, NO_x, carbon monoxide, and PM_{10} particulates. A natural-gas-fired plant would also have unregulated carbon dioxide emissions that could contribute to global warming, although less than a coal-fired plant. During December 2000, EPA issued regulatory findings on emissions of hazardous air pollutants from electric utility steam-generating units (65 FR 79825). Natural-gas-fired power plants were found by EPA to

emit arsenic, formaldehyde, and nickel (65 FR 79825). Unlike coal- and oil-fired plants, EPA did not determine that regulation of emissions of hazardous air pollutants from natural-gas-fired power plants should be regulated under Section 112 of the Clean Air Act.

Construction activities would result in temporary fugitive dust. Exhaust emissions would also come from vehicles and motorized equipment used during the construction process.

For these reasons, the appropriate characterization of air impacts from a natural-gas-fired plant would be MODERATE; the impacts, primarily NO_x, would be clearly noticeable but would not be sufficient to destabilize air resources as a whole (NRC 2001b).

Siting the natural-gas-fired plant elsewhere would not significantly change air-quality impacts because the alternate site could be in an area that is not a serious nonattainment area for ozone. In addition, more or less stringent pollution control equipment could be installed to meet the regulations. Therefore, the impacts would be MODERATE (NRC 2001b)

- **Waste**

There are only small amounts of solid waste products (i.e., ash) from burning natural gas. Combustion of natural gas results in few by-products because of the clean nature of the fuel. The GEIS concluded that waste generation from natural-gas-fired technology would be minimal (NRC 1996). Other than spent catalyst used for NO_x reduction, waste generation at an operating natural-gas-fired plant would be largely limited to typical office wastes. Construction-related debris would be generated during construction activities. This impact would be SMALL; waste generation impacts would be so minor that they would not noticeably alter important resource attributes (NRC 2001b).

Siting the facility at an alternate site would not alter the waste generation; therefore, the impacts would continue to be SMALL (NRC 2001b).

- **Human Health**

In the GEIS, the staff identified cancer and emphysema as potential health risks from natural-gas-fired plants (NRC 1996). The risk may be attributable to NO_x emissions that contribute to ozone formation, which in turn contributes to health risks.

As discussed in Section 8.2.1.1 for the coal-fired alternative, legislative and regulatory control of the nation's emissions and air quality are protective of human health, and the human health impacts from natural-gas-fired generation would be SMALL: human health effects would not be detectable or would be so minor that they would neither destabilize nor noticeably alter important attributes of the resource (NRC 2001b).

Siting of the facility at an alternate greenfield site would not alter the possible human health effects. Therefore, the impacts would be SMALL (NRC 2001b).

- **Socioeconomics**

The staff assumed that natural-gas-fired plant construction would take place while ANO-2 continues operation, with completion of the replacement plant timed to coincide with the end of operations for the nuclear plant. The natural-gas-fired alternative would take much less time to construct than other alternative plants. According to the GEIS, a 1000-MW(e) plant would take a peak of up to about 1200 workers (fewer most of the time) and about 3 years to construct (NRC 1996), but Entergy assumed that the construction workforce would be smaller, about 500 to 700 workers (Entergy 2003). During construction, the surrounding communities would experience demands on housing and public services that could have MODERATE impacts. After construction, the communities would be impacted by the loss of jobs, construction workers would leave, the ANO-2 workforce would decline through a decommissioning period to a minimal maintenance size, and the natural-gas-fired plant would introduce a replacement tax base and about 100 new jobs (NRC 2001b).

The GEIS concluded that socioeconomic impacts from constructing a natural-gas-fired plant would not be very noticeable and that the small operational workforce would have the lowest socioeconomic impacts (local purchases and taxes) of nonrenewable technologies. Compared to the coal-fired and nuclear alternatives, the smaller size of the construction workforce, the shorter construction time frame, and the smaller size of the operations workforce would reduce some of the socioeconomic impacts. For these reasons, the socioeconomic impacts of natural-gas-fired generation would be SMALL to MODERATE. Depending on other growth in the area, socioeconomic effects could be noticed, but they would not destabilize important attributes of the resource (NRC 2001b).

Construction at an alternate site would relocate, but not eliminate, some socioeconomic impacts. The community around the site would still experience the impact of the loss of ANO-2 operational jobs and the tax base. The communities around the new site would have to absorb the impacts of a temporary workforce and a small permanent workforce. Therefore, the impacts would be MODERATE to LARGE, based on net job and tax-base losses in the area. This impact is about the same in the area as for the no-action alternative (NRC 2001b).

In the GEIS, the staff concluded that socioeconomic impacts from constructing a natural-gas-fired plant would not be very noticeable and that the small operational workforce would have the lowest socioeconomic impacts of any nonrenewable technology (NRC 1996).

Transportation impacts associated with construction personnel commuting to the plant site would depend on the population density and transportation infrastructure in the vicinity of the

site. The impacts can be classified as MODERATE. Impacts associated with operating personnel commuting to the plant site would be SMALL.

Overall, socioeconomic impacts resulting from construction of a natural-gas-fired plant at the ANO-2 site would be SMALL to MODERATE, but the impacts would be MODERATE to LARGE (including impacts in Pope County) if the replacement plant were built elsewhere.

- **Aesthetics**

The combustion turbines and heat-recovery boilers would be relatively low structures and would be screened from most offsite vantage points by woodlands. The taller steam turbine building (approximately 30 m [100 ft] in height) and the exhaust stacks (approximately 70 m [230 ft] in height) would be visible offsite (NRC 2001b).

The GEIS analysis noted that land-related impacts, such as aesthetic impacts, would be SMALL unless site-specific factors indicate a particular sensitivity. As in the case of the coal-fired alternative, aesthetic impacts from the natural-gas-fired alternative would be noticeable. However, because structures associated with natural-gas-fired power plant are shorter than structures for coal-fired plants and are more amenable to screening by vegetation, it was determined that the aesthetic resources would not be destabilized by the natural-gas-fired alternative. For these reasons, aesthetic impacts from a natural-gas-fired plant would be SMALL to MODERATE; the impacts would be clearly noticeable, but would not destabilize this important resource (NRC 2001b).

Alternate locations could reduce the aesthetic impact of natural-gas-fired generation if siting was in an area that was already industrialized. In such a case, however, the introduction of the steam generator building, stacks, and cooling tower plumes would probably still have a SMALL to MODERATE incremental impact (NRC 2001b). If a new electric power transmission line were needed, the aesthetic impact at an alternate site could be LARGE. Aesthetic impacts would be mitigated if the plant were located in an industrial area adjacent to other power plants. Overall, the aesthetic impacts associated with a replacement natural-gas-fired plant with a closed-cycle cooling system at an alternate site can be categorized as SMALL to LARGE, with site-specific factors determining the final categorization.

- **Historic and Archaeological Resources**

The GEIS analysis noted, as for the coal-fired alternative, that cultural resource impacts of the natural-gas-fired alternative would be SMALL unless important site-specific resources were affected. Construction of a natural-gas-fired alternative at the existing ANO-2 site would affect a smaller area within the footprint of the coal-fired alternative. As discussed in Section 8.2.1.1 of this SEIS, site knowledge minimizes the possibility of cultural resource impacts. Cultural

resource impacts would be SMALL; that is, cultural resource impacts would not be detectable or would be so minor that they would neither destabilize nor noticeably alter important attributes of the resource (NRC 2001b).

An inventory of historic and archaeological resources would likely be needed for any onsite property that has not been previously surveyed. Other lands, if any, that are acquired to support the plant would also likely need an inventory of field resources, identification and recording of existing historic and archaeological resources, and possible mitigation of adverse effects from subsequent ground-disturbing actions related to physical expansion of the plant site.

Before construction, studies would likely be needed to identify, evaluate, and address mitigation of the potential impacts of new plant construction on historic and archaeological resources. The studies would likely be needed for all areas of potential disturbance at the proposed plant site and along associated rights-of-way where new construction would occur (e.g., studies in rights-of-way for new roads, transmission lines, and pipelines).

Impacts to historic and archaeological resources can be managed and mitigated to a certain extent under current laws and regulations. Therefore, impacts to historical and archaeological resources from a natural-gas-fired plant at the existing ANO-2 site are considered to be SMALL.

Construction at an alternate site could necessitate instituting cultural resource preservation measures, but impacts could generally be managed and maintained as SMALL. Surveys of historic and archaeological resources would be required prior to pipeline construction and for other areas associated with this alternative where ground would be disturbed (NRC 2001b).

- **Environmental Justice**

Environmental impacts on minority and low-income populations associated with a replacement natural-gas-fired plant built at an alternate site would depend upon the site chosen and the nearby population distribution. Some impacts on housing availability and prices during construction might occur, and this could disproportionately affect minority and low-income populations. Closure of ANO-2 would result in the loss of approximately 600 operating jobs (half those at the Arkansas Nuclear One site), only about 100 of which would be replaced. Resulting economic conditions could reduce employment prospects for minority or low-income populations in the area encompassed by Pope, Johnson, and Yell Counties. Pope County would also experience a loss of property tax revenue, which could affect its ability to provide services and programs. These losses would likely have SMALL to MODERATE environmental justice impacts, given the large proportion of the tax base in Pope County attributable to

ANO-2. Overall, impacts of a new natural-gas-fired plant at either the Arkansas Nuclear One site or an alternate site are considered to be SMALL to MODERATE.

8.2.2.2 Once-Through Cooling System

The environmental impacts of constructing a natural-gas-fired generation system at an alternate site using a once-through cooling system are similar to the impacts for a natural-gas-fired plant using closed-cycle cooling with cooling towers. However, there are some environmental differences between the closed-cycle and once-through cooling systems. Table 8-5 summarizes the incremental differences.

8.2.3 Nuclear Power Generation

Since 1997, NRC has certified three new standard designs for nuclear power plants under 10 CFR Part 52, Subpart B: (1) the U.S. Advanced Boiling Water Reactor (10 CFR Part 52, Appendix A), (2) the System 80+ Design (10 CFR Part 52, Appendix B), and (3) the AP600 Design (10 CFR Part 52, Appendix C). All of these plants are light-water reactors. Although no applications for a construction permit or a combined license based on these certified designs have been submitted to the NRC, the submission of the design certification applications indicates continuing interest in the possibility of licensing new nuclear power plants. Recent volatility in prices of natural gas and electricity has made new nuclear power plant construction more attractive from a cost standpoint. Additionally, System Energy Resources, Inc.; Exelon Generation Company, LLC; and Dominion Nuclear North Anna, LLC have recently submitted applications for early site permits for new advanced nuclear power plants under the procedures in 10 CFR Part 52, Subpart A (SERI 2003; Dominion 2003; Exelon 2003). Therefore, construction of a new nuclear power plant, either at the ANO-2 site or at an alternate site using both closed- and open-cycle cooling is considered in this section. The staff assumed that the new nuclear plant would have a 40-year operating life.

The NRC has summarized environmental data associated with the uranium fuel cycle in Table S-3 of 10 CFR 51.51. The impacts shown in Table S-3 are representative of the impacts that would be associated with a replacement nuclear power plant built to one of the certified designs. The impacts shown in Table S-3 are for a 1000-MW(e) reactor and would need to be adjusted slightly to reflect replacement of ANO-2, which has a capacity of 1023 MW(e). The environmental impacts associated with transporting fuel and waste to and from a light-water nuclear power reactor are summarized in Table S-4 of 10 CFR 51.52. The summary of NRC's findings on NEPA issues for license renewal of nuclear power plants in Table B-1 of 10 CFR Part 51, Subpart A, Appendix B, is also relevant, although not directly applicable, for consideration of environmental impacts associated with the operation of a replacement nuclear power plant. Additional environmental impact information for a replacement nuclear power plant using

closed-cycle cooling with cooling towers or once-through cooling is presented in Section 8.2.3.1 and Section 8.2.3.2, respectively.

Table 8-5. Summary of Environmental Impacts of Natural-Gas-Fired Generation with Once-Through Cooling at the Existing Arkansas Nuclear One, Unit 2 Site or at an Alternate Greenfield Site in the Entergy Service Area

	Existing ANO-2 Site		Alternate Site	
Impact Category	**Impact**	**Comparison with Closed-Cycle Cooling System**	**Impact**	**Comparison with Closed-Cycle Cooling System**
Land Use	SMALL to MODERATE	10 to 12 ha (25 to 30 ac) less land required because cooling towers and associated infrastructure are not needed.	SMALL to MODERATE	10 to 12 ha (25 to 30 ac) less land required because cooling towers and associated infrastructure are not needed.
Ecology	SMALL	Less terrestrial habitat lost and cooling tower effects eliminated. Increased water withdrawal, but aquatic impact would be similar to current ANO-2 operations.	SMALL to MODERATE	Impact would depend on ecology at the site. No impact to terrestrial ecology from cooling tower drift. Increased water withdrawal and possible greater impact to aquatic ecology.
Water Use and Quality				
Surface Water	SMALL	No discharge of cooling tower blowdown containing dissolved solids. Increased water withdrawal would be insignificant to Lake Dardanelle.	SMALL to MODERATE	No discharge of cooling tower blowdown. Increased water withdrawal and more thermal load on receiving body of water.
Groundwater	SMALL	No change	SMALL to LARGE	Groundwater impacts would depend on uses and available supply. It is unlikely that groundwater would be used for once-through cooling, but could be used for sanitary water.

Table 8-5. (contd)

	Existing ANO-2 Site		Alternate Site	
Impact Category	Impact	Comparison with Closed-Cycle Cooling System	Impact	Comparison with Closed-Cycle Cooling System
Air Quality	MODERATE	No change	MODERATE	No change
Waste	SMALL	No change	SMALL	No change
Human Health	SMALL	No change	SMALL	No change
Socioeconomics	SMALL to MODERATE	No change	MODERATE to LARGE	No change
Aesthetics	SMALL to MODERATE	Reduced aesthetic impact because cooling towers would not be used.	SMALL to LARGE	Reduced aesthetic impact because cooling towers would not be used.
Historical and Archaeological Resources	SMALL	Less land affected.	SMALL	Less land affected.
Environmental Justice	SMALL to MODERATE	No change	SMALL to MODERATE	No change

8.2.3.1 Closed-Cycle Cooling System

The overall impacts of a new nuclear generating plant using a closed-cycle cooling system at the Arkansas Nuclear One site or an alternate site are discussed in the following sections. The extent of impacts at an alternate site will depend on the location of the particular site selected. A summary of the potential impacts follows.

- **Land Use**

If a new nuclear plant were to be constructed at the ANO-2 site, the staff assumed that the current facilities would be used to the extent practicable, reducing the amount of new construction that would be required. Specifically, the staff assumed that a replacement nuclear power plant would use the existing cooling system, switchyard, offices, and transmission line rights-of-way.

Land use could require disturbance of previously undeveloped land. There would be no net change in land needed for uranium mining because land needed to supply the new nuclear plant would offset land needed to supply uranium for fueling the existing ANO-2 reactor. The impact of a replacement nuclear generating plant on land use at the existing site is best characterized as MODERATE. The impact would be greater than the OL renewal alternative (NRC 2003).

According to the GEIS, land-use requirements for a new nuclear unit at an alternate greenfield site would be approximately 200 to 400 ha (500 to 1000 ac) (NRC 1996). Additional land could be needed for an electric power transmission line, a rail spur to bring building materials to the construction site, and/or pipelines to supply cooling-water intake and discharge. Depending particularly on transmission line routing, siting a new nuclear plant with closed-cycle cooling at an alternate site would result in MODERATE to LARGE land-use impacts.

- **Ecology**

Locating a replacement nuclear power plant at the existing site would alter ecological resources because of the need to convert additional land to industrial use. Some of this land, however, would have been previously disturbed. Even assuming siting in a previously disturbed area, the impacts likely would somewhat alter the ecology of the site. Intake and discharge of cooling water from Lake Dardanelle could have adverse aquatic resource impacts. There would be some impact on terrestrial ecology from cooling tower drift. Siting at a new plant at the existing site would have a MODERATE ecological impact that would be greater than the impact associated with renewal of the ANO-2 OL primarily due to construction-related impacts.

A new nuclear plant at an alternate site would introduce construction impacts and new incremental operational impacts. Even assuming siting at a previously disturbed area, the impacts would alter the ecology. Impacts could include wildlife habitat loss, reduced productivity, habitat fragmentation, and a local reduction in biological diversity. Use of cooling water from a nearby surface water body could have adverse aquatic resource impacts. If needed, construction and maintenance of the transmission line would have ecological impacts. Overall, the ecological impacts at an alternate site would be MODERATE to LARGE (NRC 2003).

- **Water Use and Quality**

Surface Water. A replacement nuclear power plant located at the existing site would probably use the existing closed-cycle cooling system. It would obtain potable water from the City Corporation water system (owned by the city of Russellville) in a manner similar to the current practice. Thus, the environmental impacts would be similar to those from current operations at the existing site. Surface water impacts are expected to remain SMALL; the impacts would be sufficiently minor that they would not noticeably alter important attributes of the resource.

For a replacement reactor located at an alternate site, new intake structures would need to be constructed to provide water needs for the facility. Impacts would depend on the volume of water withdrawn for makeup relative to the amount available from the intake source and the characteristics of the surface water. Plant discharges would be regulated by agencies of the State of Arkansas. Some erosion and sedimentation may occur during construction. The impacts would be SMALL to MODERATE.

Groundwater. No groundwater is currently used for operation of ANO-1 or ANO-2. It is unlikely that groundwater would be used for an alternative nuclear power plant sited at the existing site, so the impacts would be SMALL. However, a nuclear power plant sited at an alternate site may use groundwater. The impacts of such a withdrawal rate on an aquifer would be site-specific and dependent on aquifer recharge and other withdrawal rates from the aquifer. Therefore, the overall impacts would be SMALL to LARGE.

- **Air Quality**

Construction of a new nuclear plant at the Arkansas Nuclear One site or an alternate site would result in fugitive emissions during the construction process. Exhaust emissions would also come from vehicles and motorized equipment used during the construction process. An operating nuclear plant would have minor air emissions associated with diesel generators. These emissions would be regulated. Emissions for a plant sited in Arkansas would be regulated by the Arkansas Department of Environmental Quality. Overall, emissions and associated impacts would be SMALL (NRC 2003).

- **Waste**

The waste impacts associated with operation of a nuclear power plant either at the existing ANO-2 site or at an alternate site are set forth in Table B-1 of 10 CFR Part 51, Subpart A, Appendix B. In addition to the impacts shown in Table B-1, construction-related debris would be generated during construction activities and removed to an appropriate disposal site. Siting the replacement nuclear power plant at an alternate site would not alter waste generation. Overall, waste impacts of a new nuclear plant at either the existing site or at an alternate site are considered SMALL (NRC 2003).

- **Human Health**

Human health impacts for an operating nuclear power plant at either the ANO-2 site or an alternate site are set forth in Table B-1 of 10 CFR Part 51, Subpart A, Appendix B. Siting the replacement nuclear power plant at an alternate site would not alter human health impacts. Overall, human health impacts of a new nuclear power plant at either the ANO-2 site or an alternate site are considered SMALL (NRC 2003).

- **Socioeconomics**

The staff assumed that the construction period for a new nuclear plant would be 5 years and the peak workforce would be 2500. The staff also assumed that construction would take place while the existing nuclear unit continues operation and would be completed by the time ANO-2 permanently ceases operation. During construction, the communities surrounding the Arkansas

Nuclear One site would experience demands on housing and public services that could have MODERATE impacts. In the GEIS, the staff noted that socioeconomic impacts at a rural site would be larger than at an urban site because more of the peak construction workforce would need to move to the area to work (NRC 1996). These impacts would be tempered by construction workers commuting to the site from other counties. After construction, the communities would be impacted by the loss of construction jobs (NRC 2003).

The replacement nuclear unit is assumed to have an operating workforce comparable to the approximately 630 workers currently at ANO-2. The replacement nuclear unit would provide a new tax base to offset the loss of tax base associated with decommissioning ANO-2. The appropriate characterization of socioeconomic impacts not related to transportation for operating replacement nuclear units constructed at the site is SMALL to MODERATE.

During the 5-year construction period, up to 2500 construction workers would be working at the site in addition to the approximately 1260 workers at ANO-1 and ANO-2. The addition of the construction workers could place significant traffic loads on existing highways, particularly those leading to the site. Such impacts could be MODERATE to LARGE. Transportation impacts related to commuting of plant operating personnel would be similar to current impacts associated with operation of ANO-2 and are considered SMALL.

Construction of a replacement nuclear power plant at an alternate site would relocate some socioeconomic impacts but would not eliminate them. The communities around the existing ANO-2 site would still experience the impact of ANO-2 operational job loss and loss of tax base (although potentially tempered by projected economic growth), and the communities around the new site would have to absorb the impacts of a large, temporary workforce (up to 2500 workers at the peak of construction) and a permanent workforce of approximately 630 workers. In the GEIS, the NRC noted that socioeconomic impacts at a rural site would be larger than at an urban site because more of the peak construction workforce would need to move to the area to work (NRC 1996). Impacts at alternate sites would need to be analyzed on a case-by-case basis. Socioeconomic impacts at rural sites could be LARGE (NRC 2003).

Transportation-related impacts associated with commuting workers at an alternate site are site-dependent, but could be MODERATE to LARGE. Transportation impacts related to commuting of plant operating personnel would also be site-dependent, but can be characterized as SMALL (NRC 2003).

If a replacement nuclear unit was built at an alternate site, the communities around the existing ANO-2 site would experience the impact of operational job losses, and Pope County would lose

a portion of its tax base. These losses would have MODERATE to LARGE socioeconomic impacts, given the fact that ANO-2 represents about one-fourth of all property tax the total revenue in Pope County and the Russellville School District (half of the total due to ANO-1 and ANO-2). Overall, the staff considers the potential impacts of a new nuclear plant at either the existing site or an alternate site to be SMALL to LARGE.

- **Aesthetics**

The containment buildings for a replacement nuclear power plant built at the existing site and other associated buildings would be visible offsite during daylight hours. The nuclear unit would also be visible at night because of outside lighting. Visual impacts could be mitigated by landscaping and selecting a color for buildings that is consistent with the environment. Visual impact at night could be mitigated by reduced use of lighting and appropriate use of shielding. No exhaust stacks would be needed. No additional cooling towers would be needed, assuming use of the existing closed-cycle cooling system (NRC 2003).

A replacement nuclear plant at the existing site would be visible from Lake Dardanelle. However, with appropriate mitigation, the visual impact could be kept SMALL to MODERATE. Noise from operation of a replacement nuclear power plant would potentially be audible offsite in calm wind conditions or when the wind is blowing in the direction of the listener. Mitigation measures such as reduced or no use of outside loudspeakers could be employed to reduce noise levels, thus keeping the impact SMALL (NRC 2003).

At an alternate site, depending on placement, there would be an aesthetic impact from the buildings. The containment buildings for a replacement nuclear power plant, other associated buildings, the cooling towers, and the plume from the cooling towers would be visible during daylight hours. Natural draft towers could be up to 160 m (520 ft) high. Mechanical draft towers could be up to 30 m (100 ft) high and also would have an associated impact from noise and condensate plumes. Noise and light from the plant would be detectable offsite. Visual impacts of buildings and structures could be mitigated by landscaping and selecting a color that is consistent with the environment. Visual impact at night could be mitigated by reduced use of lighting and appropriate use of shielding. There also would be a significant aesthetic impact associated with construction of a new transmission line (if needed) to connect to other lines to enable delivery of electricity. The impact of noise and light would be mitigated if the plant is located in an industrial area adjacent to other power plants, in which case the impact could be SMALL. The impact could be MODERATE if a transmission line needs to be built to the alternate site. The impact could be LARGE if a previously undisturbed site is selected or if a lengthy transmission line is required to connect the replacement plant to the power grid (NRC 2003).

- **Historic and Archaeological Resources**

At the existing site, an inventory of historic and archaeological resources would be needed for onsite property that has not been previously developed. Other lands acquired to support the plant would also need an inventory of field resources, identification and recording of existing historic and archeological resources, and possible mitigation of adverse effects from subsequent ground-disturbing actions related to physical expansion of the plant site.

Before construction at the Arkansas Nuclear One site or an alternate site, studies would likely be needed to identify, evaluate, and address mitigation of the potential impacts of new plant construction on historic and archeological resources. The studies would likely be needed for all areas of potential disturbance at the proposed plant site and along associated rights-of-way where new construction would occur (e.g., rights-of-ways for new roads, transmission lines, and rail lines). Historic and archaeological resource impacts can generally be managed and mitigated. Therefore, the staff considers the impacts to historic and archeological resources of a new nuclear plant at either the existing site or an alternate site to be SMALL.

- **Environmental Justice**

Environmental impacts on minority and low-income populations associated with a replacement nuclear plant built at an alternate site would depend on the site chosen and the nearby population distribution. The environmental justice impact of replacing ANO-2 with a new nuclear unit at the existing site would be SMALL to MODERATE. Some impacts on housing availability and prices during construction might occur, and this could disproportionately affect minority and low-income populations. Closure of ANO-2 would result in the loss of approximately 600 operating jobs, which would be replaced if the new plant is built at the existing site, but not if it is built at an alternate site. Resulting economic conditions could reduce employment prospects for minority or low-income populations. Pope County would experience a loss of about one-fourth of its property tax revenue, which could affect its ability to provide services and programs. However, these losses would likely have SMALL to MODERATE environmental justice impacts, and would be similar to the no-action alternative (Section 8.1). Therefore, the staff considers the environmental justice impacts of a new nuclear plant at either the existing site or at an alternate site to be SMALL to MODERATE.

- **Summary**

The staff's conclusions regarding the environmental impacts of a new nuclear plant with closed-cycle cooling are summarized in Table 8-6.

Table 8-6. Summary of Environmental Impacts from Nuclear Power Generation with Closed-Cycle Cooling at the Existing Arkansas Nuclear One, Unit 2 Site or at an Alternate Greenfield Site in the Entergy Service Area

	Existing ANO-2 Site		Alternate Site	
Impact Category	**Impact**	**Comments**	**Impact**	**Comments**
Land Use	MODERATE	Requires 200 to 400 ha (500 to 1000 ac) for the plant and 400 ha (1000 ac) for uranium mining.	MODERATE to LARGE	Same as Arkansas Nuclear One site, plus land for transmission line
Ecology	MODERATE	Potential disturbance of undeveloped areas at the current site. Some impacts from cooling tower drift on terrestrial ecology.	MODERATE to LARGE	Impact depends on location and ecology of the site, surface water body used for intake and discharge, and transmission line routes; potential habitat loss and fragmentation; reduced productivity and biological diversity.
Water Use and Quality				
Surface Water	SMALL	Uses existing intake and discharge structures and cooling system	SMALL to MODERATE	Impact will depend on the volume of water withdrawn and discharged, and the characteristics of the surface water body.
Groundwater	SMALL	ANO-2 does not use groundwater nor is expected to use groundwater during license renewal.	SMALL to LARGE	Groundwater impacts would depend on uses and available supply.
Air Quality	SMALL	Fugitive emissions and emissions from vehicles and equipment during construction. Small amount of emissions from diesel generators and possibly other sources during operation. Emissions would be similar to current releases at the site.	SMALL	Same as Arkansas Nuclear One site
Waste	SMALL	Waste impacts for an operating nuclear power plant are set out in 10 CFR Part 51, Appendix B, Table B-1. Debris would be generated and removed during construction.	SMALL	Same as Arkansas Nuclear One site
Human Health	SMALL	Human health impacts for an operating nuclear power plant are set out in 10 CFR Part 51, Appendix B, Table B	SMALL	Same as Arkansas Nuclear One site

Table 8-6. (contd)

	Existing ANO-2 Site		Alternate Site	
Impact Category	Impact	Comments	Impact	Comments
Socioeconomics	SMALL to LARGE	During construction, impacts would be SMALL to MODERATE. Up to 2500 workers during peak period of the 5-year construction period. Operating workforce assumed to be similar to ANO-2; tax base preserved. Impacts during operation would be SMALL. Transportation impacts associated with construction workers could be MODERATE to LARGE. Transportation impacts of commuting workers during operations would be SMALL.	SMALL to LARGE	Construction impacts depend on location. Impacts at a rural location could be LARGE. Pope County would experience loss of tax base and employment with MODERATE impacts. Transportation impacts associated with construction workers could be MODERATE to LARGE. Transportation impacts of commuting workers during operations would be SMALL.
Aesthetics	SMALL to MODERATE	Likely would use existing cooling tower at the current site.	SMALL to LARGE	Impacts would depend on the characteristics of the alternate site. Impacts would be SMALL if the plant is located adjacent to an industrial area. New transmission lines would add to the impacts and could be MODERATE. If a previously undisturbed site is selected, the impacts could be LARGE.
Historic and Archaeological Resources	SMALL	Potential impacts can be effectively managed.	SMALL	Potential impacts can be effectively managed.
Environmental Justice	SMALL to MODERATE	Pope County would lose tax revenue and jobs, with SMALL to MODERATE impacts on minority and low-income populations.	SMALL to MODERATE	Impacts at alternate site vary depending on population distribution and characteristics at site. Pope County would lose tax revenue and jobs, with SMALL to MODERATE impacts on minority and low-income populations.

8.2.3.2 Once-Through Cooling System

The environmental impacts of constructing a nuclear power plant that uses once-through cooling either at the existing site or at an alternate site are similar to the impacts for a nuclear power plant using closed-cycle cooling with cooling towers. However, there are some differences in the environmental impacts between the closed-cycle and once-through cooling systems. In those impact categories related to land-area requirements, such as land use, terrestrial ecology, and cultural resources, the impacts are likely to be smaller if the site uses a once-through cooling system rather than a closed-cycle cooling system. However, the impacts of a plant with a once-through cooling system are likely to be greater than a plant with a closed-cycle cooling system in the areas of water use and aquatic ecology because of the need for greater quantities of cooling water. Table 8-7 summarizes the incremental differences.

Table 8-7. Summary of Environmental Impacts of New Nuclear Generation Using Once-Through Cooling at the Existing Arkansas Nuclear One, Unit 2 Site or at an Alternate Greenfield Site in the Entergy Service Area

	Existing ANO-2 Site		Alternate Site	
Impact Category	Impact	Comparison with Closed-Cycle Cooling System	Impact	Comparison with Closed-Cycle Cooling System
Land Use	MODERATE	10 to 12 ha (25 to 30 ac) less land required because cooling towers and associated infrastructure are not needed.	MODERATE to LARGE	10 to 12 ha (25 to 30 ac) less land required because cooling towers and associated infrastructure are not needed.
Ecology	MODERATE	Slightly less terrestrial habitat loss, no cooling tower drift, but increased water usage with increased impacts to the aquatic ecology.	MODERATE to LARGE	Impact would depend on ecology at the site. No impact to terrestrial ecology from cooling tower drift. Increased water withdrawal with possible greater impact to aquatic ecology.
Water Use and Quality				
Surface Water	SMALL	No discharge of cooling tower blowdown. Increased water withdrawal and more thermal load on receiving body of water.	SMALL to MODERATE	No discharge of cooling tower blowdown. Increased water withdrawal and more thermal load on receiving body of water.
Groundwater	SMALL	No change	SMALL to LARGE	No change
Air Quality	SMALL	No change	SMALL	No change
Waste	SMALL	No change	SMALL	No change
Human Health	SMALL	No change	SMALL	No change
Socioeconomics	SMALL to MODERATE	No change	MODERATE to LARGE	No change
Aesthetics	SMALL	Reduced aesthetic impact because cooling towers would not be used	SMALL to LARGE	Reduced aesthetic impact because cooling towers would not be used, but impacts could still be large if lengthy transmission line is required.
Historic and Archaeological Resources	SMALL	Less land impacted	SMALL	Less land impacted
Environmental Justice	SMALL to MODERATE	No change	SMALL to LARGE	No change

8.2.4 Purchased Electrical Power

If available, purchased power from other sources could potentially obviate the need to renew the ANO-2 OL. "Purchased power" is power purchased and transmitted from electric generation plants not owned by the applicant and located elsewhere within the region, nation, Canada, or Mexico.

Entergy purchases substantial amounts of electric capacity on the wholesale market. The majority of the power is purchased on the wholesale market from the Tennessee Valley Authority (TVA). For the purposes of this analysis, it is assumed that replacement power would come from the TVA. Approximately 45 percent of electricity from the TVA is generated using fossil fuels; therefore, air emissions would be greater from purchased power than from generation by ANO-2. Other large generators in the region would have as high, if not higher, emissions rates, because energy production in the region is generally from older coal-fired plants that have the highest emission per kilowatt hour (kWh) of all generation sources (NRC 2001). If new generating units were used to provide purchased electricity, considering the current and projected development of additional generating capabilities in the country, natural-gas-fired, combined-cycle units, such as those described in Section 8.2.2, would be the most likely candidates. These also would have larger environmental impacts than the relicensing option, as discussed in Section 8.2.2.

In theory, imported power is a feasible alternative to ANO-2 license renewal. There is no assurance, however, that sufficient capacity or energy would be available in the 2018 through 2038 time frame to replace the 1023-MW(e) net base load generating capacity of ANO-2. For example, EIA projects that total gross U.S. imports of electricity from Canada and Mexico will gradually increase from 38.4 billion kWh in year 2001 to 48.9 billion kWh in year 2005 and then gradually decrease to 24.4 billion kWh in year 2020 (DOE/EIA 2004a). On balance, it appears unlikely that electricity imported from Canada or Mexico would be able to replace the ANO-2 generating capacity.

More importantly, regardless of the technology used to generate imported power, the generating technology would be one of those described in this SEIS and in the GEIS (probably coal, natural gas, nuclear, or hydroelectric). The GEIS description of other technology impacts is representative of imported power impacts related to ANO-2 license renewal alternatives (NRC 2001b).

The staff has assumed that any environmental impacts associated with the production of purchased power would be evaluated under separate NEPA or comparable environmental analyses and, therefore do not need to be reconsidered in relation to the ANO-2 OL renewal.

8.2.5 Other Alternatives

Other generation technologies are discussed in the following sections. As described in the following sections, none of these alternatives is considered feasible as a replacement for the 1023 net MW(e) base load capacity of ANO-2.

8.2.5.1 Oil-Fired Generation

Oil is not considered a stand-alone fuel because it is not cost-competitive when natural gas is available. The cost of an oil-fired operation is about eight times as expensive as a nuclear or coal-fired operation. In addition, future increases in oil prices are expected to make oil-fired generation increasingly more expensive than coal-fired generation. EIA projects that oil-fired plants will account for very little of the new generation capacity in the United States through the year 2025 because of higher fuel costs and lower efficiencies compared to other available technologies (DOE/EIA 2004a). For these reasons, oil-fired generation is not a feasible alternative to ANO-2 license renewal, nor is it likely to be included in a mix with other resources except as a backup fuel (NRC 2001b). In Section 8.3.11 of the GEIS, the staff estimated that construction of a 1000-MW(e) oil-fired plant would require about 49 ha (120 ac) (NRC 1996). Operation of oil-fired plants would have environmental impacts (including impacts on the aquatic environment and air) that would be similar to those from a coal-fired plant (Section 8.2.1).

8.2.5.2 Wind Power

Wind turbines typically operate at a 25 to 35 percent capacity factor compared to 80 to 95 percent for a base load plant (NWPPC 2000). This low capacity factor results from the high degree of intermittence of wind energy in many locations. Current energy storage technologies are too expensive to permit wind power plants to serve as large base load plants. The largest commercially available wind turbines are in the range of 1 MW to 1.5 MW; therefore, at least 682 to 1023 units would be required to replace the ANO-2 generating capacity. Given the intermittent nature of the wind resource (perhaps 30 to 35 percent availability), approximately three times this number would be required to replace the power generated by ANO-2.

Wind energy has a large land requirement, approximately 150,000 acres of land to generate 1000 MW(e) of electricity. Also, new easements, road building, and some clearing for towers and blades would be required. This eliminates the possibility of co-locating a wind-energy facility with a retired nuclear power plant. A siting plan would be required. Construction of several hundred wind turbines would also require extensive construction of transmission lines to bring the power and the energy to market. This would have a LARGE impact upon much of the natural environment in the affected areas (NRC 2001b).

Most of Arkansas is in wind power Class 1 or 2 regions (average wind speeds at a 10-m [33-ft] elevation of 0 to 4.4 m/s [0 to 9.8 mph]) (Elliott et al. 1986; NWTC 2000). In general, Class 3 or higher can be used for utility-scale commercial power production, but wind turbines are considered economical in wind power Classes 4 through 7 (average wind speeds of 5.6 to 9.4 m/s [12.5 to 21.1 mph]) (NREL 2004a). There are Class 3 and 4 areas along ridge tops in the Boston Mountains and the Ouachita Mountains (Elliott et al. 1986).

As of October 2003, there were approximately 0.1 MW of grid-connected wind power facilities in Arkansas, with an additional 410 MW of additional capacity in various stages of planning (AWEA 2003). Access to many of the best wind power sites would require extensive road building, as well as clearing (for towers and blades) and leveling (for the tower bases and associated facilities) in steep terrain. Also, many of the best quality wind sites are on ridges and hilltops that could have greater archaeological sensitivity than surrounding areas.

Wind power could be included in a combination of alternatives to replace ANO-2. The environmental impacts of a large-scale wind farm are described in the GEIS (NRC 1996). The construction of roads, transmission lines, and turbine tower supports would result in short-term impacts, such as increases in erosion and sedimentation, and decreases in air quality from fugitive dust and equipment emissions. Construction in undeveloped areas would have the potential to disturb and impact cultural resources or habitat for sensitive species. During operation, some land near wind turbines could be available for compatible uses such as agriculture. The continuing aesthetic impact would be considerable, and there is a potential for bird collisions with turbine blades. Wind farms generate very little waste and pose no human health risk other than from occupational injuries. Although most impacts associated with a wind farm are SMALL or can be mitigated, some impacts such as the continuing aesthetic impact and impacts to sensitive habitats could be LARGE, depending on the location.

8.2.5.3 Solar Power

Solar technologies use the sun's energy and light to provide heat and cooling, light, hot water, and electricity for homes, businesses, and industry. Neither photovoltaic nor thermal solar power technologies currently can compete with conventional fossil-fueled generation technologies in grid-connected applications because of higher capital costs per kilowatt of capacity. The average capacity factor of photovoltaic cells is about 25 percent (NRC 1996), and the capacity factor for solar thermal systems is about 25 to 40 percent (NRC 1996). Energy storage requirements limit the use of solar-energy systems as base load electricity supply.

There are substantial impacts to natural resources (wildlife habitat, land-use, and aesthetic impacts) from construction of solar-generating facilities. As stated in the GEIS, land requirements are high. Approximately 140 km^2 (54 mi^2) for photovoltaic technology (NRC 1996) and approximately 60 km^2 (23 mi^2) for solar thermal systems (NRC 1996) would be required to replace the 1023 MW(e) produced by ANO-2. There is not enough land for either type of solar electric system at the existing ANO-2 site and both would have LARGE environmental impacts at an alternate site.

The construction impacts would be similar to those associated with a large wind farm as discussed in Section 8.2.5.2. The operating facility would also have considerable aesthetic impact. Solar installations pose no human health risk other than from occupational injuries.

The manufacturing process for constructing a large amount of photovoltaic cells would result in waste generation, but this waste generation has not been quantified. Some impacts, such as impacts to sensitive areas, loss of productive land, and the continuing aesthetic impact, could be LARGE, depending on the location.

The existing ANO-2 site receives about 4.5 kWh of direct normal solar radiation per square meter per day (using Little Rock as a proxy) compared to greater than 7 kWh of solar radiation per square meter per day in areas of the western United States such as California or Arizona, which are most promising for solar technologies (NREL 2004b). Because of the natural resource impacts (land and ecological), the relatively low rate of solar radiation in the area, the intermittent nature of the resource in the area, and the high cost, solar power is not deemed a feasible base load alternative to renewal of the ANO-2 OL. Some onsite-generated solar power (e.g., from rooftop photovoltaic applications) may substitute for a portion of the electric power from the grid. Implementation of solar generation on a scale large enough to replace the ANO-2 generating capacity would likely result in LARGE environmental impacts.

Installations of solar panels on residential and commercial rooftops are referred to as "distributed solar power." Based on an average house size of 139 m^2 (1500 ft^2) with a usable roof space of 70 m^2 (753 ft^2) and an optimistic conversion efficiency of 15 percent, more than 466,500 new or existing homes would have to be fitted with solar panels to replace the power generated on an average daily basis from ANO-2 (no capacity credit could be given for solar power at night or during periods of heavy cloudiness, unless power storage were included in the system). Without significant government or utility incentives, installation of distributed solar panels on this scale is unlikely. However, distributed solar power could be included in a combination of alternatives to replace ANO-2. Distributed solar power would result in fewer construction-related impacts because solar panels would usually be placed on existing buildings, eliminating the need for land clearing or transmission lines. Aesthetic impacts would be only marginally greater than those already created by the existing or new buildings. Impacts from the manufacture of solar panels would still occur.

8.2.5.4 Hydropower

Hydroelectric power has an average annual capacity factor of 46 percent. Section 8.3.4 of the GEIS indicates that the percentage of the U.S. electrical generation consisting of hydroelectricity is expected to decline because hydroelectric facilities have become difficult to site as a result of public concern over flooding, land requirements, destruction of natural habitat, and alteration of natural river courses (NRC 1996). Section 8.3.4 of the GEIS estimates land use of 405,000 ha (1 x 10^6 ac) per 1000 MW(e) for hydroelectric power, resulting in a LARGE environmental impact. Due to the lack of locations for siting a hydroelectric facility large enough to replace the generating capacity of ANO-2, local hydropower is not a feasible alternative to ANO-2 license renewal (NRC 2001b).

Arkansas has an estimated 737 MW of undeveloped hydroelectric resource (Francfort 1993). This amount is less than needed to replace the 1000-MW(e) generating capacity of ANO-2. However, as stated in Section 8.3.4 of the GEIS, the percentage of U.S. generating capacity supplied by hydropower is expected to decline. DOE/EIA states that potential sites for hydroelectric dams have already been largely established in the United States, and environmental concerns are expected to prevent the development of any new sites in the future (DOE/EIA 2003a).

In the GEIS, the staff estimated that approximately 405,000 ha (1×10^6 ac) of land would be required to replace the 1023 MW(e) produced by ANO-2 using large-scale hydroelectric power (NRC 1996). Due to the relatively low amount of undeveloped hydropower resource in Arkansas and the large land-use and related environmental and ecological resource impacts associated with siting hydroelectric facilities large enough to replace ANO-2, the staff concludes that local hydropower is not a feasible alternative to renewal of the ANO-2 OL. Any development of hydroelectric facilities large enough to replace ANO-2 would result in LARGE environmental impacts.

8.2.5.5 Geothermal Energy

Geothermal energy generation technology has an average capacity factor of 90 percent and can be used for base load power where available. However, geothermal technology is not widely used as base load generation due to the limited geographical availability of the resource and immature status of the technology (NRC 1996). As discussed in the GEIS, geothermal plants might be located in the western continental United States (e.g., Alaska and Hawaii) where hydrothermal reservoirs are prevalent (NRC 1996), but this technology is not applicable to the region where the replacement of 1023 MW(e) is needed. Arkansas has geothermal resources, but they are low- to moderate-temperature resources suitable only for direct applications such as heat pumps, not for electricity production (DOE/EERE 2003). There is no feasible location for geothermal generation of electricity within the Entergy service area (NRC 2001b). The staff concludes that generation of electricity from geothermal resources is not a feasible alternative to renewal of the ANO-2 OL.

8.2.5.6 Wood Waste

A wood-burning facility can provide base load power and operate with an average annual capacity factor of around 70 to 80 percent and with 20 to 25 percent energy conversion efficiency (NRC 1996). The energy conversion efficiency of a conventional fossil-fired plant is on the order of 35 percent. The cost of the fuel required for this type of facility is highly variable and site-specific. Entergy has estimated that the rough cost for construction of this type of facility in the ANO-2 area, where the replacement of 1023 MW(e) is needed, is approximately $800 per kW (Entergy 2003). Among the factors influencing costs are the environmental

considerations and restrictions that are influenced by public perceptions, easy access to fuel sources, and environmental factors. In addition, the technology is expensive and inefficient. Therefore, economics alone eliminate biomass technology as a reasonable alternative (NRC 2001b).

The larger wood-waste power plants are only 40 to 50 MW(e) in size. Estimates in the GEIS suggest that the overall level of construction impact per MW of installed capacity should be approximately the same as that for a coal-fired plant, although facilities using wood waste for fuel would be built at smaller scales (NRC 1996). Like coal-fired plants, wood-waste plants require large areas for fuel storage and processing and involve the same type of combustion equipment.

Because of uncertainties associated with obtaining sufficient wood and wood waste to fuel a base load generating facility, ecological impacts of large-scale timber cutting (e.g., soil erosion and loss of wildlife habitat), and relatively low energy conversion efficiency, the staff has determined that wood waste is not a feasible alternative to renewing the ANO-2 OL.

8.2.5.7 Municipal Solid Waste

The initial capital costs for this technology are much greater than the comparable steam-turbine technology found at wood-waste facilities. This is due to the need for specialized municipal solid waste-handling and waste-separation equipment and stricter environmental emissions controls. The decision to burn municipal waste to generate energy is usually driven by the need for an alternative to landfills rather than by energy considerations (NRC 2001b). Entergy has concluded that high costs prevent this technology from being economically competitive (Entergy 2003).

Municipal waste combustors incinerate waste and use the resultant heat to generate steam, hot water, or electricity. The combustion process can reduce the volume of waste by up to 90 percent and the weight of the waste by up to 75 percent (EPA 2002). Municipal waste combustors use three basic types of technologies: mass burn, modular, and refuse-derived fuel (DOE/EIA 2001a). Mass burning technologies are most commonly used in the United States. This group of technologies process raw municipal solid waste "as is," with little or no sizing, shredding, or separation before combustion. Because of the need for specialized waste-separation and waste-handling equipment for municipal solid waste, the initial capital costs for municipal solid-waste plants are greater than for comparable steam-turbine technology at wood-waste facilities (NRC 1996).

Growth in the municipal waste combustion industry slowed dramatically during the 1990s after rapid growth during the 1980s. The slower growth was due to three primary factors: (1) the Tax Reform Act of 1986, which made capital-intensive projects such as municipal waste

combustion facilities more expensive relative to less capital-intensive waste disposal alternative such as landfills; (2) the 1994 Supreme Court decision (*C&A Carbone, Inc. v. Town of Clarkstown*), which struck down local flow-control ordinances that required waste to be delivered to specific municipal waste combustion facilities rather than landfills with lower fees; and (3) increasingly stringent environmental regulations that increased the capital cost necessary to construct and maintain municipal waste combustion facilities (DOE/EIA 2001b).

Similar to the combustion of coal, municipal solid-waste combustors generate an ash residue that is buried in landfills. The ash residue is composed of bottom ash and fly ash. Bottom ash refers to that portion of the unburned waste that falls to the bottom of the grate or furnace. Fly ash represents the small particles that rise from the furnace during the combustion process. Fly ash is generally removed from flue gases using fabric filters and/or scrubbers (DOE/EIA 2001b).

Currently, there are approximately 98 waste-to-energy plants operating in the United States. These plants generate approximately 2750 MW(e), or an average of approximately 28 MW(e) per plant (IWSA 2003). Therefore, approximately 37 typical waste-to-energy plants would be required to replace the 1023-MW(e) base load capacity of ANO-2. Therefore, the staff concludes that generating electricity from municipal solid waste would not be a feasible alternative to renewal of the ANO-2 OL.

8.2.5.8 Other Biomass-Derived Fuels

In addition to wood and municipal solid waste fuels, there are several other concepts for fueling electric generators, including burning energy crops, converting crops to a liquid fuel such as ethanol (ethanol is primarily used as a gasoline additive for automotive fuel), and gasifying energy crops (including wood waste). In the GEIS, the staff stated that none of these technologies has progressed to the point of being competitive on a large scale or of being reliable enough to replace a base load plant such as ANO-2 (NRC 1996). In addition, these systems have LARGE impacts on land use (NRC 2001b). For these reasons, such fuels do not offer a feasible alternative to renewal of the ANO-2 OL.

8.2.5.9 Fuel Cells

Fuel cells work without combustion so the environmental side effects of combustion are avoided. Power is produced electrochemically by passing a hydrogen-rich fuel over an anode and air over a cathode, and then separating the two by an electrolyte. The only by-products are heat, water, and carbon dioxide. Hydrogen fuel can come from a variety of hydrocarbon resources by subjecting them to steam under pressure. Natural gas is typically used as the source of hydrogen.

Phosphoric acid fuel cells are the most mature fuel cell technology, but they are only in the initial stages of commercialization. Recent estimates suggest that to be competitive, a company would have to achieve a price of $1000 to $1500 per kW. The current production capacity of all fuel cell manufacturers only totals about 100 MW per year and costs are still above $3000 per kW (California Stationary Fuel Cell Collaborative 2003). The use of fuel cells for base load capacity requires very large energy-storage devices that are not feasible for storage of sufficient electricity to meet the base load generating requirements. This is a very expensive source of generation, which prevents it from being competitive. Therefore, fuel cells are not considered a feasible alternative to license renewal (NRC 2001b).

Phosphoric acid fuel cells are generally considered first-generation technology. These are commercially available today at a cost of approximately $4000 to $4500 per kW of installed capacity (DOE/FE 2004a). Higher-temperature, second-generation fuel cells achieve higher fuel-to-electricity and thermal efficiencies. The higher temperatures contribute to improved efficiencies and give the second-generation fuel cells the capability to generate steam for cogeneration and combined-cycle operations.

DOE has had a performance target that by 2010, second-generation fuel cell technologies using molten carbonate and solid oxide technology will be commercially available at a cost of $400 per kW of installed capacity by the end of the decade (approximately 2010) (DOE/FE 2004b). Molten carbonate fuel cells have progressed to the threshold of commercial availability (DOE/FE 2004b). DOE has launched the Solid State Energy Conversion Alliance with industrial and research partners with the goal to bring solid oxide fuel cells cost down to $400 per kW by the end of this decade (DOE/FE 2004c). For comparison, the installed capacity cost for a natural-gas-fired, combined-cycle plant is approximately $456 per kW (DOE/EIA 2001a). As market acceptance and manufacturing capacity increase, natural-gas-fueled fuel cell plants in the 50- to 100-MW range are projected to become available. At the present time, however, fuel cells are not economically or technologically competitive with other alternatives for base load electricity generation, and progress in market growth and cost reduction has been slower than anticipated (California Stationary Fuel Cell Collaborative 2003). Fuel cells are, consequently, not a feasible alternative to renewal of the ANO-2 OL.

8.2.5.10 Delayed Retirement

The delayed retirement of fossil generation sources could not be used to replace ANO-2's 1023-MW(e) generating capacity because the sources facing retirement in the Entergy system are used for peaking and intermediate generation. Additionally, there is no guarantee that these fossil units could economically operate for an additional 20 years after the current decision dates. Entergy does not have plans to retire any of its base load fossil plants (Entergy 2003). Therefore, delayed retirement of base load fossil generation could not be used as an alternative.

8.2.5.11 Utility-Sponsored Conservation

The concept of conservation as a resource does not meet the primary NRC criterion, "...that a reasonable set of alternatives should be limited to analysis of single, discrete electric generation sources, and only electric generation sources that are technically feasible and commercially viable." Conservation is neither single nor discrete, nor is it a source of generation (NRC 2001b).

As a result of a review of electricity conservation success nationally as reported by EIA, which shows companies saving about 1.4 percent of annual electricity generation and 2.5 percent of peak demand through energy efficiency and load management programs (DOE/EIA 2003b), it is assumed that it would potentially be possible to displace approximately 2.5 percent of the generation in Arkansas with an ambitious targeted program (a saving of about 136 to 283 MW, depending on whether average or peak conditions are assumed [DOE/EIA 2003c for Arkansas production]). The environmental impacts of an energy conservation program would be SMALL, but the potential to displace the entire generation at ANO-2 solely with conservation is not realistic. Therefore, the conservation option by itself is not considered a reasonable replacement for the ANO-2 OL renewal alternative.

8.2.6 Combination of Alternatives

NRC indicated in the GEIS that, while many methods are available for generating electricity and a huge number of combinations or mixes can be assimilated to meet system needs, such expansive consideration would be too unwieldy given the purposes of the alternatives analysis (NRC 1996). Therefore, NRC determined that a reasonable set of alternatives should be limited to analysis of single discrete electrical generation sources and only those electric generation technologies that are technically reasonable and commercially viable (NRC 1996). Consistent with the NRC determination, Entergy has not evaluated mixes of generating sources.

Even though individual alternatives might not be sufficient on their own to replace the ANO-2 generating capacity because of the small size of the resource or lack of cost-effective opportunities, it is conceivable that a combination of alternatives might be cost effective.

ANO-2 has an average net generating capacity of 1023 MW(e). There are many possible combinations of alternatives. Table 8-8 contains a summary of the environmental impacts of one assumed combination of alternatives consisting of 500 MW(e) of combined-cycle, natural-gas-fired generation at either the existing ANO-2 site or an alternate site using closed-cycle cooling, 240 MW(e) purchased from other generators, and 240 MW(e) gained from additional DSM measures. The impacts associated with the combined-cycle, natural-gas-fired units are based on the natural-gas-fired generation impact assumptions discussed in Section 8.2.2,

adjusted for the reduced generating capacity. For the combination of alternatives, the staff assumed that a replacement natural-gas-fired plant would use the existing intake and discharge structures, while a natural-gas-fired plant located at an alternative site would use a closed-cycle cooling system. While the DSM measures would have few environmental impacts, operation of the new natural-gas-fired plant would result in increased emissions (compared to the OL renewal alternative) and other environmental impacts. The environmental impacts of power generation associated with power purchased from other generators would still occur, but would be located elsewhere within the region, nation, or another country, as discussed in Section 8.2.4. The environmental impacts associated with purchased power are not shown in Table 8-8. The staff concludes that it is unlikely that the environmental impacts of any reasonable combination of generating and conservation options could be reduced to the level of impacts associated with renewal of the ANO-2 OL.

8.3 Summary of Alternatives Considered

The environmental impacts of the proposed action, renewal of the ANO-2 OL, are SMALL for all impact categories (except collective offsite radiological impacts from the fuel cycle and from HLW and spent fuel disposal, for which a single significance level was not assigned). Alternative actions (i.e., no-action alternative [Section 8.1], new-generation alternatives [from coal, natural gas, and nuclear discussed in Sections 8.2.1 through 8.2.3, respectively], purchased electrical power [Section 8.2.4], alternative technologies [Section 8.2.5], and the combination of alternatives [Section 8.2.6]) were considered.

The no-action alternative would result in decommissioning ANO-2 and would have SMALL environmental impacts for all impact categories except socioeconomics, which may have SMALL to MODERATE impacts. The no-action alternative would result in a net reduction in power production. The power not generated by ANO-2 during the license renewal term would likely be replaced by (1) DSM and energy conservation, (2) power purchased from other electricity providers, (3) generating alternatives other than ANO-2, or (4) some combination of these options. This replacement power would produce additional environmental impacts, as discussed in Section 8.2.

For each of the new-generation alternatives (coal, natural gas, and nuclear), the environmental impacts would be greater than the impacts of license renewal. For example, the land-disturbance impacts resulting from construction of any new facility would be greater than the impacts of continued operation of ANO-2. The impacts of purchased electrical power would still occur, but would occur elsewhere. Alternative technologies are not considered feasible at this time for replacement of the ANO-2 base load power and it is unlikely that the environmental impacts of any reasonable combination of generation and conservation options could be reduced to the level of impacts associated with renewal of the ANO-2 OL.

Table 8-8. Summary of Environmental Impacts for an Alternate Greenfield Site for an Assumed Combination of Generating (Combined-Cycle Natural-Gas-Fired Generation, and DSM) and Acquisition Alternatives at the Existing Arkansas Nuclear One, Unit 2 Site

	Existing ANO-2 Site		Alternate Site	
Impact Category	**Impact**	**Comments**	**Impact**	**Comments**
Land Use	SMALL to MODERATE	8 ha (20 ac) for natural-gas-fired plant power block, offices, roads, and parking areas. Additional impact for construction of an underground natural gas pipeline, electric power transmission line, and cooling-water intake/discharge piping.	SMALL to MODERATE	No change
Ecology	SMALL	Uses previously disturbed areas of the existing site, plus gas pipeline. Impacts to terrestrial ecology from cooling tower drift.	SMALL to MODERATE	Impact depends on location and ecology of the sites, surface water body used for intake and discharge, and transmission and pipeline routes; potential habitat loss and fragmentation; reduced productivity and biological diversity; impacts to terrestrial ecology from cooling tower drift. Some increase in bird mortality associated with wind towers.
Water Use and Quality				
Surface Water	SMALL	Uses part of the existing cooling system. Discharge of cooling tower blowdown will have impacts.	SMALL to MODERATE	Impact depends on volume of water withdrawal and discharge, the constituents in the discharge water, and the characteristics of the surface water body. Discharge of cooling tower blowdown will have impacts.
Groundwater	SMALL	Use of groundwater unlikely.	SMALL to MODERATE	Impact depends on the quantity of water withdrawn.
Air Quality	MODERATE	Primarily NO_x. Impacts could be noticeable but not destabilizing. Plant would emit SO_x, carbon monoxide, PM_{10} particulates, and some hazardous air pollutants. Roughly half the emissions as for the natural gas alternative, plus additional emissions from producers of purchased power.	MODERATE	No change
Waste	SMALL	Minimal waste generated.	SMALL	No change
Human Health	SMALL	Impacts considered minor.	SMALL	No change

Table 8-8. (contd)

	Existing ANO-2 Site		Alternate Site	
Impact Category	Impact	Comments	Impact	Comments
Socioeconomics	SMALL to MODERATE	During construction impacts would be SMALL to MODERATE. Possibly over 200 additional workers needed during the peak construction period followed by reduction from current workforce. Impacts during operation would be SMALL. Net loss of much of the ANO-2 tax base with SMALL to MODERATE effects.	MODERATE	Construction impacts depend on location, but could be significant if location is in a rural area. Pope County would experience loss of tax base and employment with potentially SMALL to MODERATE impacts. Impacts during operation would be SMALL. Transportation impacts associated with construction workers would be MODERATE.
Aesthetics	SMALL to MODERATE	SMALL aesthetic impact resulting from the impact of plant unit and stack for gas plant (similar to existing plant). May be MODERATE if other power supplies involve new transmission lines or coal-fired generation.	SMALL to MODERATE	Alternate location could reduce aesthetic impact if siting is in an industrial area. MODERATE impact from the natural-gas-fired plant, stacks, and cooling towers and associated plumes.
Historic and Archaeological Resources	SMALL	Impacts can generally be managed or mitigated.	SMALL	No change
Environmental Justice	SMALL to MODERATE	Impacts on minority and low-income communities should be similar to those experienced by the population as a whole. Some impacts on housing may occur during construction; loss of existing jobs on minority and low-income populations most likely SMALL to MODERATE, slightly less than in the no-action alternative.	SMALL to MODERATE	Impacts vary depending on population distribution and makeup water at site. Pope County would lose tax revenue and jobs; however, the impacts on minority and low-income populations would likely be SMALL to MODERATE.

8.4 References

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10 CFR Part 50. Code of Federal Regulations, Title 10, *Energy*, Part 50, "Domestic Licensing of Production and Utilization Facilities."

10 CFR Part 51. Code of Federal Regulations, Title 10, *Energy*, Part 51, "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions."

10 CFR Part 52. Code of Federal Regulations, Title 10, *Energy*, Part 52, "Early Site Permits, Standard Design Certifications, and Combined Licenses for Nuclear Power Plant."

40 CFR Part 51. Code of Federal Regulations, Title 40, *Protection of Environment*, Part 51, "Requirements for Preparation, Adoption, and Submittal of Implementation Plans."

40 CFR Part 60. Code of Federal Regulations, Title 40, *Protection of Environment*, Part 60, "Standards for Performance for New Stationary Sources."

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9.0 Summary and Conclusions

By letter dated October 15, 2003, Entergy Operations, Inc. (Entergy) submitted an application to the U.S. Nuclear Regulatory Commission (NRC) to renew the operating license (OL) for Arkansas Nuclear One, Unit 2 (ANO-2) for an additional 20-year period (Entergy 2003a). If the OL is renewed, State regulatory agencies and Entergy will ultimately decide whether the plant will continue to operate based on factors such as the need for power or other matters within the State's jurisdiction or the purview of the owners. If the OL is not renewed, then the plant must be shut down at or before the expiration of the current OL, which expires on July 17, 2018.

Section 102 of the National Environmental Policy Act of 1969 (NEPA) (42 USC 4321) directs that an environmental impact statement (EIS) is required for major Federal actions that significantly affect the quality of the human environment. The NRC has implemented Section 102 of NEPA in Title 10 of the Code of Federal Regulations (CFR) Part 51, which identifies licensing and regulatory actions that require an EIS. In 10 CFR 51.20(b)(2), the Commission requires preparation of an EIS or a supplement to an EIS (SEIS) for renewal of a reactor OL; 10 CFR 51.95(c) states that the EIS prepared at the OL renewal stage will be a supplement to the *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (GEIS), NUREG-1437, Volumes 1 and 2 (NRC 1996, 1999).[a]

Upon acceptance of the Entergy application, the NRC began the environmental review process described in 10 CFR Part 51 by publishing a notice of intent to prepare an EIS and conduct scoping (68 FR 71174) on December 22, 2003. The staff visited the ANO-2 site in February 2004 and held public scoping meetings on February 3, 2004, in Russellville, Arkansas (NRC 2004). The staff reviewed the Entergy Environmental Report (ER) (Entergy 2003b) and compared it to the GEIS, consulted with other agencies, and conducted an independent review of the issues following the guidance set forth in NUREG-1555, Supplement 1, *Standard Review Plans for Environmental Reviews for Nuclear Power Plants, Supplement 1: Operating License Renewal* (NRC 2000). The staff also considered the public comments received during the scoping process for preparation of the draft version of this SEIS. The public comments received during the scoping process that were considered to be within the scope of the environmental review are provided in Appendix A, Part 1, of this SEIS.

The draft SEIS was published and distributed for public comment on September 7, 2004. The staff held a public meeting in Russellville, Arkansas, in October 2004, to describe the results of the NRC environmental review and to answer questions to provide members of the public with information to assist them in formulating their comments on this SEIS. All comments on the

(a) The GEIS was originally issued in 1996. Addendum 1 to the GEIS was issued in 1999. Hereafter, all references to the "GEIS" include the GEIS and its Addendum 1.

draft SEIS were considered by the staff in developing the final SEIS. These comments are addressed in Appendix A, Part 2, of the SEIS.

This SEIS includes the NRC staff's analysis that considers and weighs the environmental effects of the proposed action, the environmental impacts of alternatives to the proposed action, and mitigation measures available for reducing or avoiding adverse effects. It also includes the staff's recommendation regarding the proposed action.

The NRC has adopted the following statement of purpose and need for license renewal from the GEIS:

> The purpose and need for the proposed action (renewal of an operating license) is to provide an option that allows for power generation capability beyond the term of a current nuclear power plant operating license to meet future system generating needs, as such needs may be determined by State, utility, and, where authorized, Federal (other than NRC) decisionmakers.

The goal of the staff's environmental review, as defined in 10 CFR 51.95(c)(4) and the GEIS, is to determine

> ...whether or not the adverse environmental impacts of license renewal are so great that preserving the option of license renewal for energy planning decisionmakers would be unreasonable.

Both the statement of purpose and need and the evaluation criterion implicitly acknowledge that there are factors, in addition to license renewal, that will ultimately determine whether an existing nuclear power plant continues to operate beyond the period of the current OL.

NRC regulations [10 CFR 51.95(c)(2)] contain the following statement regarding the content of SEISs prepared at the license renewal stage:

> The supplemental environmental impact statement for license renewal is not required to include discussion of need for power or the economic costs and economic benefits of the proposed action or of alternatives to the proposed action except insofar as such benefits and costs are either essential for a determination regarding the inclusion of an alternative in the range of alternatives considered or relevant to mitigation. In addition, the supplemental environmental impact statement prepared at the license renewal stage need not discuss other issues not related to the environmental effects of the proposed action and the alternatives, or any aspect of the storage of spent fuel for the facility

within the scope of the generic determination in § 51.23(a) and in accordance with § 51.23(b).[a]

The GEIS contains the results of a systematic evaluation of the consequences of renewing an OL and operating a nuclear power plant for an additional 20 years. It evaluates 92 environmental issues using the NRC's three-level standard of significance – SMALL, MODERATE, or LARGE – developed using the Council on Environmental Quality guidelines. The following definitions of the three significance levels are set forth in the footnotes to Table B-1 of 10 CFR Part 51, Subpart A, Appendix B:

SMALL – Environmental effects are not detectable or are so minor that they will neither destabilize nor noticeably alter any important attribute of the resource.

MODERATE – Environmental effects are sufficient to alter noticeably, but not to destabilize, important attributes of the resource.

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

For 69 of the 92 issues considered in the GEIS, the staff analysis in the GEIS shows the following:

(1) 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.

(2) A single significance level (i.e., SMALL, MODERATE, or LARGE) has been assigned to the impacts (except for collective off-site radiological impacts from the fuel cycle and from high-level waste [HLW] and spent fuel disposal).

(3) 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 not to be sufficiently beneficial to warrant implementation.

(a) The title of 10 CFR 51.23 is "Temporary storage of spent fuel after cessation of reactor operations – generic determination of no significant environmental impact."

These 69 issues were identified in the GEIS as Category 1 issues. In the absence of new and significant information, the staff relied on conclusions as amplified by supporting information in the GEIS for issues designated Category 1 in Table B-1 of 10 CFR Part 51, Subpart A, Appendix B.

Of the 23 issues that do not meet the criteria set forth above, 21 are classified as Category 2 issues requiring analysis in a plant-specific supplement to the GEIS. The remaining two issues, environmental justice and chronic effects of electromagnetic fields, were not categorized. Environmental justice was not evaluated on a generic basis and must also be addressed in a plant-specific supplement to the GEIS. Information on the chronic effects of electromagnetic fields was not conclusive at the time the GEIS was prepared.

This SEIS documents the staff's consideration of all 92 environmental issues identified in the GEIS. The staff considered the environmental impacts associated with alternatives to license renewal and compared the environmental impacts of license renewal and the alternatives. The alternatives to license renewal that were considered include the no-action alternative (not renewing the OL for ANO-2) and alternative methods of power generation. These alternatives were evaluated assuming that the replacement power generation plant is located at either the Arkansas Nuclear One site or some other unspecified greenfield location.

9.1 Environmental Impacts of the Proposed Action – License Renewal

Entergy and the staff have established independent processes for identifying and evaluating the significance of any new information on the environmental impacts of license renewal. Neither Entergy nor the staff has identified information that is both new and significant related to Category 1 issues that would call into question the conclusions in the GEIS. Similarly, neither the scoping process, Entergy, nor the staff has identified any new issue applicable to ANO-2 that has a significant environmental impact. Therefore, the staff relies upon the conclusions of the GEIS for all Category 1 issues that are applicable to ANO-2.

Entergy's license renewal application presents an analysis of the Category 2 issues that are applicable to ANO-2, plus environmental justice and chronic effects from electromagnetic fields. The staff has reviewed the Entergy analysis for each issue and has conducted an independent review of each issue plus environmental justice and chronic effects from electromagnetic fields. Six Category 2 issues are not applicable because they are related to plant design features or site characteristics not found at ANO-2. Four Category 2 issues are not discussed in this SEIS because they are specifically related to refurbishment. In its ER (Entergy 2003b), Entergy stated that its evaluation of structures and components, as required by 10 CFR 54.21, did not identify any major plant refurbishment activities or modifications necessary to support the

continued operation of ANO-2 for the license renewal term. In addition, any replacement of components or additional inspection activities are within the bounds of normal plant component replacement and, therefore, are not expected to affect the environment outside of the bounds of the plant operations evaluated in the *Final Environmental Statement Related to Operation of Arkansas Nuclear One, Unit 2* (AEC 1977).

Eleven Category 2 issues related to operational impacts and postulated accidents during the license renewal term, as well as environmental justice and chronic effects of electromagnetic fields, are discussed in detail in this SEIS. Five of the Category 2 issues and environmental justice apply to both refurbishment and to operation during the license renewal term and are only discussed in this SEIS in relation to operation during the license renewal term. For all 11 Category 2 issues and environmental justice, the staff concludes that the potential environmental effects are of SMALL significance in the context of the standards set forth in the GEIS. In addition, the staff determined that appropriate Federal health agencies have not reached a consensus on the existence of chronic adverse effects from electromagnetic fields. Therefore, no further evaluation of this issue is required. For severe accident mitigation alternatives (SAMAs), the staff concludes that a reasonable, comprehensive effort was made to identify and evaluate SAMAs. Based on its review of the SAMAs for ANO-2, and the plant improvements already made, the staff concludes that four candidate SAMAs are potentially cost-beneficial. However, these SAMAs do not relate to adequately managing the effects of aging during the period of extended operation and, therefore, need not be implemented as part of the license renewal pursuant to 10 CFR Part 54.

Mitigation measures were considered for each Category 2 issue. Current measures to mitigate the environmental impacts of plant operation were found to be adequate, and no additional mitigation measures were deemed sufficiently beneficial to be warranted.

The following sections discuss unavoidable adverse impacts, irreversible or irretrievable commitments of resources, and the relationship between local short-term use of the environment and long-term productivity.

9.1.1 Unavoidable Adverse Impacts

An environmental review conducted at the license renewal stage differs from the review conducted in support of a construction permit because the plant 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. The environmental impacts to be evaluated for license renewal are those associated with refurbishment and continued operation during the license renewal term.

The adverse impacts of continued operation identified are considered to be of SMALL significance, and none warrants implementation of additional mitigation measures. The adverse impacts of likely alternatives if ANO-2 ceases operation at or before the expiration of the current OL will not be smaller than those associated with continued operation of this unit, and they may be greater for some impact categories in some locations.

9.1.2 Irreversible or Irretrievable Resource Commitments

The commitment of resources related to construction and operation of ANO-2 during the current license renewal term was made when the plant was built. The resource commitments to be considered in this SEIS are associated with continued operation of the plant for an additional 20 years. These resources include materials and equipment required for plant maintenance and operation, the nuclear fuel used by the reactors, and ultimately, permanent offsite storage space for the spent fuel assemblies.

The most significant resource commitments related to operation during the license renewal term are the fuel and the permanent storage space for spent nuclear fuel. Entergy replaces approximately one-third of the fuel assemblies during every refueling outage, which occurs on an 18-month cycle (Entergy 2003a).

The likely power generation alternatives if ANO-2 ceases operation on or before the expiration of the current OL will require a commitment of resources for construction of the replacement plants as well as for fuel to run the plants.

9.1.3 Short-Term Use Versus Long-Term Productivity

An initial balance between short-term use and long-term productivity of the environment at the ANO-2 site was set when the plant was approved and construction began. That balance is now well established. Renewal of the OL for ANO-2 and continued operation of the plant will not alter the existing balance, but may postpone the availability of the site for other uses. Denial of the application to renew the OL will lead to shutdown of the plant and will alter the balance in a manner that depends on subsequent uses of the site. For example, the environmental consequences of turning the site into a park or an industrial facility are quite different.

9.2 Relative Significance of the Environmental Impacts of License Renewal and Alternatives

The proposed action is renewal of the OL for ANO-2. Chapter 2 describes the site, power plant, and interactions of the plant with the environment. As noted in Chapter 3, no refurbishment and no refurbishment impacts are expected at ANO-2. Chapters 4 through 7

discuss environmental issues associated with renewal of the OL. Environmental issues associated with the no-action alternative and alternatives involving power generation and use reduction are discussed in Chapter 8.

The significance of the environmental impacts from the proposed action (approval of the application for renewal of the OL), the no-action alternative (denial of the application), alternatives involving nuclear, coal-fired, or gas-fired generation of power at the existing ANO-2 site and an unspecified alternate greenfield site, and a combination of alternatives are compared in Table 9-1. Continued use of a closed-cycle cooling system for ANO-2 is assumed for Table 9-1. Substitution of once-through cooling for the recirculating cooling system in the evaluation of the nuclear and natural-gas-fired and coal-fired generation alternatives would result in somewhat greater environmental impacts in some impact categories.

Table 9-1 shows that the significance of the environmental effects of the proposed action are SMALL for all impact categories (except for collective offsite radiological impacts from the fuel cycle and from high-level waste and spent fuel disposal, for which a single significance level was not assigned [Chapter 6]). The alternative actions, including the no-action alternative, may have environmental effects in at least some impact categories that reach MODERATE or LARGE significance.

9.3 Staff Conclusions and Recommendations

Based on (1) the analysis and findings in the GEIS (NRC 1996, 1999); (2) the ER submitted by Entergy (Entergy 2003b); (3) consultation with Federal, State, and local agencies; (4) the staff's own independent review; and (5) the staff's consideration of public comments received during the environmental review, the recommendation of the staff is that the Commission determine that the adverse environmental impacts of license renewal for ANO-2 are not so great that preserving the option of license renewal for energy-planning decisionmakers would be unreasonable.

Table 9-1. Summary of Environmental Significance of Arkansas Nuclear One, Unit 2 License Renewal, the No-Action Alternative, and Alternative Methods of Generation Using Closed-Cycle Cooling

	Proposed Action	No-Action Alternative	Coal-Fired Generation	Natural-Gas-Fired Generation		New Nuclear Generation		Combination of Alternatives	
Impact Category	License Renewal	Denial of Renewal	Greenfield Site[a]	Existing ANO-2 Site	Greenfield Site[a]	Existing ANO-2 Site	Greenfield Site[a]	Existing ANO-2 Site	Greenfield Site[a]
Land Use	SMALL	SMALL	MODERATE to LARGE	SMALL to MODERATE	SMALL to MODERATE	MODERATE	MODERATE to LARGE	SMALL to MODERATE	SMALL to MODERATE
Ecology	SMALL	SMALL	MODERATE to LARGE	MODERATE	SMALL to MODERATE	MODERATE	MODERATE to LARGE	SMALL	SMALL to MODERATE
Water Use and Quality–Surface Water	SMALL	SMALL	SMALL to MODERATE	SMALL	SMALL to MODERATE	SMALL	SMALL to MODERATE	SMALL	SMALL to MODERATE
Water Use and Quality–Groundwater	SMALL	SMALL	SMALL to LARGE	SMALL	SMALL to LARGE	SMALL	SMALL to LARGE	SMALL	SMALL to MODERATE
Air Quality	SMALL	SMALL	MODERATE	MODERATE	MODERATE	SMALL	SMALL	MODERATE	MODERATE
Waste	SMALL	SMALL	MODERATE	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL
Human Health	SMALL[b]	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL
Socioeconomics	SMALL	SMALL to MODERATE	MODERATE to LARGE	SMALL to MODERATE	MODERATE to LARGE	SMALL to LARGE	SMALL to LARGE	SMALL to MODERATE	MODERATE
Aesthetics	SMALL	SMALL	MODERATE to LARGE	SMALL to MODERATE	SMALL to LARGE	SMALL to MODERATE	SMALL to LARGE	SMALL to MODERATE	SMALL to MODERATE
Historic and Archaeological Resources	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL
Environmental Justice	SMALL	SMALL to MODERATE	SMALL to LARGE	SMALL to MODERATE	SMALL to MODERATE	SMALL to MODERATE	SMALL to MODERATE	SMALL to MODERATE	SMALL to MODERATE

(a) For the purpose of bounding potential impacts, a greenfield site is assumed to be an undeveloped site with no previous construction.
(b) Except for collective offsite radiological impacts from the fuel cycle and from high-level waste and spent-fuel disposal, for which a significance level was not assigned. See Chapter 6 for details.

9.4 References

10 CFR Part 51. Code of Federal Regulations, *Title 10, Energy,* Part 51, "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions."

10 CFR Part 54. Code of Federal Regulations, *Title 10, Energy,* Part 54, "Requirements for Renewal of Operating Licenses for Nuclear Power Plants."

68 FR 71174. December 22, 2003. "Notice of Intent to Prepare an Environmental Impact Statement and Conduct Scoping Process." *Federal Register,* U.S. Nuclear Regulatory Commission.

Entergy Operations, Inc. (Entergy). 2003a. *Application for Renewed Operating License, Arkansas Nuclear One, Unit 2.* Russellville, Arkansas.

Entergy Operations, Inc. (Entergy). 2003b. *Applicant's Environmental Report, Operating License Renewal Stage Arkansas Nuclear One, Unit 2.* Russellville, Arkansas.

National Environmental Policy Act of 1969 (NEPA). 42 USC 4321, et seq.

U.S. Atomic Energy Commission (AEC). 1977. *Final Environmental Statement Related to Operation of Arkansas Nuclear One Unit 2, Arkansas Power & Light Company,* Docket No. 50-368. Washington, D.C.

U.S. Nuclear Regulatory Commission (NRC). 1996. *Generic Environmental Impact Statement for License Renewal of Nuclear Plants.* NUREG-1437, Volumes 1 and 2, Washington, D.C.

U.S. Nuclear Regulatory Commission (NRC). 1999. *Generic Environmental Impact Statement for License Renewal of Nuclear Plants: Main Report, Section 6.3, Transportation, Table 9.1, Summary of Findings on NEPA Issues for License Renewal of Nuclear Power Plants.* NUREG-1437, Volume 1, Addendum 1, Washington, D.C.

U.S. Nuclear Regulatory Commission (NRC). 2000. *Standard Review Plans for Environmental Reviews for Nuclear Power Plants, Supplement 1: Operating License Renewal.* NUREG-1555, Supplement 1, Washington, D.C.

U.S. Nuclear Regulatory Commission (NRC). 2004. *Environmental Impact Statement Scoping Process: Summary Report - Arkansas Nuclear One, Unit 2, Pope County, Arkansas.* May 20, 2004, Washington, D.C.

Appendix A

Comments Received on the Environmental Review

Appendix A

Comments Received on the Environmental Review

Part I – Comments Received During Scoping

On October 15, 2003, the U.S. Nuclear Regulatory Commission (NRC) received an application from Entergy Operations, Inc. (Entergy) dated October 14, 2003, for renewal of the operating license (OL) of Arkansas Nuclear One, Unit 2 (ANO-2). ANO-2 is located in Pope County, Arkansas. There are two nuclear power units at the Arkansas Nuclear One site. A final environmental impact statement regarding renewal of the license for Arkansas Nuclear One, Unit 1 (ANO-1) was issued on April 15, 2001, and NRC issued its decision to renew the OL of ANO-1 on June 12, 2001. The OL for ANO-1 was renewed and will expire in 2034. The current ANO-2 OL expires on July 17, 2018. ANO-2 is a pressurized water reactor designed by Combustion Engineering.

As part of the application for renewal of the ANO-2 OL, Entergy submitted an Environmental Report (ER) prepared in accordance with the requirements of the Code of Federal Regulations (CFR) 51, which contains the NRC requirements for implementing the National Environmental Policy Act of 1969 (NEPA) and the implementing regulations promulgated by the Council on Environmental Quality. Section 51.53 outlines requirements for preparation and submission of post-construction ERs to NRC.

Section 51.53(c)(3) was based upon the findings documented in NUREG-1437, *Generic Environmental Impact Statement for License Renewal of Nuclear Power Plants* (GEIS). The GEIS, in which the staff identified and evaluated the environmental impacts associated with license renewal, was first issued as a draft for public comment. The staff received input from Federal and State agencies, public organizations, and private citizens before developing the final document. As a result of the assessments in the GEIS, a number of impacts were determined to be small and to be generic to all nuclear power plants. These small, generic impacts were designated as Category 1 impacts. In the absence of new and significant information that may cause the conclusions to fall outside those of the GEIS, an applicant for license renewal may adopt the conclusions contained in the GEIS for Category 1 impacts. Category 2 impacts are those impacts that have been determined to be plant-specific and are required to be evaluated in the applicant's ER.

The Commission determined that NRC does not have a role in energy planning decisionmaking for existing plants, which should be left to State regulators and utility officials. Therefore, an applicant for license renewal need not provide an analysis of the need for power or the economic costs and economic benefits of the proposed action. Additionally, the Commission determined that the applicant's ER need not discuss any aspect of spent-fuel storage for the

facility that is within the scope of the generic determination in 10 CFR 51.23(a) and in accordance with 10 CFR 51.23(b). This determination was based on the Nuclear Waste Policy Act of 1982 and the Commission's Waste Confidence Rule, 10 CFR 51.23.

On December 22, 2003, NRC published a Notice of Intent in the *Federal Register* (68 FR 71174) to notify the public of the staff's intent to prepare a plant-specific supplement to the GEIS to support the renewal application for the ANO-2 OL. The plant-specific supplement to the GEIS will be prepared in accordance with requirements and guidance provided by NEPA, the Council of Environmental Quality (CEQ), and 10 CFR Part 51. As outlined by NEPA, NRC initiated the scoping process with the issuance of the *Federal Register* Notice of Intent. The NRC invited the applicant, Federal, State, and local government agencies; local organizations; and individuals to participate in the scoping process by providing oral comments at the scheduled public meetings and/or submitting written suggestions and comments no later than February 20, 2004. The scoping process included two public scoping meetings held at the Russellville Holiday Inn in Russellville, Arkansas, on February 3, 2004. NRC announced the meetings in local newspapers (*Arkansas Democrat Gazette*, *Russellville Courier*, *Dardanelle Post Dispatch*, and *Dover Times*), on a cable television channel (Cox Cable), in issued press releases, and through flyers distributed locally. Approximately 40 people attended the meetings, including the NRC environmental review team, members of the public, representatives from Entergy, and representatives from State and local government agencies. Both sessions began with NRC staff members providing a brief overview of the license renewal process and the NEPA process. Following the prepared statements presented by the NRC representatives, the meetings were opened for public participation. The transcripts of the meetings can be found as an attachment to the meeting summary, which was issued on February 24, 2004. The meeting summary is available electronically for public inspection in the NRC Public Document Room or from the Publicly Available Records component of NRC's document system (ADAMS) under accession number ML040570279. ADAMS is accessible from the NRC Website at http://www.nrc.gov/reading-rm/adams.html (the Public Electronic Reading Room) (note the URL is case-sensitive).

The scoping process provides an opportunity for public participation to identify issues to be addressed in the plant-specific supplement to the GEIS and to highlight public concerns and issues. The Notice of Intent identified the following objectives of the scoping process:

- define the proposed action
- determine the scope of the supplement to the GEIS and identify significant issues to be analyzed in depth
- identify and eliminate peripheral issues

- identify any environmental assessments and other environmental impact statements being prepared that are related to the supplement to the GEIS
- identify other environmental review and consultation requirements
- indicate the schedule for preparation of the supplement to the GEIS
- identify any cooperating agencies
- describe how the supplement to the GEIS will be prepared.

At the conclusion of the scoping period, the NRC staff and its contractor reviewed the transcripts and all written material received, and identified individual comments. Four letters containing comments were received during the scoping period. All comments and suggestions received orally during the scoping meetings or in writing were considered. Each set of comments from a given commenter was given a unique alpha identifier (Commenter ID letter), allowing each set of comments from a commenter to be traced back to the letter in which the comments were submitted.

Table A-1 identifies the individuals providing comments and the Commenter ID letter associated with each person's set of comments. The Commenter ID letter is preceded by ANO2-S (which stands for Arkansas Nuclear One Unit 2 scoping). The comments are listed in the order in which they were received. Accession numbers indicate the location of the written comments in ADAMS.

The comments were grouped into the following subsections:

1. Comments Regarding License Renewal and Its Processes (Section A.1.1)
2. Comments Concerning Threatened or Endangered Species Issues (Section A.1.2)
3. Comments Concerning Aquatic Ecology Issues (Section A.1.3)
4. Comments Concerning Socioeconomic Issues (Section A.1.4)

Each comment is summarized in the following pages. For reference, the unique identifier for each comment (Commenter ID letter listed in Table A-1 plus the comment number) is provided.

Table A-1. Individuals Providing Comments During Scoping Comment Period for License Renewal of Arkansas Nuclear One, Unit 2

Commenter ID	Commenter	Affiliation	Date	Comment Source and ADAMS Accession Number
ANO2-S-A	G. Cranmore	National Oceanic and Atmospheric Administration	December 17, 2003	Comment Letter ML040130740
ANO2-S-B	S. Formica	Arkansas Department of Environmental Quality	January 30, 2004	Comment Letter ML040500677
ANO2-S-C	S. R. King	United Keetoowah Band	January 15, 2004	Comment Letter ML040580312
ANO2-S-D	M. Harney	U.S. Fish and Wildlife Service	January 14, 2004	Comment Letter ML040510185

The afternoon and evening transcripts can be found under accession number ML040570279.

In those cases where no new environmental information was provided by the commenter, no further evaluation will be performed.

The ANO-2 supplement to the GEIS (which is the supplemental environmental impact statement [SEIS]) takes into account all the relevant issues raised during the scoping process. The SEIS addresses both Category 1 and Category 2 issues, along with any new information identified as a result of scoping. The SEIS relies on conclusions supported by information in the GEIS for Category 1 issues and includes the analysis of Category 2 issues. The ANO-2 supplement to the GEIS was made available for public comment. The comment period offered the opportunity for the applicant; interested Federal, State, and local government agencies; local organizations; and members of the public to provide input to NRC's environmental review process. The comments received on the draft SEIS were considered in the preparation of the final ANO-2 SEIS. The final ANO-2 SEIS, along with the staff's Safety Evaluation Report, will provide much of the basis for the NRC's decision on the ANO-2 license renewal application.

A.1 Comments and Responses

The comments and suggestions received as part of the scoping process are discussed below. Parenthetical numbers after each comment refer to the Commenter's ID letter and the comment number. Comments can be tracked to the commenter and the source document through the ID letter and comment number listed in Table A-1.

A.1.1 Comments Regarding License Renewal and Its Processes

Comment: The Arkansas Department of Environmental Quality has reviewed the information submitted on the referenced project. We have no comments at this time. (ANO2-S-B-1)

Comment: We have no comment at this time, but reserve the right for future comment. Please keep us informed about this project. (ANO2-S-C-1)

Response: *The comments are general in nature and do not provide any significant, new information; therefore, they will not be evaluated further.*

A.1.2 Comments Concerning Threatened or Endangered Species Issues

As stated in 10 CFR Part 51, Table B-1, threatened or endangered species issues are a Category 2 issue.

Comment: It is National Oceanic and Atmospheric Administration (NOAA) Fisheries' opinion that the project will have no effect on listed species or critical habitat protected by the Endangered Species Act under NOAA Fisheries' purview. No further consultation with NOAA Fisheries pursuant to section 7(a)(2) of the Endangered Species Act is required. Consultation with NOAA Fisheries, Habitat Conservation Division, pursuant to the Magnuson-Stevens Fishery Conservation and Management Act's requirements for essential fish habitat consultation (16 U.S.C. 1855 (b)(2) and 50 CFR 600.905-.930, Subpart K), may be required. (ANO2-S-A-1)

Comment: The endangered least tern (*Sterna antillarum*) and the threatened bald eagle (*Haliaeetus leucocephalus*) are present in the vicinity of the projected area. However, the proposed relicensing of the existing plant is not likely to impact any listed species. (ANO2-S-D-1)

Response: *The comments regarding the presence of threatened or endangered species in the vicinity of the ANO-2 site are general in nature and do not provide significant, new information. Discussions of threatened or endangered species in the vicinity of the ANO-2 site can be found in Chapters 2 and 4 of this draft SEIS.*

A.1.3 Comments Concerning Aquatic Ecology Issues

As stated in 10 CFR Part 51, Table B-1, Category 1 and 2 aquatic ecology issues include:

Category 1 Issues

- Accumulation of contaminants in sediments or biota
- Entrainment of phytoplankton and zooplankton
- Cold shock
- Thermal plume barrier to migrating fish
- Distribution of aquatic organisms
- Premature emergence of aquatic insects
- Gas supersaturation (gas bubble disease)
- Low dissolved oxygen in the discharge
- Losses from predation, parasitism, and disease among organisms exposed to sublethal stresses
- Stimulation of nuisance organisms.

Category 2 Issues

- Entrainment of fish and shellfish in early life stages
- Impingement of fish and shellfish
- Heat shock.

Comment: The Service has become aware that a block net shad barrier is now being used on the entrance to the intake canal during the fall and winter months. The detailed use and effects of this barrier should be included in any environmental assessments and/or environmental impact statements regarding ANO operations. We believe this barrier may have both positive and negative effects on the fishery. In addition to reducing temperature induced shad entrainment and impingement the barrier may also prevent impingement of other healthy species. However, the barrier appears to prevent and/or discourage other species from entering the intake canal, which is a valuable fisheries habitat and a popular recreation fishing location for much of the year. The Service recommends the establishment of specific protocols for the deployment of the barrier only when necessary to prevent increased temperature induced shad entrainment and impingement. Water temperature monitoring, meteorological data, and forecasts should provide sufficient indication of water temperatures approaching and departing shad thermal intolerances. Limiting shad barrier use by having deployment coincide with these water temperatures will maintain habitat availability and recreational use to the maximum extent, while maintaining ANO's ability to reduce shad impingement when necessary. Fisheries and recreational use of the intake canal have historically been reduced during the winter and for

this reason along with the benefits to ANO operations, the Service believes that the use of the barrier when necessary will have limited effects on fisheries or recreation. (ANO2-S-D-2)

Response: *The comments are noted. Chapter 2 of this draft SEIS provides a discussion of the block net shad barrier. Chapter 4 provides an analysis of the environmental impacts of that barrier.*

A.1.4 Comments Concerning Socioeconomic Issues

As stated in 10 CFR Part 51, Table B-1, Category 1 and 2 socioeconomic issues include:

Category 1 Issues

- Public services: public safety, social services, and tourism and recreation
- Public services, education (license renewal term)
- Aesthetics impacts (refurbishment)
- Aesthetics impacts (license renewal)
- Aesthetics impacts of transmission lines (license renewal term).

Category 2 Issues

- Housing impacts
- Public services: public utilities
- Public services, education (refurbishment)
- Offsite land use (refurbishment)
- Offsite land use (license renewal term)
- Public services, transportation
- Historic and archaeological resources.

Comment: Further, the Service is aware that security barriers have been placed in the intake and effluent canals restricting access and recreational use. These restrictions and the effects of these barriers on the fisheries and recreation access should be included in any environmental assessment and/or environmental impact statements regarding ANO operations. These areas provide high quality habitat and water conditions that attract high densities of fish seasonally and therefore these areas and the adjacent waters have been and continue to be popular recreational fishing areas. The Service recommends documenting the loss of these valuable recreational uses and the benefits of creating a fisheries refugia. By restricting access to these areas, ANO is providing high-quality habitat refugia for fish by limiting take or harassment from recreational fishing to adjacent areas. In the past the dense fish concentrations in these areas have resulted in high levels of take. Limiting take will improve the

quality and quantity of the fisheries and recreational fishing in Lake Dardanelle as a whole annually and in the long term. The Service recommends coordinating with the Arkansas Game and Fish Commission and/or other fisheries researchers to examine the effects of these changes on the fisheries in Lake Dardanelle. (ANO2-S-D-3)

Response: *The comments are noted. Chapter 2 of the draft SEIS provides a discussion of the security barriers and the role they play in restricting recreational fishing in the intake and effluent canals. Chapter 4 discusses in detail the environmental impacts the barriers may have on recreational fishing.*

Part II – Comments Received on the Draft SEIS

Pursuant to 10 CFR Part 51, the staff transmitted the *Generic Environmental Impact Statement for License Renewal of Nuclear Plants, Regarding Arkansas Nuclear One, Unit 2, Draft Report for Comment* (NUREG-1437, Supplement 19, referred to as the draft SEIS) to Federal, State, Native American Tribal, and local government agencies as well as interested members of the public. As part of the process to solicit public comments on the draft SEIS, the staff:

- placed a copy of the draft SEIS in the NRC's electronic Public Document Room, on its license renewal website at http://www.nrc.gov, and at the Ross Pendergraft Library at Arkansas Tech University, Russellville, Arkansas
- sent copies of the draft SEIS to the applicant, members of the public who requested copies, and certain Federal, State, Native American Tribal, and local agencies
- published a notice of availability of the draft SEIS in the *Federal Register* on September 7, 2004, (69 FR 54161)
- issued public announcements, such as advertisements in local newspapers and postings in public places, of the availability of the draft SEIS
- announced and held a public meeting in Russellville, Arkansas, on October 21, 2004, to describe the results of the environmental review and answer related questions
- issued public service announcements and press releases announcing the issuance of the draft SEIS, the public meetings, and instructions on how to comment on the draft SEIS
- established a website to receive comments on the draft SEIS through the Internet.

During the comment period, the staff received a total of four comment letters. No comments were received during the public meeting; the staff has reviewed the public meeting transcripts and the comment letters that are part of the docket file for the application, all of which are available in the NRC's electronic Public Document Room. Appendix A, Part II, Section A.2, contains a summary of the comments and the staff's responses. Appendix A, Part II, Section A.3, contains copies of the comment letters.

Each comment identified by the staff was assigned a specific alphanumeric identifier (marker). That identifier is typed in the margin of the letter at the beginning of the discussion of the comment. A cross-reference of the alphanumeric identifiers, the author of the comment, the page where the comment can be found, and the section(s) of this report in which the comment is addressed is provided in Table A-2. The four written comment letters are identified by the letters A through D. The accession number is provided for the written comments after the letter date to facilitate access to the document through the Public Electronic Reading Room (ADAMS) http://www.nrc.gov/reading-rm/adams/login.html.

The staff has determined that comments received are general in nature. In addition, the comments provide no new and significant information and do not relate to safety considerations reviewed under 10 CFR Part 54.

Table A-2. Comments Received on the Draft SEIS

Commenter ID	Commenter	Comment Source and ADAMS Accession Number	Page of Comment	Section(s) Where Addressed
ANO2-D-A1	Sandi Formica, Arkansas Department of Environmental Quality	Comment Letter ML0433502621	A-11	A.2.1
ANO2-D-B1	Ken Grunewald, Department of Arkansas Heritage	Comment Letter, ML0434102730	A-12	A.2.1
ANO2-D-C1	Michael P. Jansky, United States Environmental Protection Agency	Comment Letter, ML0434102710	A-13	A.2.1
ANO2-D-D1	Stephen R. Spencer, United States Department of the Interior	Comment Letter, ML0434102750	A-14	A.2.1

A.2 Comments and Responses on the Draft SEIS

A.2.1 General Comments

Comment: The Arkansas Department of Environmental Quality (ADEQ) has reviewed the information submitted in the referenced Generic Environmental Impact Statement for Arkansas Nuclear One, Unit 2. We have no comments. (A1)

Comment: We have no objection to the renewal of the license for Unit 2 at Nuclear One with the stipulation that any future ground disturbing activity the results from this renewal should be submitted to this office for review. (B1)

Comment: EPA classified your DSEIS and proposed action as "LO," i.e., EPA has "Lack of Objections" to the proposed alternative. (C1)

Comment: The U.S. Department of the Interior has reviewed the Draft Supplemental Environmental Impact Statement, Supplement 19, for License Renewal of Entergy Operations, Inc.'s Arkansas Nuclear One, Unit 2, Pope County, Arkansas. In this regard, we have NO COMMENT. (D1)

Response: *The comments are general in nature. The comments did not provide significant, new information; therefore, they will not be evaluated further.*

A.3 Comment Letters

11/19/04 RDB received
9/7/04
69FR54161
(1)

ADEQ
ARKANSAS
Department of Environmental Quality

November 1, 2004

Chief
Rules and Directives Branch
Division of Administrative Services
Office of Administration
Mailstop T-6D59
U.S. Regulatory Commission
Washington, D.C. 20555-0001

RE: Notice of Availability of the Draft Plant-Specific Supplement 19 to the Generic Environmental Impact Statement (GEIS) Regarding License Renewal of Arkansas Nuclear One, Unit 2, Pope County, Arkansas; TAC NO. MB8405

ANO2-D-A1

Dear Chief:

The Arkansas Department of Environmental Quality (ADEQ) has reviewed the information submitted in the referenced Generic Environmental Impact Statement for Arkansas Nuclear One, Unit 2.

We have no comments.

If you have any questions, please contact Audree Miller at 501-682-0015.

Sincerely,

Sandi Formica
Chief, Environmental Preservation Division

cc: Mary Leath, Chief Deputy Director,
Martin Maner, Water Division
Mike Hile, Air Division
Dennis Green, Hazardous Waste Division

E-RFDS = ADM-03
Addr = T. Kenyon (TSK2)

GEIS Review Complete
Template = ADM013

ARKANSAS DEPARTMENT OF ENVIRONMENTAL QUALITY
8001 NATIONAL DRIVE / POST OFFICE BOX 8913 / LITTLE ROCK, ARKANSAS 72219-8913 / TELEPHONE 501-682-0744 / FAX 501-682-0798
www.adeq.state.ar.us

RDB received 12/1/04

9/7/04
69 FR 54161
(3)

The Department of Arkansas Heritage

Mike Huckabee, Governor
Cathie Matthews, Director

Arkansas Arts Council
•
Arkansas Natural Heritage Commission
•
Historic Arkansas Museum
•
Delta Cultural Center
•
Old State House Museum

Arkansas Historic Preservation Program

1500 Tower Building
323 Center Street
Little Rock, AR 72201
(501)324-9880
fax: (501)324-9184
tdd: (501)324-9811
e-mail: info@arkansaspreservation.org
website: www.arkansaspreservation.org

November 5, 2004

Mr. Samson S. Lee
Acting Program Director
License Renewal and Environmental Impacts
Nuclear Regulatory Commission
Division of Regulatory Improvement Programs
Office of Nuclear Reactor Regulation
Washington, D.C. 20555-0001

RE: Pope County - Russellville
Section 106 Review - NRC
Arkansas Nuclear One, Unit 2 License Renewal Review
(Docket No.: 50-368)
AHPP Tracking No: 53729

Dear Mr. Lee:

My staff has reviewed Supplement 19 to the "Generic Environmental Impact Statement for License Renewal of Nuclear Plants." We have no objection to the renewal of the license for Unit 2 at Nuclear One with the stipulation that any future ground disturbing activity the results from this renewal should be submitted to this office for review. We also remind Entergy Arkansas that it would be in their long term interest to survey the Nuclear One property for cultural resources so that they can be more effectively managed. ANO2-D-B1

Thank you for the opportunity to comment on this undertaking. If you have any questions, please contact Steve Imhoff of my staff at (501) 324-9880.

Sincerely,

Ken Grunewald
Deputy State Historic Preservation Officer

cc: Dr. Richard Allen, Cherokee Nation
Mr. R. Perry Beavers, Muscogee Creek Nation
Mr. Robert Cast, Caddo Tribe of Oklahoma
Mr. Terry Cole, Choctaw Nation of Oklahoma
Ms. Susan D'Auteuil, Arkansas Public Service Commission
Dr. Ann M. Early, Arkansas Archeological Survey
Ms. Carrie V. Wilson, Quapaw Tribe of Oklahoma
Mr. Garry Young, Entergy Operations, Inc.

An Equal Opportunity Employer

SISP Review Complete
Template = ADM-013

E-RIDS = ADM-03
Add = T. Kenyon
(TJK2)

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 6
1445 ROSS AVENUE, SUITE 1200
DALLAS, TX 75202-2733

ix A

November 10, 2004

Thomas J. Kenyon
Chief, Rules Review and Directives Branch
U.S. Nuclear Regulatory Commission
Mail Stop T6-D59
Washington, DC 20555-0001

Dear Mr. Kenyon:

In accordance with our responsibilities under Section 309 of the Clean Air Act, the National Environmental Policy Act (NEPA), and the Council on Environmental Quality Regulations (CEQ) for Implementing NEPA, the U.S. Environmental Protection Agency (EPA) Region 6 office in Dallas, Texas, has completed its review of the Draft Supplemental Environmental Impact Statement (DSEIS) for the proposed operating license (OL) renewal of Arkansas Nuclear One (ANO), Unit 2, located in southwestern Pope County, Arkansas, for an additional 20-year period.

The DEIS evaluates and identifies the potential environmental impacts associated with the Proposed Action and Alternatives, including the No-Action Alternative. The DSEIS concludes that the impacts of the OL renewal for ANO, Unit 2, are not so great that preserving the option of licences renewal would be unreasonable. This recommendation is based on the analysis and findings in the DSEIS, the Environmental Report submitted by Entergy; consultation with Federal, State, and local agencies, NRC staff independent review, and consideration of public comments received during the scoping process.

EPA classified your DSEIS and proposed action as "LO," i.e., EPA has "Lack of Objections" to the proposed alternative. Our classification will be published in the Federal Register according to our responsibility under Section 309 of the Clean Air Act, to inform the public of our views on proposed Federal actions.

ANO2-D-C1

EPA appreciates the opportunity to review the DSEIS. We request that you send our office one (1) copy of the Final SEIS at the same time that it is sent to the Office of Federal Activities (2251A), EPA, 1200 Pennsylvania Avenue, N.W., Washington, D.C. 20044.

Sincerely yours,

Michael P. Jansky, P.E.

Michael P. Jansky, PE
Regional EIS Coordinator

ADD received 12/1/04

United States Department of the Interior

OFFICE OF THE SECRETARY
Office of Environmental Policy and Compliance
P.O. Box 26567 (MC-9)
Albuquerque, New Mexico 87125-6567

TAKE PRIDE IN AMERICA

November 23, 2004

9/7/04
69FR 54161
(2)

9043.1
ER 04/666

Chief, Rules and Directives Branch
Division of Administrative Services
Office of Administration
Mailstop T-6D59
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

Dear Sir/Madam:

ANO2-D-D1

The U.S. Department of the Interior has reviewed the Draft Supplemental Environmental Impact Statement, Supplement 19, for License Renewal of Entergy Operations, Inc.'s Arkansas Nuclear One, Unit 2, Pope County, Arkansas. In this regard, we have NO COMMENT.

Thank you for the opportunity to review this document.

Sincerely,

Stephen R. Spencer
Regional Environmental Officer

SISP Review Complete
Template = ADM-013

E-RIDS = ADM-03
Add = T. Kenyon (TJK2)

Appendix B

Contributors to the Supplement

Appendix B

Contributors to the Supplement

The overall responsibility for the preparation of this supplement was assigned to the Office of Nuclear Reactor Regulation, U.S. Nuclear Regulatory Commission. The statement was prepared by members of the Office of Nuclear Reactor Regulation with assistance from Pacific Northwest National Laboratory and Information Systems Laboratory.

Name	Affiliation	Function or Expertise
	NUCLEAR REGULATORY COMMISSION	
T. J. Kenyon	Nuclear Reactor Regulation	Project Manager
S. Imboden	Nuclear Reactor Regulation	Project Manager
A. Kugler	Nuclear Reactor Regulation	Section chief
M. Masnik	Nuclear Reactor Regulation	Project Management, Ecology
J. Tappert	Nuclear Reactor Regulation	Former Section Chief
R. Palla	Nuclear Reactor Regulation	Severe Accident Mitigation Alternatives
A. Williamson	Nuclear Reactor Regulations	General Scientist
	PACIFIC NORTHWEST NATIONAL LABORATORY[a]	
D. A. Neitzel		Task Leader
K. D. Leigh		Deputy Task Leader
J.A. Stegen		Deputy Task Leader
J. V. Ramsdell, Jr.		Meteorology and Air Quality
M. J. Scott		Socioeconomics, Environmental Justice, and Alternatives
E. E. Hickey		Decommissioning and Radiation Protection
A. L. Bunn		Aquatic Ecology
C. A. Brandt		Terrestrial Ecology
L. W. Vail		Hydrology and Alternatives
P. L. Hendrickson		Land Use and Related Federal Programs
P. R. Nickens		Cultural Resources
C. A. Counts		Technical Editor
B. K. Wilson		Publication Assistant
T. I. Russell		Publication Design
D. A. Schulz		Publication Design
S. M. Tackett		Publication Design
R. M. Urbina		Publication Design
	INFORMATION SYSTEMS LABORATORY	
K. Green		Severe Accident Mitigation Alternatives

(a) Pacific Northwest National Laboratory is operated for the U.S. Department of Energy by Battelle Memorial Institute.

Appendix C

Chronology of NRC Staff Environmental Review Correspondence Related to Entergy Operations, Inc.'s Application for License Renewal of Arkansas Nuclear One, Unit 2

Appendix C

Chronology of NRC Staff Environmental Review Correspondence Related to Entergy Operations, Inc.'s Application for License Renewal of Arkansas Nuclear One, Unit 2

This appendix contains a chronological listing of correspondence between the U.S. Nuclear Regulatory Commission (NRC) and Entergy Operations, Inc. (Entergy) and other correspondence related to the NRC staff's environmental review, under Title 10 of the Code of Federal Regulations Part 51, of Entergy's application for renewal of the Arkansas Nuclear One, Unit 2 (ANO-2) operating license. All documents, with the exception of those containing proprietary information, have been placed in the Commission's Public Document Room, at One White Flint North, 11555 Rockville Pike (first floor), Rockville, MD, and are available electronically from the Public Electronic Reading Room found on the Internet at the following web address: http://www.nrc.gov/reading-rm.html. From this site, the public can gain access to the NRC's Agencywide Document Access and Management Systems (ADAMS), which provides text and image files of NRC's public documents in the Publicly Available Records (PARS) component of ADAMS. The ADAMS accession numbers for each document are included below.

October 14, 2003	Letter from Mr. Craig G. Anderson, Entergy, to NRC, submitting the application for the renewal of the operating license for ANO-2 (Accession No. ML032890492).
October 14, 2003	Letter from NRC to Ms. Francis Hager, Ross Pendergraft Library, regarding the maintenance of reference material for the ANO-2 license renewal application (Accession No. ML032870521).
October 21, 2003	Letter from NRC to Mr. Craig G. Anderson, Entergy, regarding the receipt and availability of the license renewal application for ANO-2 (Accession No. ML032940160).
October 24, 2003	Federal Register Notice of receipt of application for renewal of Facility Operating License No. NPF-6 for an additional 20-year period (68 FR 61020).
October 24, 2003	NRC press release announcing the availability of the license renewal application for ANO-2 (Accession No. ML032970035).

November 14, 2003 Letter from NRC to Mr. Craig G. Anderson, Entergy, regarding acceptance of the application for license renewal of ANO-2 and opportunity for a hearing (Accession No. ML033210028).

November 20, 2003 NRC press release announcing opportunity for hearing on application for license renewal of ANO-2 (Accession No. ML033240195).

November 24, 2003 Federal Register Notice of acceptance for docketing of the application and notice of opportunity for a hearing regarding the application for license renewal of ANO-2 (68 FR 65963).

December 9, 2003 Letter from NRC to Ms. Margaret Harney, U.S. Fish and Wildlife Service, requesting a list of protected species within the area under evaluation for license renewal of ANO-2 (Accession No. ML033440389).

December 11, 2003 Letter from NRC to Dr. Roy Crabtree, NOAA Fisheries, requesting a list of protected species within the area under evaluation for license renewal of ANO-2 (Accession No. ML033450067).

December 13, 2003 Letter from NRC to Chief Jerry G. Haney, Seminole Nation of Oklahoma, inviting participation in the environmental scoping process for the license renewal of ANO-2 (Accession No. ML033500198).

December 13, 2003 Letter from NRC to Chief Chadwick Smith, Cherokee Nation of Oklahoma, inviting participation in the environmental scoping process for the license renewal of ANO-2 (Accession No. ML033500127).

December 15, 2003 Letter from NRC to Chief R. Perry Beaver, Muscogee (Creek) Nation of Oklahoma, inviting participation in the environmental scoping process for the license renewal of ANO-2 (Accession No. ML033500439).

December 15, 2003 Letter from NRC to Chairman John Berrey, Quapaw Tribe of Oklahoma, inviting participation in the environmental scoping process for the license renewal of ANO-2 (Accession No. ML033500225).

December 15, 2003 Letter from NRC to Chief Jim Gray, Osage Nation, inviting participation in the environmental scoping process for the license renewal of ANO-2 (Accession No. ML033500352).

December 15, 2003	Letter from NRC to Chief Gregory E. Pyle, Choctaw Nation of Oklahoma, inviting participation in the environmental scoping process for the license renewal of ANO-2 (Accession No. ML033510533).
December 17, 2003	Letter from NOAA Fisheries providing a response to the December 11, 2003 NRC staff letter requesting information regarding protected species within the area under evaluation for license renewal of ANO-2 (Accession No. ML040130740).
December 17, 2003	Letter from NRC to Mr. Jeff Forbes, Entergy, forwarding the Notice of Intent to Prepare an Environmental Impact Statement and Conduct Scoping Process for the license renewal of ANO-2 (Accession No. ML033520123).
December 17, 2003	Letter from NRC to Mr. Don Klima, Advisory Council on Historic Preservation, inviting comments on the effects of license renewal of ANO-2 on historic properties in accordance with the National Historic Preservation Act (Accession No. ML033520264).
December 17, 2003	Letter from NRC to Mr. George McCluskey, State Historic Preservation Office, inviting participation in the environmental scoping process for license renewal of ANO-2 and requesting a determination of effects of license renewal on historic properties in accordance with the National Historic Preservation Act (Accession No. ML033520174).
December 18, 2003	Letter from NRC to Chairperson LaRue Parker, Caddo Nation, inviting participation in the environmental scoping process for the license renewal of ANO-2 (Accession No. ML033520394).
December 22, 2003	Federal Register Notice of Intent to Prepare an Environmental Impact Statement and Conduct Scoping Process regarding the application for license renewal of ANO-2 (68 FR 71174).
January 14, 2004	NRC meeting notice announcing public meeting in Russellville, Arkansas on February 3, 2004, to discuss the environmental scoping process for the application for the license renewal of ANO-2 (Accession No. ML040160640).

January 14, 2004	Letter from Margaret Harney, U.S. Fish and Wildlife Service, providing a response to the December 9, 2003 NRC staff letter requesting information regarding protected species within the area under evaluation for license renewal of ANO-2 (Accession No. ML040510185).
January 15, 2004	Letter from Summer R. King, United Keetoowah Band, providing no comments on environmental scoping process for the license renewal of ANO-2 (Accession No. ML040580312).
January 30, 2004	Letter from Sandi Formica, Arkansas Department of Environmental Quality, providing no comments on environmental scoping process for the license renewal of ANO-2 (Accession No. ML040500677).
February 24, 2004	Letter from NRC to Mr. Jeff Forbes, Entergy, transmitting request for additional information regarding severe accident mitigation alternatives for ANO-2 (Accession No. ML040570889).
February 24, 2004	Summary of Public Scoping Meetings to Support Review of the ANO-2 License Renewal Application (Accession No. ML040570279).
March 16, 2004	Summary of Site Audit to Support Review of the ANO-2 License Renewal Application (Accession No. ML040760664).
April 23, 2004	Letter from Timothy G. Mitchell, Entergy, to NRC regarding February 24, 2004 request for additional information regarding severe accident mitigation alternatives for ANO-2 (Accession No. ML041190272).
April 27, 2004	Summary of Telecommunication with Entergy to discuss the response to the Severe Accident Mitigation Alternatives Requests for Additional Information (Accession No. ML041200441).
May 20, 2004	Issuance of Environmental Scoping Summary Report associated with the Staff's Review of the Application by Entergy for renewal of the Operating License for ANO-2 (Accession No. ML041420534).
June 8, 2004	Letter from NRC to Ms. Margaret Harney, U.S. Fish and Wildlife Service, providing a Biological Assessment of impacts to listed species from the proposed license renewal of ANO-2 (Accession No. ML041610069).

June 29, 2004	Letter from Ms. Margaret Harney, U.S. Fish and Wildlife Service, concurring with conclusions of the Biological Assessment (Accession No. ML042010064).
July 6, 2004	Letter from Ms. Sandi Formica, Arkansas Department of Environmental Quality, providing comments on the Biological Assessment dated June 8, 2004 (Accession No. ML043070230).
July 8, 2004	Summary of Telecommunication with Entergy to discuss the response to the Severe Accident Mitigation Alternatives Requests for Additional Information (Accession No. ML041950152).
July 15, 2004	Letter from Mr. Timothy G. Mitchell, Entergy, to NRC providing clarification to a response to a request for additional information (Accession No. ML042100600).
August 30, 2004	Letter from NRC to Mr. Jeffery Forbes, Entergy, regarding the notice of availability of draft Supplement 19 to the Generic Environmental Impact Statement Regarding License Renewal for ANO-2 (Accession No. ML042430627).
August 30, 2004	Letter from NRC to U.S. Environmental Protection Agency transmitting draft Supplement 19 to the Generic Environmental Impact Statement Regarding License Renewal for ANO-2 (Accession No. ML042430559).
September 7, 2004	Federal Register Notice of availability of the draft Supplement 19 to the Generic Environmental Impact Statement and Public Meeting for the License Renewal of ANO-2 (69 FR 54161).
October 4, 2004	NRC press release announcing the availability of the draft Supplement 19 to the Generic Environmental Impact Statement Regarding License Renewal for ANO-2 (Accession No. ML042780231).
October 6, 2004	NRC meeting notice announcing public meeting in Russellville, Arkansas, on October 21, 2004, to discuss the draft Supplemental Environmental Impact Statement for the license renewal of ANO-2 (Accession No. ML042800087).

November 1, 2004	Letter from Ms. Sandi Formica, Arkansas Department of Environmental Quality, regarding the draft Supplement 19 to the Generic Environmental Impact Statement Regarding License Renewal for ANO-2 (Accession No. ML043350262).
November 5, 2004	Letter from Mr. Ken Grunewald, State Historic Preservation Office, to NRC providing comments on the draft Supplement 19 to the Generic Environmental Impact Statement Regarding License Renewal for ANO-2 (Accession No. ML043410273).
November 10, 2004	Letter from Mr. Michael Jansky, US Environmental Protection Agency, Region 6, to NRC regarding the draft Supplement 19 to the Generic Environmental Impact Statement Regarding License Renewal for ANO-2 (Accession No. ML043410271).
November 19, 2004	Summary of Public draft Supplemental Environmental Impact Statement Meeting to Support Review of the ANO-2 License Renewal Application (Accession No. ML043280679).
November 23, 2004	Letter from Mr. Stephen Spencer, U.S. Department of Interior, to NRC regarding the draft Supplement 19 to the Generic Environmental Impact Statement Regarding License Renewal for ANO-2 (Accession No. ML043410275).

Appendix D

Organizations Contacted

Appendix D

Organizations Contacted

During the course of the staff's independent review of environmental impacts from operations during the renewal term, the following Federal, State, regional, local, and Native American tribal agencies were contacted:

Arkansas Archaeological Survey, Russellville, Arkansas

Arkansas Archaeological Survey, Arkansas Tech University, Russellville, Arkansas

Arkansas Department of Environmental Quality, Little Rock, Arkansas

Arkansas Game and Fish Commission, Little Rock, Arkansas

Arkansas Historic Preservation Program, Little Rock, Arkansas

Arkansas River Valley Regional Library, Russellville, Arkansas

Arkansas Valley Alliance, Russellville, Arkansas

Caddo Nation, Binger, Oklahoma

Cherokee Nation of Oklahoma, Tahlequah, Oklahoma

Choctaw Nation of Oklahoma, Durant, Oklahoma

Muscogee (Creek) Nation of Oklahoma, Okmulgee, Oklahoma

National Oceanic and Atmospheric Administration, St. Petersburg, Florida

Osage Nation, Pawhuska, Oklahoma

Pope County Collector, Russellville, Arkansas

Pope County Department of Human Services, Russellville, Arkansas

Pope County Judge, Judge J. Ed Gibson, Russellville, Arkansas

Pope County Salvation Army, Russellville, Arkansas

Appendix D

Pope County Treasurer, Russellville, Arkansas

Quapaw Tribe of Oklahoma, Fayetteville, Arkansas

Seminole Nation of Oklahoma, Wewoka, Oklahoma

U.S. Fish and Wildlife Service, Conway, Arkansas

Appendix E

Entergy Operations, Inc.
Compliance Status and Consultation Correspondence

Appendix E

Entergy Operations Inc.
Compliance Status and Consultation Correspondence

Correspondence sent and received during the process of evaluating the application for renewal of the license for Arkansas Nuclear One, Unit 2 (ANO-2) is identified in Table E-1. Copies of the correspondence are included at the end of this appendix.

The licenses, permits, consultations, and other approvals obtained from Federal, State, regional, and local authorities for ANO-2 are listed in Table E-2.

Table E-1. Consultation Correspondence Regarding License Renewal for Arkansas Nuclear One, Unit 2

Source	Recipient	Date of Letter
U.S. Nuclear Regulatory Commission	Ms. M. Harney, U.S. Fish and Wildlife Service	December 9, 2003 (Accession No. ML033440389)
U.S. Nuclear Regulatory Commission	Dr. R. Crabtree, National Oceanic Atmospheric Administration Fisheries	December 11, 2003 (Accession No. ML033450067)
U.S. Nuclear Regulatory Commission	Mr. J. Haney, Principal Chief, Seminole Nation of Oklahoma	December 13, 2003 (Accession No. ML033500198)
U.S. Nuclear Regulatory Commission	Mr. C. Smith, Principal Chief, Cherokee Nation of Oklahoma	December 13, 2003 (Accession No. ML033500127)
U.S. Nuclear Regulatory Commission	Mr. R. Beaver, Principal Chief, Muscogee (Creek) Nation of Oklahoma	December 15, 2003 (Accession No. ML033500439)
U.S. Nuclear Regulatory Commission	Mr. J. Berrey, Chairman, Quapaw Tribe of Oklahoma	December 15, 2003 (Accession No. ML033500225)
U.S. Nuclear Regulatory Commission	Mr. J. Gray, Principal Chief, Osage Nation	December 15, 2003 (Accession No. ML033500352)

Table E-1. (contd)

Source	Recipient	Date of Letter
U.S. Nuclear Regulatory Commission	Mr. G. Pyle, Chief, Choctaw Nation of Oklahoma	December 15, 2003 (Accession No. ML033510533)
G. Cranmore, NOAA Fisheries	U.S. Nuclear Regulatory Commission	December 17, 2003 (Accession No. ML040130740).
U.S. Nuclear Regulatory Commission	Mr. D. Klima, Director, Advisory Council on Historic Preservation	December 17, 2003 (Accession No. ML033520264)
U.S. Nuclear Regulatory Commission	Mr. G. McCluskey, State Historic Preservation Office	December 17, 2003 (Accession No. ML033520174)
U.S. Nuclear Regulatory Commission	Ms. L. Parker, Tribal Chairperson, Caddo Nation	December 18, 2003 (Accession No. ML033520394)
Ms. M. Harney, U.S. Fish and Wildlife Service	U.S. Nuclear Regulatory Commission	January 14, 2004 (Accession No. ML040510185)
S. R. King, United Keetoowah Band	U.S. Nuclear Regulatory Commission	January 15, 2004 (Accession No. ML040580312)
S. Formica, Arkansas Department of Environmental Quality	U.S. Nuclear Regulatory Commission	January 30, 2004 (Accession No. ML040500677)
U.S. Nuclear Regulatory Commission	Ms. M. Harney, U.S. Fish and Wildlife Service	June 8, 2004 (Accession No. ML041610066)
Ms. M. Harney, U.S. Fish and Wildlife Service	U.S. Nuclear Regulatory Commission	June 29, 2004 (Accession No. ML0420100640)

Table E-2. Federal, State, Local, and Regional Licenses, Permits, Consultations, and Other Approvals for Arkansas Nuclear One, Unit 2

Agency	Authority	Description	Number	Issue Date	Expiration Date	Remarks
NRC	10 CFR Part 50	Operating license, Arkansas Nuclear One, Unit 2	NPF-6	July 17, 1978	July 17, 2018	Authorizes operation of Unit 2
NRC	10 CFR Part 50	Operation license, Arkansas Nuclear One, Unit 1	DPR-51	May 21,1974	May 20, 2034	Authorizes operation of Unit 1
ADEQ	Federal Water Pollution Control Act Section 402	NPDES Permit	ARD0001392	January 1, 2003	December 31, 2007	Plant wastewater discharges to Lake Dardanelle
ADEQ	Resource Conservation and Recovery Act – Subtitle C	Hazardous Waste Generator	ARD0006327 52	Not Applicable	Not Applicable	Hazardous waste generation
ADEQ	Clean Air Act Section 112	Discharge Permit		October 11, 2002	No expiration	Operation of air emission sources (diesel generators and boilers)
ASWCC	Not Applicable	Water Use Registration	4124	Not Applicable	Not Applicable	Divert water from Lake Dardanelle for plant use
ADEQ	RCRA – Subtitle I	Petroleum Storage Tank Registration	58000008 58000009	July 31, 2003	July 31, 2004	Underground diesel fuel storage
CILRWC	Export Authorization Letter	Export Permit	None	July 2, 2002	Expires June 30, 2004	Shipment of radioactive waste outside the regional compact
ACE	Clean Water Act Section 404	Dredging Permit	00241-5	Issued March 27, 1997	No expiration	Dredging of intake canal as needed
ACE	Title 10 USC Section 2668	Dardanelle Water Use Agreement	DACW03-71-0002	November 3, 1972	No expiration	Evaporative water loss from Lake Dardanelle
DOT	49 CFR 107, Subpart G	Registration	053002 034 034K	May 9, 2003	June 30, 2004	Radioactive and hazardous materials shipments
SCDHEC	South Carolina Radioactive Waste Transportation and Disposal Act (SC Code of Laws 13-7-110 et seq.)	Radioactive Waste Transport Permit	0047-03-03-X	December 31, 2003	December 31, 2004	Transportation of radioactive waste to disposal facility in South Carolina
TDEC	TCA 58-202-206	Radioactive Waste for License	T-AR001-L03	January 5, 2004	December 31, 2004	Shipment of radioactive waste to disposal/processing facility in Tennessee

Table E-2. (contd)

Agency	Authority	Description	Number	Issue Date	Expiration Date	Remarks
UDEQ	Land Disposal for Utah R313-26	Radioactive Waste Transport Permit	0209001642	October 9, 2003	October 10, 2004	Shipment of low-level radioactive waste to Envirocare of Utah, Inc

ACE = U.S. Army Corps of Engineers
ADEQ = Arkansas Department of Environmental Quality
ASWCC = Arkansas Soil and Water Conservation Commission
CILRWC = Central Interstate Low-Level Radioactive Waste Commission
CFR = *Code of Federal Regulations*
DOT = U.S. Department of Transportation
NRC = U.S. Nuclear Regulatory Commission
UDEQ = Utah Department of Environmental Quality (Division of Radiation Control)
SCDHEC = South Carolina Department of Health and Environmental Control
TDEC = Tennessee Department of Environment and Conservation
USC = United States Code

December 9, 2003

Ms. Margaret Harney
Senior Field Biologist
U.S. Fish and Wildlife Service
Arkansas Ecological Services Field Office
1500 Museum Road, Suite 105
Conway, AR 72032

SUBJECT: REQUEST FOR LIST OF PROTECTED SPECIES WITHIN THE AREA UNDER EVALUATION FOR ARKANSAS NUCLEAR ONE UNIT 2 LICENSE RENEWAL

Dear Ms. Harney:

The U.S. Nuclear Regulatory Commission (NRC) is reviewing an application submitted by Entergy Operations, Inc. (Entergy) for the renewal of the operating license for Arkansas Nuclear One Unit 2 (ANO-2). ANO-2 is located in Pope County, Arkansas, approximately 6 miles west-northwest of Russellville, Arkansas. As part of the review of the license renewal application, the NRC is preparing a Supplemental Environmental Impact Statement (SEIS) under the provision of the National Environmental Policy Act (NEPA) of 1969, as amended, which includes an analysis of pertinent environmental issues, including endangered or threatened species and impacts to fish and wildlife. This letter is being submitted under the provisions of the Endangered Species Act of 1973, as amended and the Fish and Wildlife Coordination Act of 1934, as amended.

The proposed action would include use and continued maintenance of existing plant facilities and transmission lines and would not result in new construction or disturbance. Any maintenance activities would be limited to previously disturbed areas. In total, for the specific purpose of connecting ANO-2 to the regional transmission system, there is one 500-kilovolt line which is approximately 91 miles in length. In Arkansas, this transmission line traverses the counties of Pope, Conway, Faulkner, Saline and Pulaski. Enclosure 1 is a figure from Entergy's Environmental Report showing the location of the 500-kilovolt transmission line. Enclosure 2 is a figure from Entergy's Environmental Report showing the site boundary.

ANO-2 uses a closed-cycle cooling system with one natural-draft cooling tower used to dissipate waste heat to the atmosphere. Cooling water is drawn from Lake Dardanelle through a canal to the intake structure. After moving through the condensor, circulating water rejects waste heat to the atmosphere using the natural-draft cooling tower. Approximately 75% of the cooling water is evaporated in the natural-draft cooling tower and the remaining waste heat is discharged in the form of blowdown from the circulating water system to a canal which discharges to Lake Dardanelle. This blowdown is mixed with the ANO-1 circulating water system discharge. The plant does not use groundwater to meet its water supply needs. Drinking water is provided by the City of Russellville.

To support the environmental impact statement preparation process and to ensure compliance with Section 7 of the Endangered Species Act, the NRC requests a list of species and

information on protected, proposed, and candidate species and critical habitat that may be in the vicinity of ANO-2 and its associated transmission line. In addition, please provide any information you consider appropriate under the provisions of the Fish and Wildlife Coordination Act of 1934.

Beginning on February 3, 2004, we plan to conduct a site audit. We plan to hold two public NEPA scoping meetings on February 3, 2004, at the Holiday Inn, 2407 North Arkansas Avenue, Russellville, Arkansas 72802. You and your staff are invited to attend both the site audit and the public meetings. Your office will receive a copy of the draft SEIS along with a request for comments. The anticipated publication date for the draft SEIS is September 2004.

If you have any questions concerning ANO-2, the license renewal application, or other aspects of this project, please contact Mr. Thomas Kenyon, Environmental Project Manager, at (301) 415-1120 or by e-mail at TJK2@nrc.gov.

Sincerely,

/RA/

Pao-Tsin Kuo, Program Director
License Renewal and Environmental Impacts
Division of Regulatory Improvement Programs
Office of Nuclear Reactor Regulation

Docket Nos.: 50-368

Enclosures: As stated

December 11, 2003

Dr. Roy Crabtree
Regional Administrator
NOAA Fisheries
Southeast Regional Office
9721 Executive Center Drive North
St. Petersburg, FL 33702

SUBJECT: REQUEST FOR LIST OF PROTECTED SPECIES WITHIN THE AREA UNDER EVALUATION FOR ARKANSAS NUCLEAR ONE UNIT 2 LICENSE RENEWAL

Dear Dr. Crabtree:

The U.S. Nuclear Regulatory Commission (NRC) is reviewing an application submitted by Entergy Operations, Inc. (Entergy) for the renewal of the operating license for Arkansas Nuclear One, Unit 2 (ANO-2). ANO-2 is located in Pope County, Arkansas, approximately 6 miles west-northwest of Russellville, Arkansas. As part of the review of the license renewal application, the NRC is preparing a Supplemental Environmental Impact Statement (SEIS) under the provisions of the National Environmental Policy Act (NEPA) of 1969, as amended, which includes an analysis of pertinent environmental issues, including endangered or threatened species and impacts to fish and wildlife. This letter is being submitted under the provisions of the Endangered Species Act of 1973, as amended, and the Fish and Wildlife Coordination Act of 1934, as amended.

The proposed action would include use and continued maintenance of existing plant facilities and transmission lines and would not result in any new construction or disturbance. Any maintenance activities would be limited to previously disturbed areas. In total, for the specific purpose of connecting ANO-2 to the regional transmission system, there is one 500-kilovolt line which is approximately 91 miles in length. In Arkansas, this transmission line traverses the counties of Pope, Conway, Faulkner, Saline and Pulaski. Enclosure 1 is a figure from Entergy's Environmental Report showing the location of the 500-kilovolt transmission line. Enclosure 2 is a figure from Entergy's Environmental Report showing the site boundary.

ANO-2 uses a closed-cycle cooling system with one natural-draft cooling tower used to dissipate waste heat to the atmosphere. Cooling water is drawn from Lake Dardanelle through a canal to the intake structure. After moving through the condensor, circulating water rejects waste heat to the atmosphere using the natural-draft cooling tower. Approximately 75% of the cooling water is evaporated in the natural-draft cooling tower and the remaining waste heat is discharged in the form of blowdown from the circulating water system to a canal which discharges to Lake Dardanelle. This blowdown is mixed with the ANO-1 circulating water system discharge. The plant does not use groundwater to meet its water supply needs. Drinking water is provided by the City of Russellville.

To support the environmental impact statement preparation process and to ensure compliance with Section 7 of the Endangered Species Act, the NRC requests that NOAA Fisheries provide

a list of species and information on protected, proposed, and candidate species and critical habitat that may be in the vicinity of ANO-2 and its associated transmission line. In addition, please provide any information you consider appropriate under the provisions of the Fish and Wildlife Coordination Act. The NRC has also contacted the Fish and Wildlife Service and requested a list of species and information on protected, proposed, and candidate species and critical habitat that may be in the vicinity of ANO-2 and its associated transmission line.

Beginning on February 3, 2004, we plan to conduct a site audit. We plan to hold two public NEPA scoping meetings on February 3, 2004, at the Holiday Inn, 2407 North Arkansas Avenue, Russellville, Arkansas 72802. You and your staff are invited to attend both the site audit and the public meetings. Your office will receive a copy of the draft SEIS along with a request for comments. The anticipated publication date for the draft SEIS is September 2004.

If you have any questions concerning ANO-2, the license renewal application, or other aspects of this project, please contact Mr. Thomas Kenyon, Environmental Project Manager, at (301) 415-1120 or by e-mail at TJK2@nrc.gov.

Sincerely,

/RA/

Pao-Tsin Kuo, Program Director
License Renewal and Environmental Impacts
Division of Regulatory Improvement Programs
Office of Nuclear Reactor Regulation

Docket Nos.: 50-368

Enclosures: As stated

December 13, 2003

Mr. Jerry G. Haney
Principal Chief
Seminole Nation of Oklahoma
P.O. Box 1498
Wewoka, Oklahoma 74884

SUBJECT: U.S. NUCLEAR REGULATORY COMMISSION REVIEW OF THE ARKANSAS NUCLEAR ONE, UNIT 2 LICENSE RENEWAL APPLICATION

Dear Mr. Haney:

The U.S. Nuclear Regulatory Commission (NRC) is seeking input for its environmental review of an application from Entergy Operations, Inc. (Entergy) to renew its operating license for Arkansas Nuclear One, Unit 2 (ANO-2), located in Pope County, Arkansas, approximately 6 miles west-northwest of Russellville, Arkansas. ANO-2 is in close proximity to lands that may be of interest to the Seminole Nation. As described below, the NRC process includes an opportunity for public participation in the environmental review. We want to ensure that you are aware of our efforts and, pursuant to 10 CFR 51.28(b), the NRC invites the Seminole Tribal Community to provide input to the scoping process relating to the NRC's environmental review of the application. In addition, as outlined in 36 CFR 800.8, the NRC plans to coordinate compliance with section 106 of the National Historic Preservation Act of 1966 through the requirements of the National Environmental Policy Act of 1969.

The NRC will hold public scoping meetings for the ANO-2 license renewal supplement to the NRC's "Generic Environmental Impact Statement for License Renewal of Nuclear Plants" (GEIS) (NUREG-1437). These scoping meetings will be held at the Holiday Inn, 2407 North Arkansas Avenue, Russellville, Arkansas 72802, on Tuesday, February 3, 2004. There will be two sessions to accommodate interested parties. The first session will convene at 1:30 p.m. and will continue until 4:30 p.m., as necessary. The second session will convene at 7:00 p.m., with a repeat of the overview portions of the meeting, and will continue until 10:00 p.m., as necessary. Additionally, the NRC staff will host informal discussions one hour before the start of each session. No formal comments on the proposed scope of the supplement to the GEIS will be accepted during the informal discussions. To be considered, comments must be provided either at the transcribed public meetings or in writing. The application and the environmental review process are described below.

Under NRC regulations, the original operating license for a nuclear power plant is issued for up to 40 years. The license may be renewed for up to an additional 20 years if NRC requirements are met. The current operating license for ANO-2 will expire in 2018. Entergy submitted an environmental report as part of its application for renewal of the ANO-2 operating license on October 15, 2003. The application is electronically available for inspection from the Publicly Available Records component of NRC's Agencywide Documents Access and Management System (ADAMS). ADAMS is accessible at http://www.nrc.gov/reading-rm/adams.html, which

provides access through the NRC's Public Electronic Reading Room (PERR) link. If you do not have access to ADAMS or if there are problems in accessing the documents located in ADAMS, contact the NRC's Public Document Room (PDR) Reference staff at 1-(800)-397-4209, (301) 415-4737, or by e-mail to pdr@nrc.gov. In addition, the application can be viewed on the Internet at http://www.nrc.gov/reactors/operating/licensing/renewal/applications/ano-2.html.

A paper copy of the document can be viewed at the NRC's PDR, located at One White Flint North, 11555 Rockville Pike (first floor), Rockville, Maryland, 20852-2738, and at the Ross Pendergraft Library at Arkansas Tech University, located at 305 West Q Street, Russellville, Arkansas, 72801. Also, the GEIS assesses the scope and impact of environmental effects that would be associated with license renewal at any nuclear power plant site. A copy of this document can also be found on the NRC's website or at the NRC's PDR.

The NRC is gathering information for the document that will be a ANO-2 site-specific supplement to the GEIS. The supplement will contain the results of the review of the environmental impacts on the area surrounding the ANO site that are related to terrestrial ecology, aquatic ecology, hydrology, cultural resources, and socioeconomic issues (among others) and will contain a recommendation regarding the environmental acceptability of the license renewal action.

Please submit any written comments the Seminole Tribal Community may have to offer on the scope of the environmental review by February 20, 2004. Comments should be submitted either by mail to the Chief, Rules and Directives Branch, Division of Administrative Services, Mail Stop T-6D59, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555-0001, or by e-mail to ANOEIS@nrc.gov.

At the conclusion of the scoping process, the NRC staff will prepare a summary of the significant issues identified, the conclusions reached, and will mail a copy to you.

The NRC will prepare a draft supplemental environmental impact statement (SEIS) for public comment, and will hold another public meeting in the site vicinity to solicit comments on the draft. A copy of the draft SEIS will be sent to you for your review and comment. After consideration of public comments received on the draft, the NRC will prepare a final SEIS. The

final environmental impact statement for ANO-2 is planned for April 2005. If you need additional information regarding the environmental review process, please contact Thomas Kenyon, Environmental Project Manager, at (301) 415-1120.

Sincerely,
/RA/
Pao-Tsin Kuo, Program Director
License Renewal and Environmental Impacts Program
Division of Regulatory Improvement Programs
Office of Nuclear Reactor Regulation

Docket Nos.: 50-368

December 13, 2003

Mr. Chadwick Smith
Principal Chief
Cherokee Nation of Oklahoma
P.O. Box 948
Tahlequah, OK 74465

SUBJECT: U.S. NUCLEAR REGULATORY COMMISSION REVIEW OF THE ARKANSAS NUCLEAR ONE, UNIT 2 LICENSE RENEWAL APPLICATION

Dear Mr. Smith:

The U.S. Nuclear Regulatory Commission (NRC) is seeking input for its environmental review of an application from Entergy Operations, Inc. (Entergy) to renew its operating license for Arkansas Nuclear One, Unit 2 (ANO-2), located in Pope County, Arkansas, approximately 6 miles west-northwest of Russellville, Arkansas. ANO-2 is in close proximity to lands that may be of interest to the Cherokee Nation. As described below, the NRC process includes an opportunity for public participation in the environmental review. We want to ensure that you are aware of our efforts and, pursuant to 10 CFR 51.28(b), the NRC invites the Cherokee Tribal Community to provide input to the scoping process relating to the NRC's environmental review of the application. In addition, as outlined in 36 CFR 800.8, the NRC plans to coordinate compliance with section 106 of the National Historic Preservation Act of 1966 through the requirements of the National Environmental Policy Act of 1969.

The NRC will hold public scoping meetings for the ANO-2 license renewal supplement to the NRC's "Generic Environmental Impact Statement for License Renewal of Nuclear Plants" (GEIS) (NUREG-1437). These scoping meetings will be held at the Holiday Inn, 2407 North Arkansas Avenue, Russellville, Arkansas 72802, on Tuesday, February 3, 2004. There will be two sessions to accommodate interested parties. The first session will convene at 1:30 p.m. and will continue until 4:30 p.m., as necessary. The second session will convene at 7:00 p.m., with a repeat of the overview portions of the meeting, and will continue until 10:00 p.m., as necessary. Additionally, the NRC staff will host informal discussions one hour before the start of each session. No formal comments on the proposed scope of the supplement to the GEIS will be accepted during the informal discussions. To be considered, comments must be provided either at the transcribed public meetings or in writing. The application and the environmental review process are described below.

Under NRC regulations, the original operating license for a nuclear power plant is issued for up to 40 years. The license may be renewed for up to an additional 20 years if NRC requirements are met. The current operating license for ANO-2 will expire in 2018. Entergy submitted an environmental report as part of its application for renewal of the ANO-2 operating license on October 15, 2003. The application is electronically available for inspection from the Publicly Available Records component of NRC's Agencywide Documents Access and Management System (ADAMS). ADAMS is accessible at http://www.nrc.gov/reading-rm/adams.html, which

provides access through the NRC's Public Electronic Reading Room (PERR) link. If you do not have access to ADAMS or if there are problems in accessing the documents located in ADAMS, contact the NRC's Public Document Room (PDR) Reference staff at 1-(800)-397-4209, (301) 415-4737, or by e-mail to pdr@nrc.gov. In addition, the application can be viewed on the Internet at http://www.nrc.gov/reactors/operating/licensing/renewal/applications/ano-2.html.

A paper copy of the document can be viewed at the NRC's PDR, located at One White Flint North, 11555 Rockville Pike (first floor), Rockville, Maryland, 20852-2738, and at the Ross Pendergraft Library at Arkansas Tech University, located at 305 West Q Street, Russellville, Arkansas, 72801. Also, the GEIS assesses the scope and impact of environmental effects that would be associated with license renewal at any nuclear power plant site. A copy of this document can also be found on the NRC's website or at the NRC's PDR.

The NRC is gathering information for the document that will be a ANO-2 site-specific supplement to the GEIS. The supplement will contain the results of the review of the environmental impacts on the area surrounding the ANO site that are related to terrestrial ecology, aquatic ecology, hydrology, cultural resources, and socioeconomic issues (among others) and will contain a recommendation regarding the environmental acceptability of the license renewal action.

Please submit any written comments the Cherokee Tribal Community may have to offer on the scope of the environmental review by February 20, 2004. Comments should be submitted either by mail to the Chief, Rules and Directives Branch, Division of Administrative Services, Mail Stop T-6D59, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555-0001, or by e-mail to ANOEIS@nrc.gov.

At the conclusion of the scoping process, the NRC staff will prepare a summary of the significant issues identified, the conclusions reached, and will mail a copy to you.

The NRC will prepare a draft supplemental environmental impact statement (SEIS) for public comment, and will hold a public meeting in the site vicinity to solicit comments on the draft. A copy of the draft SEIS will be sent to you for your review and comment. After consideration of public comments received on the draft, the NRC will prepare a final SEIS. The issuance of a final environmental impact statement for ANO-2 is planned for April 2005. If you need

additional information regarding the environmental review process, please contact Thomas Kenyon, Environmental Project Manager, at (301) 415-1120.

Sincerely,
/RA/
Pao-Tsin Kuo, Program Director
License Renewal and Environmental Impacts Program
Division of Regulatory Improvement Programs
Office of Nuclear Reactor Regulation

Docket Nos.: 50-368

December 15, 2003

Mr. R. Perry Beaver
Principal Chief
Muscogee (Creek) Nation of Oklahoma
P.O. Box 580
Okmulgee, Oklahoma 74447

SUBJECT: U.S. NUCLEAR REGULATORY COMMISSION REVIEW OF THE ARKANSAS NUCLEAR ONE, UNIT 2 LICENSE RENEWAL APPLICATION

Dear Mr. Beaver:

The U.S. Nuclear Regulatory Commission (NRC) is seeking input for its environmental review of an application from Entergy Operations, Inc. (Entergy) to renew its operating license for Arkansas Nuclear One, Unit 2 (ANO-2), located in Pope County, Arkansas, approximately 6 miles west-northwest of Russellville, Arkansas. ANO-2 is in close proximity to lands that may be of interest to the Muscogee (Creek) Nation. As described below, the NRC process includes an opportunity for public participation in the environmental review. We want to ensure that you are aware of our efforts and, pursuant to 10 CFR 51.28(b), the NRC invites the Muscogee (Creek) Tribal Community to provide input to the scoping process relating to the NRC's environmental review of the application. In addition, as outlined in 36 CFR 800.8, the NRC plans to coordinate compliance with section 106 of the National Historic Preservation Act of 1966 through the requirements of the National Environmental Policy Act of 1969.

The NRC will hold public scoping meetings for the ANO-2 license renewal supplement to the NRC's "Generic Environmental Impact Statement for License Renewal of Nuclear Plants" (GEIS) (NUREG-1437). These scoping meetings will be held at the Holiday Inn, 2407 North Arkansas Avenue, Russellville, Arkansas 72802, on Tuesday, February 3, 2004. There will be two sessions to accommodate interested parties. The first session will convene at 1:30 p.m. and will continue until 4:30 p.m., as necessary. The second session will convene at 7:00 p.m., with a repeat of the overview portions of the meeting, and will continue until 10:00 p.m., as necessary. Additionally, the NRC staff will host informal discussions one hour before the start of each session. No formal comments on the proposed scope of the supplement to the GEIS will be accepted during the informal discussions. To be considered, comments must be provided either at the transcribed public meetings or in writing. The application and the environmental review process are described below.

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The NRC is gathering information for the document that will be a ANO-2 site-specific supplement to the GEIS. The supplement will contain the results of the review of the environmental impacts on the area surrounding the ANO site that are related to terrestrial ecology, aquatic ecology, hydrology, cultural resources, and socioeconomic issues (among others) and will contain a recommendation regarding the environmental acceptability of the license renewal action.

Please submit any written comments the Muscogee (Creek) Tribal Community may have to offer on the scope of the environmental review by February 20, 2004. Comments should be submitted either by mail to the Chief, Rules and Directives Branch, Division of Administrative Services, Mail Stop T-6D59, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555-0001, or by e-mail to ANOEIS@nrc.gov.

At the conclusion of the scoping process, the NRC staff will prepare a summary of the significant issues identified, the conclusions reached, and will mail a copy to you.

The NRC will prepare a draft supplemental environmental impact statement (SEIS) for public comment, and will hold another public meeting in the site vicinity to solicit comments on the draft. A copy of the draft SEIS will be sent to you for your review and comment. After consideration of public comments received on the draft, the NRC will prepare a final SEIS. The issuance of a final environmental impact statement for ANO-2 is planned for April 2005. If you

need additional information regarding the environmental review process, please contact Thomas Kenyon, Environmental Project Manager, at (301) 415-1120.

Sincerely,
/RA/
Pao-Tsin Kuo, Program Director
License Renewal and Environmental Impacts Program
Division of Regulatory Improvement Programs
Office of Nuclear Reactor Regulation

Docket Nos.: 50-368

December 15, 2003

Mr. John Berrey
Chairman
Quapaw Tribe of Oklahoma
223 East Lafayette
Fayetteville, AR 72703

SUBJECT: U.S. NUCLEAR REGULATORY COMMISSION REVIEW OF THE ARKANSAS NUCLEAR ONE, UNIT 2 LICENSE RENEWAL APPLICATION

Dear Mr. Berrey:

The U.S. Nuclear Regulatory Commission (NRC) is seeking input for its environmental review of an application from Entergy Operations, Inc. (Entergy) to renew its operating license for Arkansas Nuclear One, Unit 2 (ANO-2), located in Pope County, Arkansas, approximately 6 miles west-northwest of Russellville, Arkansas. ANO-2 is in close proximity to lands that may be of interest to the Quapaw Tribe. As described below, the NRC process includes an opportunity for public participation in the environmental review. We want to ensure that you are aware of our efforts and, pursuant to 10 CFR 51.28(b), the NRC invites the Quapaw Tribal Community to provide input to the scoping process relating to the NRC's environmental review of the application. In addition, as outlined in 36 CFR 800.8, the NRC plans to coordinate compliance with section 106 of the National Historic Preservation Act of 1966 through the requirements of the National Environmental Policy Act of 1969.

The NRC will hold public scoping meetings for the ANO-2 license renewal supplement to the NRC's "Generic Environmental Impact Statement for License Renewal of Nuclear Plants" (GEIS) (NUREG-1437). These scoping meetings will be held at the Holiday Inn, 2407 North Arkansas Avenue, Russellville, Arkansas 72802, on Tuesday, February 3, 2004. There will be two sessions to accommodate interested parties. The first session will convene at 1:30 p.m. and will continue until 4:30 p.m., as necessary. The second session will convene at 7:00 p.m., with a repeat of the overview portions of the meeting, and will continue until 10:00 p.m., as necessary. Additionally, the NRC staff will host informal discussions one hour before the start of each session. No formal comments on the proposed scope of the supplement to the GEIS will be accepted during the informal discussions. To be considered, comments must be provided either at the transcribed public meetings or in writing. The application and the environmental review process are described below.

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provides access through the NRC's Public Electronic Reading Room (PERR) link. If you do not have access to ADAMS or if there are problems in accessing the documents located in ADAMS, contact the NRC's Public Document Room (PDR) Reference staff at 1-(800)-397-4209, (301) 415-4737, or by e-mail to pdr@nrc.gov. In addition, the application can be viewed on the Internet at http://www.nrc.gov/reactors/operating/licensing/renewal/applications/ano-2.html.

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The NRC is gathering information for the document that will be a ANO-2 site-specific supplement to the GEIS. The supplement will contain the results of the review of the environmental impacts on the area surrounding the ANO site that are related to terrestrial ecology, aquatic ecology, hydrology, cultural resources, and socioeconomic issues (among others) and will contain a recommendation regarding the environmental acceptability of the license renewal action.

Please submit any written comments the Quapaw Tribal Community may have to offer on the scope of the environmental review by February 20, 2004. Comments should be submitted either by mail to the Chief, Rules and Directives Branch, Division of Administrative Services, Mail Stop T-6D59, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555-0001, or by e-mail to ANOEIS@nrc.gov.

At the conclusion of the scoping process, the NRC staff will prepare a summary of the significant issues identified, the conclusions reached, and will mail a copy to you.

The NRC will prepare a draft supplemental environmental impact statement (SEIS) for public comment, and will hold another public meeting in the site vicinity to solicit comments on the draft. A copy of the draft SEIS will be sent to you for your review and comment. After consideration of public comments received on the draft, the NRC will prepare a final SEIS. The issuance of a final environmental impact statement for ANO-2 is planned for April 2005. If you

need additional information regarding the environmental review process, please contact Thomas Kenyon, Environmental Project Manager, at (301) 415-1120.

Sincerely,
/RA/
Pao-Tsin Kuo, Program Director
License Renewal and Environmental Impacts Program
Division of Regulatory Improvement Programs
Office of Nuclear Reactor Regulation

Docket Nos.: 50-368

December 15, 2003

Mr. Jim Gray
Principal Chief
Osage Nation
P.O. Box 779
Pawhuska, OK 74056

SUBJECT: U.S. NUCLEAR REGULATORY COMMISSION REVIEW OF THE ARKANSAS NUCLEAR ONE, UNIT 2 LICENSE RENEWAL APPLICATION

Dear Mr. Gray:

The U.S. Nuclear Regulatory Commission (NRC) is seeking input for its environmental review of an application from Entergy Operations, Inc. (Entergy) to renew its operating license for Arkansas Nuclear One, Unit 2 (ANO-2), located in Pope County, Arkansas, approximately 6 miles west-northwest of Russellville, Arkansas. ANO-2 is in close proximity to lands that may be of interest to the Osage Nation. As described below, the NRC process includes an opportunity for public participation in the environmental review. We want to ensure that you are aware of our efforts and, pursuant to 10 CFR 51.28(b), the NRC invites the Osage Tribal Community to provide input to the scoping process relating to the NRC's environmental review of the application. In addition, as outlined in 36 CFR 800.8, the NRC plans to coordinate compliance with section 106 of the National Historic Preservation Act of 1966 through the requirements of the National Environmental Policy Act of 1969.

The NRC will hold public scoping meetings for the ANO-2 license renewal supplement to the NRC's "Generic Environmental Impact Statement for License Renewal of Nuclear Plants" (GEIS) (NUREG-1437). These scoping meetings will be held at the Holiday Inn, 2407 North Arkansas Avenue, Russellville, Arkansas 72802, on Tuesday, February 3, 2004. There will be two sessions to accommodate interested parties. The first session will convene at 1:30 p.m. and will continue until 4:30 p.m., as necessary. The second session will convene at 7:00 p.m., with a repeat of the overview portions of the meeting, and will continue until 10:00 p.m., as necessary. Additionally, the NRC staff will host informal discussions one hour before the start of each session. No formal comments on the proposed scope of the supplement to the GEIS will be accepted during the informal discussions. To be considered, comments must be provided either at the transcribed public meetings or in writing. The application and the environmental review process are described below.

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October 15, 2003. The application is electronically available for inspection from the Publicly Available Records component of NRC's Agencywide Documents Access and Management System (ADAMS). ADAMS is accessible at http://www.nrc.gov/reading-rm/adams.html, which provides access through the NRC's Public Electronic Reading Room (PERR) link. If you do not have access to ADAMS or if there are problems in accessing the documents located in ADAMS, contact the NRC's Public Document Room (PDR) Reference staff at 1-(800)-397-4209, (301) 415-4737, or by e-mail to pdr@nrc.gov. In addition, the application can be viewed on the Internet at http://www.nrc.gov/reactors/operating/licensing/renewal/applications/ano-2.html.

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Please submit any written comments the Osage Tribal Community may have to offer on the scope of the environmental review by February 20, 2004. Comments should be submitted either by mail to the Chief, Rules and Directives Branch, Division of Administrative Services, Mail Stop T-6D59, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555-0001, or by e-mail to ANOEIS@nrc.gov.

At the conclusion of the scoping process, the NRC staff will prepare a summary of the significant issues identified, the conclusions reached, and will mail a copy to you.

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need additional information regarding the environmental review process, please contact Thomas Kenyon, Environmental Project Manager, at (301) 415-1120.

Sincerely,
/RA/
Pao-Tsin Kuo, Program Director
License Renewal and Environmental Impacts Program
Division of Regulatory Improvement Programs
Office of Nuclear Reactor Regulation

Docket Nos.: 50-368

December 15, 2003

Mr. Gregory E. Pyle
Chief
Choctaw Nation of Oklahoma
P.O. Drawer 1210
16th and Locust Streets
Durant, Oklahoma 74702-1210

SUBJECT: U.S. NUCLEAR REGULATORY COMMISSION REVIEW OF THE ARKANSAS NUCLEAR ONE, UNIT 2 LICENSE RENEWAL APPLICATION

Dear Mr. Pyle:

The U.S. Nuclear Regulatory Commission (NRC) is seeking input for its environmental review of an application from Entergy Operations, Inc. (Entergy) to renew its operating license for Arkansas Nuclear One, Unit 2 (ANO-2), located in Pope County, Arkansas, approximately 6 miles west-northwest of Russellville, Arkansas. ANO-2 is in close proximity to lands that may be of interest to the Choctaw Nation. As described below, the NRC process includes an opportunity for public participation in the environmental review. We want to ensure that you are aware of our efforts and, pursuant to 10 CFR 51.28(b), the NRC invites the Choctaw Tribal Community to provide input to the scoping process relating to the NRC's environmental review of the application. In addition, as outlined in 36 CFR 800.8, the NRC plans to coordinate compliance with section 106 of the National Historic Preservation Act of 1966 through the requirements of the National Environmental Policy Act of 1969.

The NRC will hold public scoping meetings for the ANO-2 license renewal supplement to the NRC's "Generic Environmental Impact Statement for License Renewal of Nuclear Plants" (GEIS) (NUREG-1437). These scoping meetings will be held at the Holiday Inn, 2407 North Arkansas Avenue, Russellville, Arkansas 72802, on Tuesday, February 3, 2004. There will be two sessions to accommodate interested parties. The first session will convene at 1:30 p.m. and will continue until 4:30 p.m., as necessary. The second session will convene at 7:00 p.m., with a repeat of the overview portions of the meeting, and will continue until 10:00 p.m., as necessary. Additionally, the NRC staff will host informal discussions one hour before the start of each session. No formal comments on the proposed scope of the supplement to the GEIS will be accepted during the informal discussions. To be considered, comments must be provided either at the transcribed public meetings or in writing. The application and the environmental review process are described below.

Under NRC regulations, the original operating license for a nuclear power plant is issued for up to 40 years. The license may be renewed for up to an additional 20 years if NRC requirements are met. The current operating license for ANO-2 will expire in 2018. Entergy submitted an environmental report as part of its application for renewal of the ANO-2 operating license on October 15, 2003. The application is electronically available for inspection from the Publicly Available Records component of NRC's Agencywide Documents Access and Management

System (ADAMS). ADAMS is accessible at http://www.nrc.gov/reading-rm/adams.html, which provides access through the NRC's Public Electronic Reading Room (PERR) link. If you do not have access to ADAMS or if there are problems in accessing the documents located in ADAMS, contact the NRC's Public Document Room (PDR) Reference staff at 1-(800)-397-4209, (301) 415-4737, or by e-mail to pdr@nrc.gov. In addition, the application can be viewed on the Internet at http://www.nrc.gov/reactors/operating/licensing/renewal/applications/ano-2.html.

A paper copy of the document can be viewed at the NRC's PDR, located at One White Flint North, 11555 Rockville Pike (first floor), Rockville, Maryland, 20852-2738, and at the Ross Pendergraft Library at Arkansas Tech University, located at 305 West Q Street, Russellville, Arkansas, 72801. Also, the GEIS assesses the scope and impact of environmental effects that would be associated with license renewal at any nuclear power plant site. A copy of this document can also be found on the NRC's website or at the NRC's PDR.

The NRC is gathering information for the document that will be a ANO-2 site-specific supplement to the GEIS. The supplement will contain the results of the review of the environmental impacts on the area surrounding the ANO site that are related to terrestrial ecology, aquatic ecology, hydrology, cultural resources, and socioeconomic issues (among others) and will contain a recommendation regarding the environmental acceptability of the license renewal action.

Please submit any written comments the Choctaw Tribal Community may have to offer on the scope of the environmental review by February 20, 2004. Comments should be submitted either by mail to the Chief, Rules and Directives Branch, Division of Administrative Services, Mail Stop T-6D59, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555-0001, or by e-mail to ANOEIS@nrc.gov.

At the conclusion of the scoping process, the NRC staff will prepare a summary of the significant issues identified, the conclusions reached, and will mail a copy to you.

The NRC will prepare a draft supplemental environmental impact statement (SEIS) for public comment, and will hold another public meeting in the site vicinity to solicit comments on the draft. A copy of the draft SEIS will be sent to you for your review and comment. After consideration of public comments received on the draft, the NRC will prepare a final SEIS. The issuance of a final environmental impact statement for ANO-2 is planned for April 2005. If you

need additional information regarding the environmental review process, please contact Thomas Kenyon, Environmental Project Manager, at (301) 415-1120.

Sincerely,
/RA/
Pao-Tsin Kuo, Program Director
License Renewal and Environmental Impacts Program
Division of Regulatory Improvement Programs
Office of Nuclear Reactor Regulation

Docket Nos.: 50-368

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southeast Regional Office
9721 Executive Center Drive North
St. Petersburg, FL 33702
(727) 570-5312, FAX 570-5517
http://caldera.sero.nmfs.gov

12/23/03
68FR71174
(1)

DEC 17 2003

Dear Colleague:

The National Marine Fisheries Service (NOAA Fisheries) Protected Resources Division has reviewed your letter pursuant to section 7(a)(2) of the Endangered Species Act (ESA) concerning request for list of protected species within the area under evaluation for Arkansas Nuclear One Unit 2 License Renewal, dated December 11, 2003.

____We cannot determine impacts to threatened or endangered species, or designated critical habitat, under NOAA Fisheries' purview because the letter lacks sufficient information to evaluate the project. Enclosed are guidelines to conduct a proper biological evaluation.

____As requested, enclosed is a list of federally-protected species under the jurisdiction of NOAA Fisheries for the state of _____. Biological information on federally-protected sea turtles, shortnose and gulf sturgeon, smalltooth sawfish, and other listed species and candidate species can be found at the following website addresses: NOAA Fisheries Southeast Regional Office (http://caldera.sero.nmfs.gov/protect/protect.htm); NOAA Fisheries Office of Protected Resources (http://www.nmfs.noaa.gov/prot_res/prot_res.html); U.S. Fish and Wildlife Service (http://noflorida.fws.gov/SeaTurtles/seaturtle-info.htm), http://www.turtles.org; http://www/seaturtle.org; http://alabama.fws.gov/gs/; http://endangered.fws.gov/wildlife.html#Species; the Ocean Conservancy (http://www.emc-ocean.org/main.php3); the Caribbean Conservation Corporation (http://www.cccturtle.org/); Florida Fish and Wildlife Conservation Commission (http://floridaconservation.org/psm/turtles/turtle.htm); http://obis.env.duke.edu/data/sp_profiles.php; www.mote.org/~colins/Sawfish/SawfishHomePage.html; www.floridasawfish.com; www.flmnh.ufl.edu/fish/sharks/InNews/sawprop.htm.

✓ It is NOAA Fisheries' opinion that the project will have no effect on listed species or critical habitat protected by the ESA under NOAA Fisheries' purview. No further consultation with NOAA Fisheries pursuant to section 7(a)(2) of the ESA is required. Consultation with NOAA Fisheries, Habitat Conservation Division, pursuant to the Magnuson-Stevens Fishery Conservation and Management Act's requirements for essential fish habitat consultation (16 U.S.C. 1855 (b)(2) and 50 CFR 600.905-.930, subpart K), may be required. Please contact our Habitat Conservation Division at (727) 570-5317.

If you have any questions, please contact the ESA section 7 coordinator, Eric Hawk, at (727) 570-5312, or by e-mail at eric.hawk@noaa.gov.

Sincerely,

Georgia Cranmore
Assistant Regional Administrator
for Protected Resources

____Enclosure
File:1514-22. M. NRC
O:\forms\no-effect letter.wpd
I/SER/2003/ 01530

E-ESS = ADM-03
Cell = T. Kenyon (TSK2)
A. Kugler (ASK1)

Template - ADM-013

December 17, 2003

Mr. Don Klima, Director
Office of Federal Agency Programs
Advisory Council on Historic Preservation
Old Post Office Building
1100 Pennsylvania Avenue, NW, Suite 809
Washington, DC 20004

SUBJECT: ARKANSAS NUCLEAR ONE UNIT 2 LICENSE RENEWAL REVIEW

Dear Mr. Klima:

The U.S. Nuclear Regulatory Commission (NRC) staff is reviewing an application to renew the operating license for Arkansas Nuclear One, Unit 2 (ANO-2), which is located in Pope County, Arkansas, approximately 6 miles west-northwest of Russellville, Arkansas. ANO-2 is operated by Entergy Operations, Inc. (Entergy). The application for renewal was submitted by Entergy on October 15, 2003, pursuant to NRC requirements at Title 10 of the *Code of Federal Regulations* Part 54 (10 CFR Part 54). The NRC has established that, as part of the staff review of any nuclear power plant license renewal action, a site-specific Supplemental Environmental Impact Statement (SEIS) to its "Generic Environmental Impact Statement for License Renewal of Nuclear Plants" (GEIS), NUREG-1437, will be prepared pursuant to 10 CFR Part 51, the NRC regulations that implement the National Environmental Policy Act NEPA of 1969. In accordance with 36 CFR 800.8, the SEIS will include analyses of potential impacts to historic properties. A draft SEIS is scheduled for publication in September of 2004, and will be provided to you for review and comment.

If you have any questions or require additional information, please contact the Environmental Project Manager for the ANO-2 project, Mr. Thomas Kenyon at 301-415-1120 or TJK2@nrc.gov.

Sincerely,
/RA/
Pao-Tsin Kuo, Program Director
License Renewal and Environmental Impacts
Division of Regulatory Improvement Programs
Office of Nuclear Reactor Regulation

Docket No.: 50-368

December 17, 2003

Mr. George McCluskey
Senior Archeologist
State Historic Preservation Office
323 Center Street, Suite 1500
Little Rock, AR 72201

SUBJECT: ARKANSAS NUCLEAR ONE, UNIT 2 LICENSE RENEWAL REVIEW
(AHPP TRACKING NUMBER 47149)

Dear Mr. McCluskey:

The U.S. Nuclear Regulatory Commission (NRC) staff is reviewing an application to renew the operating license for Arkansas Nuclear One, Unit 2 (ANO-2), which is located in Pope County, Arkansas, approximately 6 miles northwest of Russellville, Arkansas. ANO-2 is operated by Entergy Operations, Inc. (Entergy). The application for renewal was submitted by Entergy on October 15, 2003, pursuant to NRC requirements at Title 10 of the *Code of Federal Regulations* Part 54 (10 CFR Part 54). The NRC has established that, as part of the staff review of any nuclear power plant license renewal action, a site-specific Supplemental Environmental Impact Statement (SEIS) to its "Generic Environmental Impact Statement for License Renewal of Nuclear Plants" (GEIS), NUREG-1437, will be prepared under the provisions of 10 CFR Part 51, the NRC rules that implement the National Environmental Policy Act of 1969 (NEPA). In accordance with 36 CFR 800.8, the SEIS will include analyses of potential impacts to historic and cultural resources.

In the context of the National Historic Preservation Act of 1966, as amended, the NRC staff has determined that the area of potential effect (APE) for a license renewal action is the area at the power plant site and its immediate environs that may be impacted by post-license renewal land disturbing operations or projected refurbishment activities associated with the proposed action. The APE may extend beyond the immediate environs in those instances where post-license renewal land disturbing operations or projected refurbishment activities, specifically related to license renewal, may potentially have an effect on known or proposed historic sites. This determination is made irrespective of ownership or control of the lands of interest.

While preparing its application, Entergy contacted your office by letter dated October 4, 2002, and your office responded on November 12, 2002. In its letter, Entergy stated that there are no plans to alter current operations over the license renewal period. Entergy further stated that no refurbishment, construction, or modification activities are planned for the purpose of license renewal. Also, Entergy has an administrative procedure in place that requires an archeological survey to be performed prior to any ground-disturbing activities on any previously undisturbed areas of the ANO site.

On February 3, 2004, the NRC will conduct two public NEPA scoping meetings at the Holiday Inn, 2407 North Arkansas Avenue, Russellville, Arkansas 72802. You and your staff are invited to attend. Your office will receive a copy of the draft SEIS along with a request for comments. The anticipated publication date for the draft SEIS is September 2004. If you have any questions or require additional information, please contact the Environmental Project Manager for the ANO-2 license renewal project, Mr. Thomas Kenyon at 301-415-1120 or TJK2@nrc.gov.

Sincerely,
/RA/
Pao-Tsin Kuo, Program Director
License Renewal and Environmental Impacts
Division of Regulatory Improvement Programs
Office of Nuclear Reactor Regulation

Docket Nos.: 50-368

Enclosure: As stated

December 18, 2003

Ms. LaRue Parker
Tribal Chairperson
Caddo Nation
P.O. Box 487
Binger, OK 73009

SUBJECT: U.S. NUCLEAR REGULATORY COMMISSION REVIEW OF THE ARKANSAS NUCLEAR ONE, UNIT 2 LICENSE RENEWAL APPLICATION

Dear Ms. Parker:

The U.S. Nuclear Regulatory Commission (NRC) is seeking input for its environmental review of an application from Entergy Operations, Inc. (Entergy) to renew its operating license for Arkansas Nuclear One, Unit 2 (ANO-2), located in Pope County, Arkansas, approximately 6 miles west-northwest of Russellville, Arkansas. ANO-2 is in close proximity to lands that may be of interest to the Caddo Nation. As described below, the NRC process includes an opportunity for public participation in the environmental review. We want to ensure that you are aware of our efforts and, pursuant to 10 CFR 51.28(b), the NRC invites the Caddo Tribal Community to provide input to the scoping process relating to the NRC's environmental review of the application. In addition, as outlined in 36 CFR 800.8, the NRC plans to coordinate compliance with section 106 of the National Historic Preservation Act of 1966 through the requirements of the National Environmental Policy Act of 1969.

The NRC will hold public scoping meetings for the ANO-2 license renewal supplement to the NRC's "Generic Environmental Impact Statement for License Renewal of Nuclear Plants" (GEIS) (NUREG-1437). These scoping meetings will be held at the Holiday Inn, 2407 North Arkansas Avenue, Russellville, Arkansas 72802, on Tuesday, February 3, 2004. There will be two sessions to accommodate interested parties. The first session will convene at 1:30 p.m. and will continue until 4:30 p.m., as necessary. The second session will convene at 7:00 p.m., with a repeat of the overview portions of the meeting, and will continue until 10:00 p.m., as necessary. Additionally, the NRC staff will host informal discussions one hour before the start of each session. No formal comments on the proposed scope of the supplement to the GEIS will be accepted during the informal discussions. To be considered, comments must be provided either at the transcribed public meetings or in writing. The application and the environmental review process are described below.

Under NRC regulations, the original operating license for a nuclear power plant is issued for up to 40 years. The license may be renewed for up to an additional 20 years if NRC requirements are met. The current operating license for ANO-2 will expire in 2018. Entergy submitted an environmental report as part of its application for renewal of the ANO-2 operating license on

October 15, 2003. The application is electronically available for inspection from the Publicly Available Records component of NRC's Agencywide Documents Access and Management System (ADAMS). ADAMS is accessible at http://www.nrc.gov/reading-rm/adams.html, which provides access through the NRC's Public Electronic Reading Room (PERR) link. If you do not have access to ADAMS or if there are problems in accessing the documents located in ADAMS, contact the NRC's Public Document Room (PDR) Reference staff at 1-(800)-397-4209, (301) 415-4737, or by e-mail to pdr@nrc.gov. In addition, the application can be viewed on the Internet at http://www.nrc.gov/reactors/operating/licensing/renewal/applications/ano-2.html.

A paper copy of the document can be viewed at the NRC's PDR, located at One White Flint North, 11555 Rockville Pike (first floor), Rockville, Maryland, 20852-2738, and at the Ross Pendergraft Library at Arkansas Tech University, located at 305 West Q Street, Russellville, Arkansas, 72801. Also, the GEIS assesses the scope and impact of environmental effects that would be associated with license renewal at any nuclear power plant site. A copy of this document can also be found on the NRC's website or at the NRC's PDR.

The NRC is gathering information for the document that will be a ANO-2 site-specific supplement to the GEIS. The supplement will contain the results of the review of the environmental impacts on the area surrounding the ANO site that are related to terrestrial ecology, aquatic ecology, hydrology, cultural resources, and socioeconomic issues (among others) and will contain a recommendation regarding the environmental acceptability of the license renewal action.

Please submit any written comments the Caddo Tribal Community may have to offer on the scope of the environmental review by February 20, 2004. Comments should be submitted either by mail to the Chief, Rules and Directives Branch, Division of Administrative Services, Mail Stop T-6D59, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555-0001, or by e-mail to ANOEIS@nrc.gov.

At the conclusion of the scoping process, the NRC staff will prepare a summary of the significant issues identified, the conclusions reached, and will mail a copy to you.

The NRC will prepare a draft supplemental environmental impact statement (SEIS) for public comment, and will hold another public meeting in the site vicinity to solicit comments on the draft. A copy of the draft SEIS will be sent to you for your review and comment. After consideration of public comments received on the draft, the NRC will prepare a final SEIS. The issuance of a final environmental impact statement for ANO-2 is planned for April 2005. If you

need additional information regarding the environmental review process, please contact Thomas Kenyon, Environmental Project Manager, at (301) 415-1120.

Sincerely,
/RA/
Pao-Tsin Kuo, Program Director
License Renewal and Environmental Impacts Program
Division of Regulatory Improvement Programs
Office of Nuclear Reactor Regulation

Docket No.: 50-368

IN REPLY REFER TO

United States Department of the Interior

FISH AND WILDLIFE SERVICE
1500 Museum Road, Suite 105
Conway, Arkansas 72032

50-368

January 14, 2004

Mr. Thomas Kenyon
Environmental Project Manager
License Renewal and Environmental Impacts
Nuclear Regulatory Commission
Washington, D.C. 20555-001

Dear Mr. Kenyon:

The Fish and Wildlife Service (Service) has reviewed the information supplied with your letter dated December 9, 2003 concerning the potential impacts of relicensing the Arkansas Nuclear One Unit 2 (ANO-2), Pope county, Arkansas. Our comments are submitted in accordance with the Endangered Species Act (ESA) (87 Stat. 884, as amended 16 U.S.C. 1531 et seq.) and the Fish and Wildlife Coordination Act (16U.S.C. 661-667e).

The endangered least tern (*Sterna antillarum*) and the threatened bald eagle (*Haliaeetus leucocephalus*) are present in the vicinity of the project area. However, the proposed relicensing of the existing plant is not likely to impact any listed species.

The Service has become aware that a block net shad barrier is now being used on the entrance to the intake canal during the fall and winter months. The detailed use and effects of this barrier should be included in any environmental assessments and/or environmental impact statements regarding ANO operations. We believe this barrier may have both positive and negative effects on the fishery. In addition to reducing temperature induced shad entrainment and impingement the barrier may also prevent impingement of other healthy species. However, the barrier appears to prevent and/or discourage other species from entering the intake canal, which is valuable fisheries habitat and a popular recreation fishing location for much of the year. The Service recommends the establishment of specific protocols for the deployment of the barrier only when necessary to prevent increased temperature induced shad entrainment and impingement. Water temperature monitoring, meteorological data, and forecasts should provide sufficient indication of water temperatures approaching and departing shad thermal intolerances. Limiting shad barrier use by having deployment coincide with these water temperatures will maintain habitat availability and recreational use to the maximum extent, while maintaining ANO's ability to reduce shad impingement when necessary. Fisheries and recreational use of the intake canal have historically been reduced during the winter and for this reason along with the benefits to

4100

ANO operations, the Service believes that the use of the barrier when necessary will have limited effects on fisheries or recreation.

Further, the Service is aware that security barriers have been placed in the intake and effluent canals restricting access and recreational use. These restrictions and the effects of these barriers on the fisheries and recreation access should be included in any environmental assessments and/or environmental impact statements regarding ANO operations. These areas provide high quality habitat and water conditions that attract high densities of fish seasonally and therefore these areas and the adjacent waters have been and and continue to be popular recreational fishing areas. The Service recommends documenting the loss of these valuable recreational uses and the benefits of creating a fisheries refugia. By restricting access to these areas ANO is providing high quality habitat refugia for fish by limiting take or harassment from recreational fishing to adjacent areas. In the past the dense fish concentrations in these areas have resulted in high levels of take. Limiting take will improve the quality and quantity of the fisheries and recreational fishing in Lake Dardanelle as a whole annually and in the long term. The Service recommends coordinating with the Arkansas Game and Fish Commission and/or other fisheries researchers to examine the effects of these changes on the fisheries in Lake Dardanelle.

We appreciate the opportunity to provide these comments.

Sincerely,

Margaret Harney

Margaret Harney
Acting Field Supervisor

cc:
Arkansas Game and Fish Commission, Little Rock, Arkansas
Attn: Bob Leonard
Arkansas Natural Heritage Commission, Little Rock, Arkansas
Attn: Cindy Osborne

4/22/03
68FR 7117

United Keetoowah Band
P.O. Box 746 • Tahlequah, Oklahoma 74465
Phone: (918) 456-8698 • Fax: (918) 456-9877

(3)

RECEIVED
2003 FEB 25 PM 2:55
Rules and Directives Branch USNRC

January 15, 2003

Pao-Tsin Kuo, Program Director
License Renewal and Environmental Impacts
Division of Regulatory Compliance
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555-0001

Dear Director Kuo:

Thank you for notifying the United Keetoowah Band of Cherokee Indians about Entergy Operations, Inc.'s application for the renewal of the operating license for Arkansas Nuclear One Unit. We have no comment at this time, but reserve the right for future comment. Please keep us informed about this project.

Sincerely,

Summer R. King
Environmental Technician
United Keetoowah Band of Cherokee Indians
P.O. Box 457
Park Hill, OK 74451
Phone: (918) 453-2823
Fax: (918) 453-2838
Email: UKBenvtech@yahoo.com

E-RIDS = ADM-03
All = T. Kenyon (TJK2)
A. Kugler (AJK1)

Template = ADM-013

ADEQ
ARKANSAS
Department of Environmental Quality

RECEIVED
2004 FEB 12 AM 8:44
Rules and Directives
Branch
USNRC

10/22/03
68FR 71174
(2)

January 30, 2004

Chief, Rules and Directives Branch
Division of Administrative Services
Office of Administration, Mailstop T-6D59
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

RE: NOI to Prepare EIS and Conduct Scoping Process for License Renewal for Arkansas Nuclear One, Unit 2, Pope County, Arkansas

Dear Chief:

The Arkansas Department of Environmental Quality (ADEQ) has reviewed the information submitted on the referenced project.

We have no comments at this time.

If you have any questions, please contact Audree Miller at 501-682-0015.

Sincerely,

Sandi Formica
Chief, Environmental Preservation Division

SF:MVE:AM:am

cc: Mary Leath, Chief Deputy Director
Martin Maner, Water Division
Dennis Green, Hazardous Waste Division
Dick Cassat, Technical Services Division

E-RIDS=ADM-03
Addressee-T. Kenyon (TSK2)
Template=ADM-013
A. Kugler (AJK1)

ARKANSAS DEPARTMENT OF ENVIRONMENTAL QUALITY
8001 NATIONAL DRIVE / POST OFFICE BOX 8913 / LITTLE ROCK, ARKANSAS 72219-8913 / TELEPHONE 501-682-0744 / FAX 501-682-0798
www.adeq.state.ar.us

June 8, 2004

Ms. Margaret Harney
Senior Field Biologist
U.S. Fish and Wildlife Service
Arkansas Ecological Services Field Office
1500 Museum Road, Suite 105
Conway, AR 72032

SUBJECT: BIOLOGICAL ASSESSMENT FOR LICENSE RENEWAL OF ARKANSAS NUCLEAR ONE, UNIT 2, AND A REQUEST FOR INFORMAL CONSULTATION (TAC NO. MB8405)

Dear Ms. Harney:

The U.S. Nuclear Regulatory Commission (NRC) has prepared the enclosed biological assessment (BA) to evaluate whether the proposed renewal of the operating license for Arkansas Nuclear One, Unit 2 (ANO-2) for an additional 20 years would have adverse effects on listed species. The proposed action (license renewal) is not a major construction activity. ANO-2 is located on Lake Dardanelle, upstream of the Dardanelle Lock and Dam on the Arkansas River at river mile 205.5.

By letter dated December 9, 2003, the NRC requested a list of Federally threatened or endangered species that may be in the vicinity of ANO-2 and its associated transmission lines. In a letter dated January 14, 2004, the U.S. Fish and Wildlife Service (FWS) provided a list of Federally listed species. The FWS identified one threatened species, the bald eagle (*Haliaeetus leucocephalus*), and one endangered species, the least tern (*Sterna antillarum*), as being present in the vicinity of the project area, but stated that the ANO-2 license renewal is not likely to impact any listed species.

The NRC, for documentation purposes, has included all species mentioned in the ANO-2 Environmental Report in the enclosed BA. The NRC included, in addition to the aforementioned species, the gray bat (*Myotis grisescens*) and the Arkansas River shiner (*Notropis girardi*). This BA provides an evaluation of the potential impact of relicensing ANO-2 for an additional 20 years of operation on the four listed species (Table 1 of enclosed BA).

The NRC has determined that the proposed action will have no effect on gray bats (*Myotis grisescens*), bald eagles (*Haliaeetus leucocephalus*), least terns (*Sterna antillarum*), and Arkansas River shiners (*Notropis girardi*). No critical habitat has been designated in Arkansas for these four listed species.

We are placing this BA in our project files and are requesting your concurrence with our determination. In reaching our conclusion, the NRC staff relied on information provided by the licensee, on research performed by NRC staff, and information from FWS (i.e., including information provided by the FWS, Arkansas Ecological Services Field Office).

M. Harney 2

If you have any questions regarding this BA or the staff's request, please contact Mr. Thomas Kenyon, Senior Environmental Project Manager, at (301) 415-1120.

Sincerely,

/RA/
Pao-Tsin Kuo, Program Director
License Renewal and Environmental Impacts Program
Division of Regulatory Improvement Programs
Office of Nuclear Reactor Regulation

Docket No.: 50-368

Enclosure: Biological Assessment

Biological Assessment

Arkansas Nuclear One, Unit 2
License Renewal Review

Pope County, Arkansas

May 2004

Docket No. 368

U.S. Nuclear Regulatory Commission
Rockville, Maryland

Biological Assessment

Evaluation of the Potential Effects on Endangered or Threatened Species from the Proposed License Renewal for the Arkansas Nuclear One, Unit 2

Setting

The proposed license renewal will apply to the facilities at the site of Arkansas Nuclear One, Unit 2 (ANO-2) located near Interstate Highway 40 (I-40) on a peninsula formed by Lake Dardanelle in southwestern Pope County, Arkansas (Figure 1). The site is located approximately 109 km (68 mi) east of Fort Smith, Arkansas, and about 91 km (57 mi) northwest of Little Rock, Arkansas (Figure 2).

The ANO-2 site is located about 9.5 km (6 mi) upstream from Dardanelle Dam on Lake Dardanelle. Lake Dardanelle, a run-of-the-river impoundment, is part of the Arkansas River and is 80 km (50 mi) long. The lake was created as part of the multi-purpose project for improvement of the Arkansas River by the construction of the Dardanelle Lock and Dam. The Dardanelle Lock and Dam facilitate navigation on the river and provide for generation of hydroelectric power as well as recreation and fish and wildlife resources. The lake was one of 17 impoundments built along the Arkansas River to provide a 724-km (450-mi) navigable channel from the Mississippi River to Catoosa, Oklahoma. Lake Dardanelle is more than 18 m (60 ft) deep at its lower end, and its average depth is 3 m (10 ft). The lake has a surface area of approximately 14,975 ha (3700 ac) and a storage capacity of 6×10^8 m^3 (486,000 ac-ft). The Arkansas River navigation channel is about 2.2 km (1.4 mi) south of the ANO-2 reactor building.

The site is located on a 3.2-km-wide and 3.2-km-long (2-mi-wide and 2-mi-long) peninsula. The peninsula elevation varies from 122 to 150 m (400 to 500 ft). The land around the site is mostly maintained meadow, and outside the property line, it is mostly forest, with the remaining land use being pasture and residential development. The site drains naturally, and surface runoff is collected in storm water drains, the intake canal, and the emergency cooling pond from which it is discharged to Lake Dardanelle. The average annual rainfall at the site is approximately 124 cm (49 in.).

North of the site, the land gradually ascends in elevation to 305 m (1000 ft) and then continues to ascend to the Boston Mountains, which have a maximum elevation of 823 m (2700 ft). The Arkansas River flows along the base of the Boston Mountains. A range of hills lies directly across the Arkansas River and south and west of the site. Mount Nebo, at an elevation of 573 m (1880 ft), is 40 km (25 mi) directly south of the site. Magazine Mountain, southwest of

Appendix E

Biological Assessment

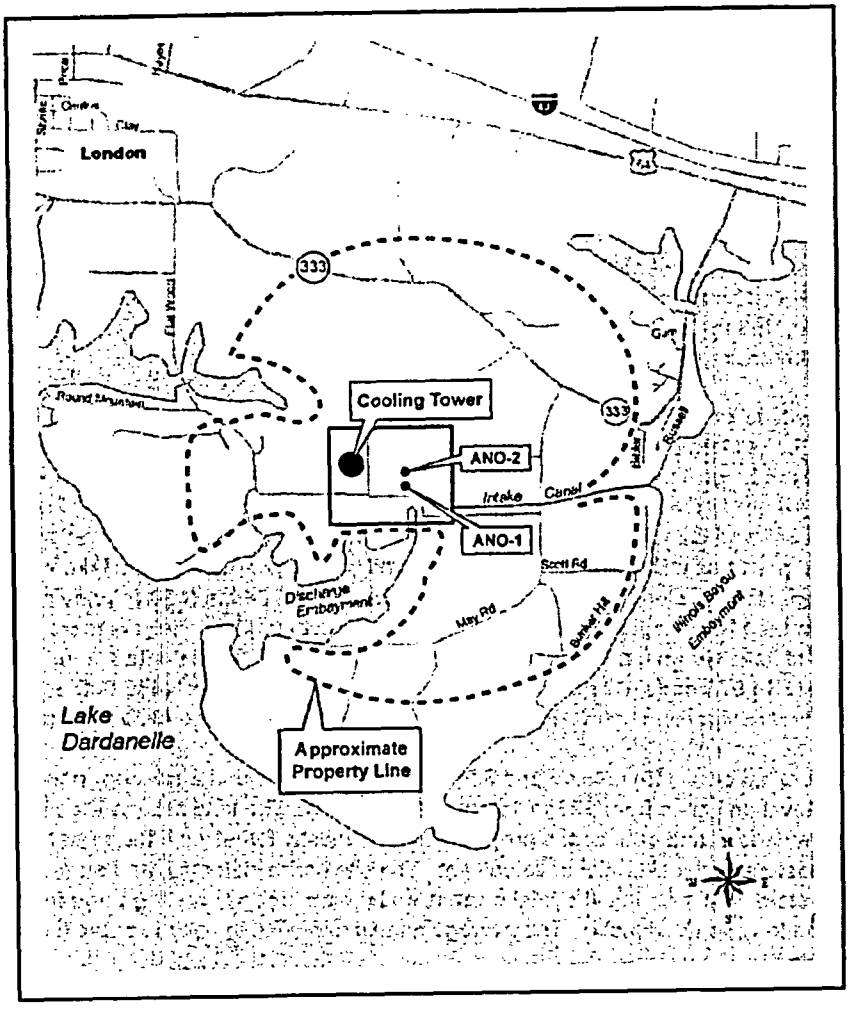

Figure 1. Arkansas Nuclear One, Unit 2 Site Map

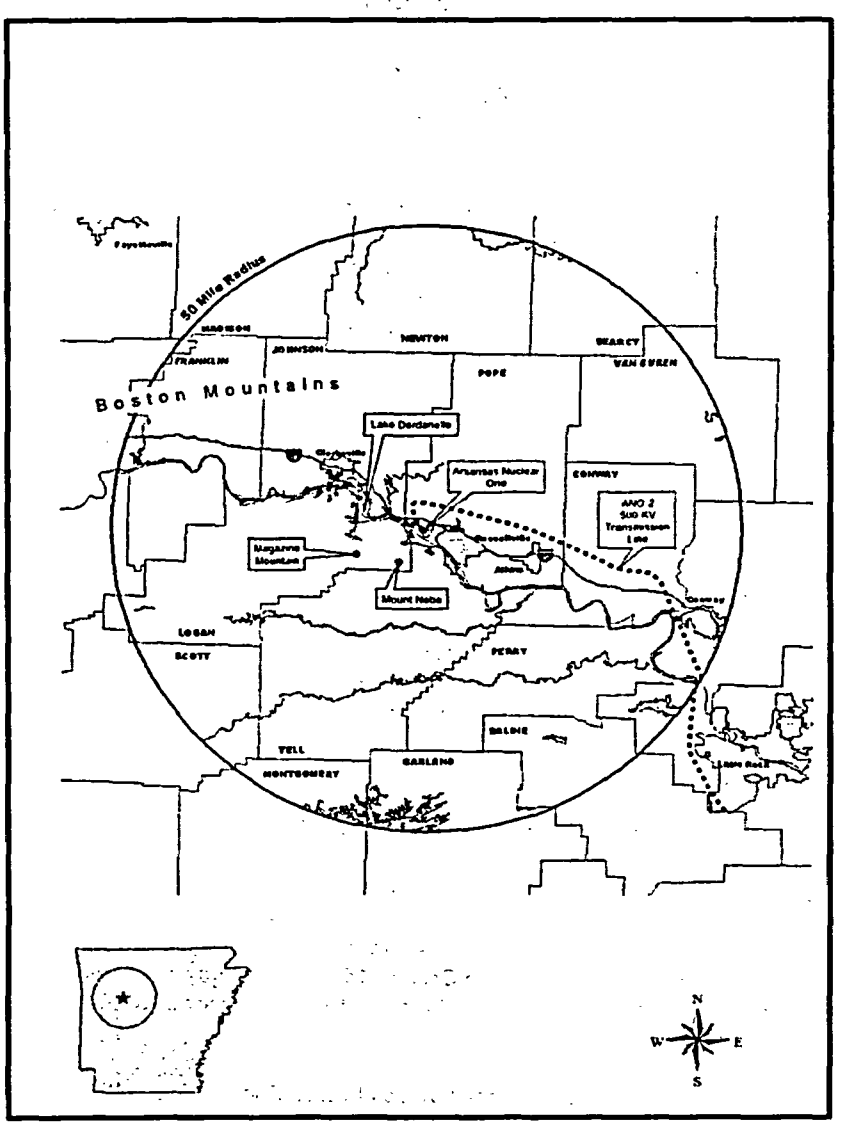

Figure 2. Location of Arkansas Nuclear One, Unit 2 and its Transmission Line

the site at an elevation of 927 m (3042 ft), is the highest point in Arkansas. The land east and south of the site is moderately level, but is interspersed with rolling hills and covered with woods.

The geology around the ANO-2 site is mostly clay with underlying bedrock. Under the site is a 4- to 7-m (13- to 24-ft)-deep layer of heavy clay or silty clay that rests on horizontally laid hard shale and sandstone of the McAlester formation. The nearest geological faults are 4 to 8 km (2.5 to 5.0 mi) from the site and have not been active for more than 65 million years. After intermittent submergence by relatively shallow seas during most of the Paleozoic Periods, the late Mississippian time opened dramatic episodes of ocean-trough development and thick sedimentary and volcanic depositions. This period was followed by late Pennsylvanian mountain-folding and faulting, which caused the bedrock features seen today. The bedrock under the site is part of a large syncline, known as the Scranton syncline, which lies in an east and west direction (AEC 1973).

ANO-2 is connected to the electric grid by a 500-kV, single-circuit transmission line that is approximately 146-km (91-mi) long (Figure 1). The transmission line extends from the existing ANO-2 500-kV station switchyard southeasterly via the Mayflower substation (southwest of Mayflower, Arkansas) and terminates at the Mabelvale substation (southwest of Little Rock, Arkansas). Throughout its length, the transmission line rights-of-way are 55 m (180 ft) wide (NRC 2001), encompass 730 ha (1804 ac), and crosses land that consists of rural property, forestland, and to a limited degree, agricultural and timber production operations (Entergy 2003a). The transmission line rights-of-way do not cross State or Federal parks, wildlife refuges, or wildlife management areas (Entergy 2003a). No critical habitat has been designated in Arkansas for any of the Federally listed species known to or that may occur in the vicinity of the ANO-2 site and its transmission line rights-of-way (FWS 2004a).

Proposed Action

The proposed action is the renewal of the operating license (OL) for ANO-2. Entergy Operations, Inc. (Entergy) operates Arkansas Nuclear One, Units 1 (ANO-1) and 2, under OLs DPR-51 and NPF-6, issued by the U.S. Nuclear Regulatory Commission (NRC). Entergy, an operating subsidiary of the Entergy Corporation, holds the licenses for these units. The OL for ANO-1 was already renewed for an additional 20 years, and now will expire in 2034. The OL for ANO-2 will expire in July 2018. Therefore, on October 15, 2003, Entergy submitted an application to the NRC to renew the ANO-2 OL for an additional 20 years of operation until July 17, 2038.

ANO-2 is a pressurized water reactor designed by Combustion Engineering, with a maximum reactor core power level output of 3026 megawatts thermal (MWt) and 1048 megawatts electric (MWe). Plant cooling is provided by a closed-cycle cooling system equipped with a natural-draft

cooling tower that dissipates heat primarily to the atmosphere. After moving through the condenser, circulating water rejects waste heat to the atmosphere through the natural-draft cooling tower. Remaining waste heat is discharged in the form of blowdown from the circulating water system to a 158-m (520-ft)-long canal discharging into Lake Dardanelle. This blowdown is mixed with the ANO-1 circulating water system discharge. For the ANO-2 service water system, water is drawn from Lake Dardanelle through a 1341-m (4400-ft)-long canal to the ANO-2 intake structure at an average rate of approximately 1009 L/sec (16,000 gpm) (NRC 1977).

The extension of the license term will result in continued operation and maintenance of the nuclear power reactor, the cooling water intake, and discharge structures and canals, cooling tower, and support facilities at the plant site. No changes are expected in terms of ecological or environmental impacts to current operations. In addition, renewal of the OL is not anticipated to require any significant new construction at the site or modification of existing terrestrial or aquatic habitats.

Vegetation management along the ANO-2 transmission line rights-of-way, which consists of mechanical and manual clearing only, will continue during the renewal period. No herbicides are used along the rights-of-way. Mechanical clearing employs tractors with mowing and tree-cutting equipment in the open areas of the rights-of-way, while manual clearing involves cutting trees around poles, down guys, anchor rods, and structure legs and foundations, and at fences and road crossings. Hazard trees (trees that pose an immediate threat to line reliability because they are leaning toward the line or potentially could fall on the line because of advanced soil erosion) outside the rights-of-way are also removed or topped. Semiannually, an aerial survey of the transmission line rights-of-way is performed to identify issues that would cause potential operational problems (e.g., erosion, vegetation control, equipment maintenance) (Entergy 2003a, 2003c).

The staff has determined that it would consult with the U.S. Fish and Wildlife Service (FWS) as part of its review of the proposed action. Consultation with FWS was initiated by Entergy on September 17, 2002 (FTN 2002a), and by the NRC on December 9, 2003 (NRC 2003), with letters requesting information about the presence of Federally listed threatened or endangered species on and in the vicinity of the ANO-2 site and its transmission line. FWS responded to Entergy on December 20, 2002, identifying the endangered interior population of the least tern (*Sterna antillarum*) as occurring along portions of the Arkansas River and the threatened Arkansas River shiner (*Notropis girardi*) as having had an historic occurrence in the river (FWS 2002). FWS concurrently concluded that no threatened or endangered species had been observed in the vicinity of the ANO-2 site and its transmission line rights-of-way (FWS 2002). In contrast, FWS responded to NRC on January 14, 2004, identifying the least tern and the threatened bald eagle (*Haliaeetus leucocephalus*) as present in the vicinity of the ANO-2 site and its transmission line (FWS 2004a). FWS concurrently concluded that no threatened or

endangered species would be likely to be impacted by continued operation of ANO-2 during the license renewal term (FWS 2004a). Consultation with NOAA indicated that they had no listed species or critical habitat in their purview associated with ANO-2 (NOAA 2003). In addition to these three Federally listed species, the Entergy Environmental Report identified the endangered gray bat (*Myotis grisescens*) as occurring in the vicinity of the ANO-2 site and its transmission line (Entergy 2003a). No critical habitat has been designated for any of the above three Federally listed terrestrial species (FWS 2004b). Critical habitat has been designated for the Arkansas River shiner, but not in the state of Arkansas (FWS 2004b).

Consultation with the Arkansas Natural Heritage Commission (ANHC) (FTN 2002b) and Arkansas Game and Fish Commission (AGFC) (FTN 2002c) was initiated by Entergy in September 2002 with letters requesting information about the presence of State-listed species on and in the vicinity of the ANO-2 site and its transmission line. No State-listed species were identified by either the ANHC (ANHC 2002) or AGFC (AGFC 2003) as occurring on or in the vicinity of the ANO-2 site or its transmission line rights-of-way.

Species Evaluated

The only Federally listed terrestrial species protected under the Endangered Species Act known to occur in the vicinity of the ANO-2 site and its transmission line rights-of-way are the least tern (interior population only) (FWS 2002; 2004b, c), bald eagle (Entergy 2003a; FWS 2004a), and gray bat (Entergy 2003a) (Table 1). No critical habitat has been designated for any of these

Table 1. Species Listed as Endangered or Threatened Under the Endangered Species Act that have been Reported to Occur Within Pope County, Arkansas, and the Arkansas River

Scientific Name	Common Name	Federal Status	Determination
Birds			
Sterna antillarum	least tern	Endangered	No Effect or Not Likely to Affect
Haliaeetus leucocephalus	bald eagle	Threatened	No Effect or Not Likely to Affect
Mammals			
Myotis grisescens	gray bat	Endangered	No Effect or Not Likely to Affect
Fish			
Notropis girardi	Arkansas River shiner	Threatened	No Effect or Not Likely to Affect

Source: (http://ecos.fws.gov/tess_public/TESSWebpageVipListed?code=V&listings=0) as of May 11, 2004.

Federally listed terrestrial species (FWS 2004a). No Federally listed plant species are known to occur in the vicinity of the ANO-2 site or its transmission line rights-of-way (Entergy 2003a; FWS 2002, 2004b). The Federally protected Arkansas River shiner is known to occur along portions of the Arkansas River. However, none have been observed in the vicinity of ANO-2 or the transmission line rights-of-way. Critical habitat has not been designated in Arkansas by the FWS or the AGFC for these species (FWS 2004d).

List of Species

There are no species currently proposed for formal listing or considered candidates for listing in the vicinity. The NRC has determined that the proposed action will either have no effect or will be not likely to adversely affect the endangered or threatened species in the vicinity of the ANO-2 plant and associated transmission line rights-of-way (Table 1). The basis for the determinations for each species in the vicinity of the plant site and transmission corridor is discussed in the following paragraphs.

1. *Myotis grisescens*, gray bat

The gray bat is a medium-sized bat with gray or chestnut-brown fur. The species was listed as Federally endangered in 1976 throughout its range by FWS (Storming Media 2004), primarily because of human and environmental disturbances and impoundment of waterways. Gray bats are year-round cave residents but migrate between caves in wintering and summering areas of the midwestern and southeastern United States. Populations are mainly concentrated in Alabama, Arkansas, Missouri, Tennessee, and Kentucky.

The gray bat is known to occur near ANO-2, where it resides in caves upstream of the Dardanelle Lock and Dam. However, these caves are 16 km (10 mi) from ANO-2 and 3.6 km (2 mi) from the transmission line rights-of-way (NRC 2001). None have been observed in the vicinity of ANO-2 or the transmission line rights-of-way. Therefore, NRC has determined that the proposed action will have either have no effect or will not be likely to adversely affect gray bats.

2. *Haliaeetus leucocephalus*, bald eagle

Arkansas ranks in the top 10 states in the number of winter bald eagle sightings (AGFC 2004). More than 1000 bald eagles are counted each winter, nearly triple the 368 recorded in 1979. Bald eagles are winter transients to the Lake Dardanelle area, where birds forage during colder periods of the winter months. Eagles have been sighted flying near the ANO-2 site, but there are no reports of eagles on the site. Nest sites have been reported at several localities on Lake Dardanelle, but none are within 16 km (10 mi) of ANO-2 or within the transmission line

rights-of-way. Therefore, NRC has determined that the proposed action will have either no effect or will not be likely to adversely affect bald eagles.

3. *Sterna antillarum*, least tern

The interior least tern is a small white bird with grayish back and wings (FWS 2004c). The species is distinguished by the combination of a black crown, white forehead, and black-tipped yellow bill. Interior least terns are present in the Arkansas and Red rivers from April through August. They nest in small colonies on exposed salt flats, reservoir beaches, and river sandbars along most of the larger rivers. Nests are small scrapes in the sand with 2 to 3 eggs laid in a clutch. The young are fairly mobile soon after hatching, and both parents feed and remain with the young until fall migration. They feed mostly on small fish. Major threats include predation, human disturbance, and the construction and operation of main stem reservoirs.

For habitat, the species requires sandbar conditions that include very low vegetation cover and protection from predators and flooding. These conditions are not present within the site area. The interior least tern breeds on sandbars in the Arkansas River near Atkins and Clarksville (about 35 and 39 river-km [22 and 24 river-mi] up- and downstream, respectively, from the ANO-2 site [Figure 1]). These nesting locations are beyond a 16-km (10-mi) radius from ANO-2 and its transmission line rights-of-way. Therefore, NRC has determined that the proposed action will have either no effect or will not be likely to adversely affect interior least terns.

4. *Notropis girardi*, Arkansas River shiner

This small (usually less than 5 cm [2 in.]) shiner is straw-colored with silvery sides. Scattered brown flecks occur on its sides behind the head. The anal fin has 8 rays compared to 7 on other shiner species found in the same habitat. This fish inhabits the main channels of sandy rivers, especially those with highly variable flows, high water temperatures and dissolved solids. During the past 20 to 30 years their abundance and distribution has declined markedly, possibly due to flow modification (USDA 2004).

The Arkansas River shiner formerly occurred throughout the main stem and in the major right bank (southern) tributary basins of the Arkansas River (Kansas Wildlife and Parks 2004). The fish is extremely dependent on flood flows from June through August to successfully spawn. Declining stream flows have now restricted its probable range to a few stream reaches in Kansas, Oklahoma, and Texas (over 290 km [180 mi] from the ANO-2 site). The fish occurs in the upper reaches of the Cimarron River only during high stream flow events.

Designated critical habitat for the Arkansas River shiner does not occur in Arkansas (FWS 2004d). Therefore, NRC has determined that the proposed action will have either no effect or will not be likely to adversely affect Arkansas River shiners.

Conclusions

The only Federally listed terrestrial species protected under the Endangered Species Act that are known to or may occur in the vicinity of the ANO-2 site and its transmission line rights-of-way are the least tern, bald eagle, and gray bat. No critical habitat has been designated for any of these Federally listed terrestrial species. No Federally listed plant species are known to occur in the vicinity of the ANO-2 site or its transmission line rights-of-way. The Federally protected Arkansas River shiner is known to occur along portions of the Arkansas River. However, none have been observed in the vicinity of ANO-2 or its transmission line rights-of-way. Critical habitat has not been designated in Arkansas by FWS or AGFC for these species. There are no species currently proposed for formal listing or considered candidates for listing in the vicinity of ANO-2. NRC has determined that the proposed action will either have no effect or will not be likely to adversely affect the endangered or threatened species in the vicinity of ANO-2 and its transmission line rights-of-way.

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IN REPLY REFER TO:

United States Department of the Interior

FISH AND WILDLIFE SERVICE
1500 Museum Road, Suite 105
Conway, Arkansas 72032

June 29, 2004

Dr. Pao-Tsin Kuo
Program Director
License Renewal and Environmental Impacts Program
Office of Nuclear Reactor Regulation
Nuclear Regulatory Commission
Washington, D.C. 20555-0001

Dear Dr. Kuo:

The Fish and Wildlife Service (Service) has reviewed the Biological Assessment for Arkansas Nuclear One, Unit 2, Pope County, Arkansas (Docket No. 50-368) supplied with your letter dated June 8, 2004. Our comments are submitted in accordance with the Endangered Species Act (87 Stat. 884, as amended 16 U.S.C. 1531 et seq.).

The Service concurs with the conclusions of the Biological Assessment that the proposed license renewal would have no effect on any federally endangered or threatened species.

We appreciate the opportunity to provide these comments.

Sincerely,

Margaret Harney

Margaret Harney
Acting Field Supervisor

Entergy

Entergy Operations, Inc.
1448 S.R. 333
Russellville, AR 72802
Tel 501 858 5000

2CAN070403

July 15, 2004

U.S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, DC 20555-0001

Subject: Clarification of a Request for Additional Information Response for Environmental Report TAC No. MB8405
Arkansas Nuclear One – Unit 2
Docket No. 50-368
License No. NPF-6

Dear Sir or Madam:

By letter dated April 23, 2004 (2CAN040402), Entergy provided responses to NRC requests for additional information (RAIs) on the Arkansas Nuclear One, Unit 2 (ANO-2) License Renewal Application Environmental Report. The responses to the RAIs were related to the severe accident mitigation alternatives (SAMAs). In a teleconference on June 15, 2004, the Staff requested a clarification to RAI 7. The clarification to RAI 7 is contained in the attachment.

There are no new commitments contained in this submittal. Should you have any questions concerning this submittal, please contact Ms. Natalie Mosher at (479) 858-4635.

I declare under penalty of perjury that the foregoing is true and correct. Executed on July 15, 2004.

Sincerely,

Timothy G. Mitchell
Director, Nuclear Safety Assurance

TGM/nbm

Attachment

A100

Appendix F

GEIS Environmental Issues Not Applicable to Arkansas Nuclear One, Unit 2

Appendix F

GEIS Environmental Issues Not Applicable to Arkansas Nuclear One, Unit 2

Table F-1 lists those environmental issues listed in the *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (GEIS) (NRC 1996, 1999)[a] and Title 10 of the Code of Federal Regulations (CFR) Part 51, Subpart A, Appendix B, Table B-1 that are not applicable to Arkansas Nuclear One, Unit 2 (ANO-2), because of plant or site characteristics.

Table F-1. GEIS Environmental Issues Not Applicable to Arkansas Nuclear One, Unit 2

ISSUE – 10 CFR Part 51, Subpart A, Appendix B, Table B-1	Category	GEIS Sections	Comment
SURFACE WATER QUALITY, HYDROLOGY, AND USE (FOR ALL PLANTS)			
Altered salinity gradients	1	4.2.1.2.2 4.4.2.2	The ANO cooling system does not discharge to an estuary.
Water-use conflicts (plants with once-through cooling systems)	1	4.2.1.3	ANO-2 uses a cooling tower rather than once-through cooling.
AQUATIC ECOLOGY (FOR PLANTS WITH ONCE-THROUGH AND COOLING POND HEAT DISSIPATION SYSTEMS)			
Entrainment of fish and shellfish in early life stages	2	4.2.2.1.2 4.4.3	This issue is related to heat-dissipation systems that are not installed at ANO-2.
Impingement of fish and shellfish	2	4.2.2.1.3 4.4.3	This issue is related to heat-dissipation systems that are not installed at ANO-2.
Heat shock	2	4.2.2.1.4 4.4.3	This issue is related to heat-dissipation systems that are not installed at ANO-2.
GROUNDWATER USE AND QUALITY			
Groundwater use conflicts (potable and service water, and dewatering; plants that use >100 gpm)	2	4.8.1.1 4.8.2.1	ANO-2 uses <100 gpm of groundwater.

(a) The GEIS was originally issued in 1996. Addendum 1 to the GEIS was issued in 1999. Hereafter, all references to the "GEIS" include the GEIS and its Addendum 1.

Table F-1. (contd)

ISSUE – 10 CFR Part 51, Subpart A, Appendix B, Table B-1	Category	GEIS Sections	Comment
GROUNDWATER USE AND QUALITY (CONTD)			
Groundwater-use conflicts (Ranney wells)	2	4.8.1.4	ANO-2 does not have or use Ranney wells.
Groundwater quality degradation (Ranney wells)	1	4.8.2.2	ANO-2 does not have or use Ranney wells.
Groundwater quality degradation (saltwater intrusion)	1	4.8.2.1	Not applicable due to the location of ANO-2.
Groundwater quality degradation (cooling ponds in salt marshes)	1	4.8.3	Not applicable due the location of ANO-2.
Groundwater quality degradation (cooling ponds at inland sites)	2	4.8.3	ANO-2 does not use a cooling pond heat dissipation system.
TERRESTRIAL RESOURCES			
Cooling pond impacts on terrestrial resources	1	4.4.4	This issue is related to a heat-dissipation system that is not installed at ANO-2.

F.1 References

10 CFR Part 51. Code of Federal Regulations, *Title 10, Energy,* Part 51, "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions."

U.S. Nuclear Regulatory Commission (NRC). 1996. *Generic Environmental Impact Statement for License Renewal of Nuclear Plants.* NUREG-1437, Volumes 1 and 2, Washington, D.C.

U.S. Nuclear Regulatory Commission (NRC). 1999. *Generic Environmental Impact Statement for License Renewal of Nuclear Plants: Main Report, Section 6.3 – Transportation, Table 9.1 Summary of findings on NEPA issues for license renewal of nuclear power plants.* NUREG-1437, Volume 1, Addendum 1, Washington, D.C.

Appendix G

NRC Staff Evaluation of Severe Accident Mitigation Alternatives for Arkansas Nuclear One, Unit 2 in Support of License Renewal Application

Appendix G

NRC Staff Evaluation of Severe Accident Mitigation Alternatives for Arkansas Nuclear One, Unit 2 in Support of License Renewal Application

G.1 Introduction

Entergy Operations, Inc. (Entergy) submitted an assessment of severe accident mitigation alternatives (SAMAs) for Arkansas Nuclear One, Unit 2 (ANO-2) as part of its Environmental Report (ER) (Entergy 2003). This assessment was based on the most recent ANO-2 Probabilistic Safety Assessment (PSA) available at that time, a plant-specific offsite consequence analysis performed using the MELCOR Accident Consequence Code System 2 (MACCS2) computer program, and insights from the ANO-2 Individual Plant Examination (IPE) (Entergy 1992) and Individual Plant Examination of External Events (IPEEE) (Entergy 1996). In identifying and evaluating potential SAMAs, Entergy considered SAMA analyses performed for other operating plants that have submitted license renewal applications, as well as industry and NRC documents that discuss potential plant improvements, such as NUREG-1560 (NRC 1997a). Entergy identified 192 potential SAMA candidates. This list was reduced to 93 unique SAMA candidates by eliminating SAMAs that were not applicable to ANO-2 because of design differences, had already been implemented, or were similar in nature and could be combined with another SAMA. Entergy assessed the costs and benefits associated with each of the remaining SAMAs and concluded in the ER that none of the candidate SAMAs evaluated would be cost-beneficial for ANO-2.

Based on a review of the SAMA assessment, the NRC issued a request for additional information (RAI) to Entergy by letter dated February 24, 2004 (NRC 2004). Key questions concerned dominant risk contributors at ANO-2 and the SAMAs that address these contributors, the potential impact of external event initiators and uncertainties on the assessment results, and detailed information on some specific candidate SAMAs. Entergy submitted additional information by letters dated April 23, 2004 (Entergy 2004a), and July 15, 2004 (Entergy 2004b), including summaries of peer review comments and their impact on the SAMA analysis, a breakout of the internal events core damage frequency (CDF) by major contributor, importance measures, and more realistic estimates of the benefits and implementation costs for several SAMAs that appeared to be cost-beneficial based on a revised screening. Entergy's responses addressed the staff's concerns.

Based on its review, the staff concluded that the contribution to risk from fire events could be higher than assumed in Entergy's SAMA analysis. The staff adjusted Entergy's risk reduction

estimates to account for a higher contribution to risk (and risk reduction) from fire events and found that two of the candidate SAMAs would be cost-beneficial and two additional SAMAs are close to being cost-beneficial. However, none of these SAMAs relate to adequately managing the effects of aging during the period of extended operation and, therefore, need not be implemented as part of license renewal pursuant to Title 10 of the Code of Federal Regulations (CFR) Part 54.

An assessment of SAMAs for ANO-2 is presented below.

G.2 Estimate of Risk for ANO-2

Entergy's estimates of offsite risk at ANO-2 are summarized in Section G.2.1. The summary is followed by the staff's review of Entergy's risk estimates in Section G.2.2.

G.2.1 Entergy's Risk Estimates

Two distinct analyses are combined to form the basis for the risk estimates used in the SAMA analysis: (1) the ANO-2 PSA model, and (2) a supplemental analysis of offsite consequences and economic impacts (essentially a Level 3 PRA model) developed specifically for the SAMA analysis. The SAMA analysis is based on the most recent PSA model available (referred to as Revision 3p2) at the time the ER was produced. It contains a Level 1 analysis to determine the CDF from internally initiated events and a Level 2 analysis to assess containment performance during severe accidents. The scope of the ANO-2 PSA does not include external events.

The baseline CDF for the purpose of the SAMA evaluation is approximately 7.2×10^{-6} per year, and is based on the risk assessment for internally-initiated events. Entergy did not include the contribution to risk from external events within the ANO-2 risk estimates; however, it did account for the potential risk reduction benefits associated with external events by doubling the estimated benefits for internal events. This is discussed further in Section G.6.2.

The breakdown of CDF by initiating event is provided in Table G-1. As shown in this table, transients and small break loss of coolant accidents (LOCAs) are dominant contributors to the CDF. Bypass events (i.e., interfacing systems LOCA and steam generator tube rupture) contribute less than 10 percent to the total internal events CDF. Anticipated transients without scram (ATWS) events and internal floods are not included in the internal events CDF. In response to a request for additional information (RAI), Entergy stated that the nominal ATWS CDF is estimated to be 1.6×10^{-6} per reactor year, and the CDF due to internal floods is less than 1×10^{-6} for all plant zones (Entergy 2004a). SAMAs to address ATWS events

Table G-1. Estimated Core Damage Frequencies at Arkansas Nuclear One, Unit 2

Initiating Event/Accident Class	CDF (per year)	% Contribution to CDF
Transients	4.2×10^{-6}	58
Small break LOCA	1.7×10^{-6}	24
Interfacing system LOCA (ISLOCA)	3.3×10^{-7}	5
Vessel rupture	2.7×10^{-7}	4
Medium break LOCA	1.9×10^{-7}	3
Large break LOCA	2.8×10^{-7}	4
Steam generator tube rupture (SGTR)	1.5×10^{-7}	2
Total CDF (from internal events)	**7.2×10^{-6}**	**100**

(Entergy 2004a). SAMAs to address ATWS events were considered in the SAMA evaluation. SAMAs to address flooding events were not explicitly considered, but would not significantly impact the risk profile given the low CDF for internal floods.

The Level 2 analysis utilized the containment event tree logic from the IPE and fault tree linking to combine the Level 1 core damage sequence failures with the Level 2 containment safeguards systems fault trees. The fault tree linking method was used to resolve dependencies that occur between the Level 1 core damage sequence failures and containment safeguards system failures. The combined sequences were then mapped into plant damage states (PDS) using the same method employed in the IPE. The updated fission product release fractions for each release category were provided in response to an RAI (Entergy 2004a).

The MACCS2 code was used to determine the offsite risk impacts on the surrounding environment and public in the offsite consequences and economic impact analyses. Inputs for this analysis include plant-specific and site-specific input values for core radionuclide inventory, source term and release characteristics, site meteorological data, projected population distribution (within a 80-km [50-mi] radius) for the year 2040, emergency response evacuation modeling, and economic data.

In its ER, Entergy estimated the dose to the population within 80 km (50 mi) of the ANO-2 site to be approximately 0.0172 person-Sv (1.72 person-rem) per year. The breakdown of the total population dose by containment release mode is summarized in Table G-2. Steam generator tube ruptures and late containment failures dominate the population dose risk at ANO-2.

Table G-2. Breakdown of Population Dose by Containment Release Mode

Containment Release Mode	Population Dose (person-rem[a] per year)	% Contribution
SGTR	0.74	43
ISLOCA	0.006	<1
Early containment failure	0.25	15
Late containment failure	0.73	42
No containment failure	0	0
Total Population Dose	**1.72**	**100**

(a) One person-Rem = 0.01 person-Sv

G.2.2 Review of Entergy's Risk Estimates

Entergy's determination of offsite risk at ANO-2 is based on the following three major elements of analysis:

- the Level 1 and 2 risk models that are the bases for the 1992 IPE submittal (Entergy 1992) and the 1996 IPEEE submittal (Entergy 1996)
- the major modifications to the IPE model incorporated in the ANO-2 PSA
- the MACCS2 analyses performed to translate fission product source terms and release frequencies from the Level 2 PRA model into offsite consequence measures.

Each of these analyses was reviewed to determine the acceptability of Entergy's risk estimates for the SAMA analysis, as summarized below.

The staff's review of the ANO-2 IPE is described in an NRC report dated May 5, 1997 (NRC 1997c). In that review, the staff evaluated the methodology, models, data, and assumptions used to estimate the CDF and characterize containment performance and fission product releases. The staff concluded that Entergy's analysis met the intent of Generic Letter 88-20 (NRC 1988); that is, the IPE was of adequate quality used to look for design or operational vulnerabilities. Although the staff reviewed certain aspects of the IPE in more detail than others, it primarily focused on the licensee's ability to examine ANO-2 for severe accident vulnerabilities and not specifically on the detailed findings or quantification estimates. Overall, the staff believed that the ANO-2 IPE was of adequate quality to be used as a tool in searching for areas with high potential for risk reduction and to assess such risk reductions, especially when the risk models are used in conjunction with insights, such as those from risk importance, sensitivity, and uncertainty analyses.

A comparison of internal events risk profiles between the IPE and the PSA used in the SAMA analysis indicate a decrease of nearly 80 percent in the total CDF (from 3.4×10^{-5} per year to 7.2×10^{-6} per year). The reduction is mainly attributed to plant design changes and modeling improvements that have been implemented at ANO-2 since the IPE was submitted. A summary listing of those changes that resulted in the greatest impact on the total CDF was provided in the ER and in response to an RAI (Entergy 2004a). The list includes:

- added alternate AC power source for station blackout (SBO)
- added auxiliary feedwater pump
- added component cooling water (CCW) relief capacity to mitigate reactor coolant pump (RCP) seal cooler tube rupture
- addressed asymmetry issues associated with removing service water (SW) pumps from service
- updated events that challenge primary safety relief valves
- revised fault tree logic to correctly account for plant risk associated with powering AC power sources 2RS-1 and 2RS-2 via swing inverters
- revised modeling for SW flow diversion to CCW
- modeled procedure change associated with fast transfer of startup transformer #2 to 2A1.

The IPE CDF value for ANO-2 is comparable to the CDF values reported in the IPEs for other Combustion Engineering (CE) plants. Figure 11.6 of NUREG-1560 shows that the IPE-based total internal events CDF for CE plants ranges from 1×10^{-5} to 2×10^{-4} per reactor-year (NRC 1997a). It is recognized that other plants have reduced their values for CDF subsequent to the IPE submittals through modeling and hardware changes. The current internal events CDF results for ANO-2 are at the low end for CE plants even when ATWS and internal floods are included in the CDF.

The staff considered the peer reviews performed for the ANO-2 PSA, and the potential impact of the review findings on the SAMA evaluation. In response to an RAI, Entergy described the previous reviews, the most significant of which was the Combustion Engineering Owners Group (CEOG) Peer Review of PSA Revision 3p0 performed in February 2002 (Entergy 2004a). The CEOG review concluded that the technical elements of the PRA were such that the PSA is generally suitable for plant risk-informed applications. Most of the recommendations from this review were addressed or reflected in Revision 3p2 of the ANO-2 PSA, which is the version that

was used for the SAMA analysis. Those recommendations not yet incorporated are in the areas of common cause failures (CCF), and the application and value of recovery actions to address failure to recover sump suction valves 2CV-5649-1 and 2CV-5650-2 (YHF2CSSUMP). Entergy evaluated the impact of these two issues on the SAMA evaluation. For CCF, Entergy stated that the current analysis is sufficient to support the SAMA analysis, and the conclusion of the evaluation would be unchanged by the resolution of the peer review comment. With regard to the application and value of recovery action YHF2CSSUMP, Entergy performed a sensitivity analysis in which the model was changed to conservatively account for failure to recover the sump suction valves. The results of the sensitivity analysis showed that SAMA CC-20 (make containment sump recirculation outlet motor-operated valves 2CV-5649-1 and 2CV-5650-2 diverse from one another by replacing one of them with an air-operated valve) may be cost-beneficial. This is discussed further in Section G.6.2.

Given that (1) the ANO-2 PSA has been peer-reviewed and the potential impact of the peer-review findings on the SAMA evaluation has been assessed, (2) Entergy satisfactorily addressed staff questions regarding the PSA (Entergy 2004a), and (3) the CDF is in the range of contemporary CDFs for CE plants, the staff concludes that the Level 1 and Level 2 PSA models are of sufficient quality to support the SAMA evaluation.

Entergy submitted an IPEEE by letter dated May 31, 1996 (Entergy 1996). Entergy did not identify any fundamental weaknesses or vulnerabilities to severe accident risk in regard to the external events related to fire, high winds, floods, and other external events. However, a number of areas were identified for improvement in the seismic area. In a letter dated February 27, 2001 (NRC 2001), the staff concluded that the submittal met the intent of Supplement 4 to Generic Letter 88-20, and that the licensee's IPEEE process is capable of identifying the most likely severe accidents and severe accident vulnerabilities.

The IPEEE uses a focused scope Electric Power Research Institute (EPRI) seismic margins analysis. This method is qualitative and does not provide the means to determine the numerical estimates of the CDF contributions from seismic initiators. Entergy found that, based on the EPRI assessment methodology, some of the plant's high-confidence, low-probability of failure (HCLPF) values were less than the 0.3-g review level earthquake used in the IPEEE. The most limiting (or lowest) HCLPF values were associated with the emergency diesel generator fuel tanks 2T-57A and 2T-57B that had calculated HCLPF capacities of 0.2-g peak ground acceleration. Other findings were associated with electrical cabinets and motor control centers. Outstanding findings were scheduled for resolution under the USI A-46 program. At the time of the IPEEE, 10 outliers remaining for ANO-2 were listed in Table 7-1 of the IPEEE Summary Report. In response to an IPEEE RAI regarding the status of the outliers, Entergy stated that all outliers in Table 7-1 had been resolved, and that no further modifications were planned (Entergy 1996, 1999).

The ANO-2 fire analysis employed the Fire Induced Vulnerability Evaluation methodology for screening of compartments. The licensee's overall approach in the IPEEE fire analysis is similar to other fire analysis techniques, employing a graduated focus on the most important fire zones using qualitative and quantitative screening criteria. The fire zones or compartments were subjected to at least two screening phases. In the first phase, a compartment was screened out if it was found to not contain any safety-related equipment or reactor trip initiators. In the second phase, a CDF criterion of 1×10^{-6} per year was applied. The licensee used the PSA model of internal events to quantify the CDF resulting from a fire initiating event. The conditional core damage probability (CCDP) was based on the equipment and systems unaffected by the fire. The CDF for each zone was obtained by multiplying the frequency of a fire in a given fire zone by the conditional core damage probability associated with that fire zone. The screening methodology applied by the licensee makes less and less conservative assumptions (e.g., equipment that may survive the fires in the area) until a fire zone is screened out. After the screening, six fire zones remained that contributed more than the screening value of 1.0×10^{-6}. In response to an RAI, Entergy provided a listing of the unscreened fire zones and the associated CDF values based on the latest fire analysis. In this latest fire analysis, 15 fire zones remain that contribute more than the screening value of 1×10^{-6}. These zones are:

Fire Zone	CDF
Turbine building	2.00×10^{-5}
Cable spreading room	1.61×10^{-5}
Intake structure	1.21×10^{-5}
Electrical equipment room	7.26×10^{-6}
Lower south electrical/piping penetration room	5.18×10^{-6}
Diesel corridor	4.87×10^{-6}
South switchgear room	3.72×10^{-6}
North switchgear room	2.28×10^{-6}
Auxiliary building el. 354'	1.93×10^{-6}
Control room	1.90×10^{-6}
New CPC room	1.79×10^{-6}
MCC2B63 room	1.75×10^{-6}
East CD equipment room	1.73×10^{-6}
Auxiliary building ext	1.22×10^{-6}
Transformer yard	1.09×10^{-6}

The fire CDF for ANO-2 is approximately 8.3×10^{-5} per year, which is about a factor of 12 higher than the internal events CDF of 7.2×10^{-6} per year. In light of this value, the staff asked

Entergy to justify their approach of doubling the internal events CDF to account for the fire events CDF, and to assess the impact on the initial and final screenings if the internal events risk reduction estimates were increased by a factor that would bound the risk from fire and seismic events (NRC 2004). In response to the RAI, Entergy stated that the doubling of the benefit to account for external events provides bounding results because the fire analysis was done as a screening analysis only and not as a determination of the fire CDF at ANO-2 (Entergy 2004a). Additionally, Entergy stated that since the fire zone CCDP is calculated by failing all equipment in the fire zone, a SAMA that reduces internal events CDF may not reduce the fire CDF for a zone; thus, the resulting benefit value is inflated and, therefore, is overly conservative. Entergy's position is that given the conservative nature of the analysis, there is reasonable assurance that the risk associated with a fire would be bounded by increasing the benefit by a factor of two.

In the staff's view, the multiplier of two used by Entergy could be justified if the external event and internal event CDFs are comparable. For ANO-2, this would imply that the fire CDF from the screening analysis would have to be conservative by a factor of 12. The staff agrees that the ANO-2 fire analysis contains numerous conservatisms and that a more realistic assessment could result in a substantially lower fire CDF. However, the staff believes that the information provided by Entergy is not sufficient to support a reduction of a factor of 12, and that a more realistic fire CDF may be closer to a factor of two to three less than the screening value. Given a factor of three reduction, the resulting fire CDF would be about 2.8×10^{-5} per year, which is four times higher than the internal events CDF. This would justify use of a multiplier of five to the averted cost estimates (for internal events) to represent the additional SAMA benefits in external events. The staff's review of the cost-benefit evaluation is described in Section G.6.2. In that review, the staff applied a multiplier of five to the internal events benefits.

The ANO-2 IPEEE evaluated high winds, floods, and other events using the progressive screening approach recommended in NUREG-1407 (NRC 1991). Based on this evaluation, the licensee determined that the risks from high winds, floods, and other events (transportation and nearby facility accidents) were not significant vulnerabilities at the plant.

The staff reviewed the process used by Entergy to extend the containment performance (Level 2) portion of the PSA to an assessment of offsite consequences (essentially a Level 3 PSA). This included consideration of the source terms used to characterize fission product releases for the applicable containment release category and the major input assumptions used in the offsite consequence analyses. The MACCS2 code was used to estimate offsite consequences. Plant-specific input to the code includes the ANO-2 reactor core radionuclide inventory, source terms for each release category, emergency evacuation modeling, site-specific meteorological data, and projected population distribution within an 80-km (50-mile) radius for the year 2040. This information is provided in Attachment E to the ER (Entergy 2003).

Entergy grouped the accident sequences into a set of 51 release modes based on their expected source term results. The frequency and calculated consequences for each of the 51 release modes are reported in Tables E.1-2 and E.1-5 of the ER, respectively (Entergy 2003). The break-out of the source term by release mode is provided in Table E.1-2 (Entergy 2003). The staff concludes that the process used to assign release categories and source terms is consistent with typical PRA practices and acceptable for use in the SAMA analysis.

The reactor core inventory input to the MACCS2 code was obtained from the MACCS2 User's Guide, and corresponds to the end-of-cycle values for a 3412 MW(t) PWR plant. A scaling factor of 0.887 was applied to provide a representative core inventory value of 3026 MW(t) for ANO-2.

Entergy used site-specific meteorological data obtained from the plant meteorological tower, processed from hourly measurements for the calendar year 1996. Because the site did not have precipitation records for 1996, data were obtained from the National Climatic Data Center of the National Oceanic and Atmospheric Administration for the nearest available recording site. Entergy stated that the weather data used in the analysis are representative and typical for the site.

The population distribution the applicant used as input to the MACCS2 analysis was estimated for the year 2040, based on U.S. Census population data for 2000, which was adjusted to account for transient population. The 1990 and 2000 census data were then used to project the future rosette section populations for the year 2040. A growth factor was determined by dividing the 80-km (50-mi) radius population in 2000 by the 1990 population. This scaling factor was then applied to the 2000 population in that sector to obtain a year 2040 projection. The staff considers the methods and assumptions for estimating population reasonable and acceptable for purposes of the SAMA evaluation.

The emergency evacuation model was modeled as a single evacuation zone extending out 16 km (10 mi) from the plant. It was assumed that 15 percent of the population will start moving 30 minutes after the alarm sounds, 80 percent of the population will start moving 90 minutes after the alarm sounds, and 5 percent of the population will starting moving 120 minutes after the alarm sounds at an average speed of 1.0 m/s (Entergy 2003). This assumption is conservative relative to the NUREG-1150 study (NRC 1990), which assumed evacuation of 99.5 percent of the population within the emergency planning zone. A sensitivity analysis that assumed that only 90 percent of the population within the emergency planning zone participated in the evacuation was performed. Another sensitivity analysis was performed to assess the importance of the warning and release delay times. The results of both sensitivity analyses showed that evacuation population and the duration have a small impact on the population dose. The evacuation assumptions and analysis are deemed reasonable and acceptable for the purposes of the SAMA evaluation.

Site-specific economic data to a distance of 80 km (50 mi) were specified for each of the counties surrounding the plant. Agricultural economic data from the ANO-1 ER were used (taken from the 1992 Census of Agriculture).

The staff concludes that the methodology used by Entergy to estimate the offsite consequences for ANO-2 provides an acceptable basis from which to proceed with an assessment of risk reduction potential for candidate SAMAs. Accordingly, the staff based its assessment of offsite risk on the CDF and offsite doses reported by Entergy as discussed in Section G.6.2.

G.3 Potential Plant Improvements

The process for identifying potential plant improvements and an evaluation of that process are discussed in this section.

G.3.1 Process for Identifying Potential Plant Improvements

Entergy's process for identifying potential plant improvements (SAMAs) consisted of the following elements:

- review of SAMA analyses submitted in support of original licensing and license renewal activities for other operating nuclear power plants
- review of other NRC and industry documentation discussing potential plant improvements (e.g., NUREG-1560)
- review of the ANO-1 SAMA evaluation, and the ANO-2 IPE and IPEEE
- review of the ANO-2 PSA model top 100 cut sets.

Based on this process, an initial set of 192 candidate SAMAs was identified, as reported in the ER. In Phase 1 of the evaluation, Entergy performed a qualitative screening of the initial list of SAMAs and eliminated SAMAs from further consideration using the following criteria:

- the SAMA is not applicable at ANO-2 because of design differences
- the SAMA has already been implemented at ANO-2
- the SAMA is sufficiently similar to and was combined with other SAMA candidates.

Based on this screening, 99 SAMAs were eliminated leaving 93 for further evaluation. Of the 99 SAMAs eliminated, 40 were eliminated because they were not applicable to ANO-2, 47 were eliminated because they already had been implemented at ANO-2, and 12 were similar to and combined with other SAMAs (Entergy 2004a). A benefit analysis was performed for each of the 93 remaining candidates. To account for external events, the maximum attainable benefit (MAB) was doubled to approximately $632,000, and then applied to the remaining candidates (see discussion in Section G.6.1 for a derivation of the MAB).

The 93 remaining SAMAs were further evaluated and subsequently eliminated in the final screening, as described in Sections G.4 and G.6.1.

G.3.2 Review of Entergy's Process

Entergy's efforts to identify potential SAMAs focused primarily on areas associated with internal initiating events. The initial list of SAMAs generally addressed the accident categories that are dominant CDF and containment failure contributors or issues that tend to have a large impact on a number of accident sequences at ANO-2.

The preliminary review of Entergy's SAMA identification process raised some concerns regarding the completeness of the set of SAMAs identified and the inclusion of plant-specific risk contributors. The staff requested clarification regarding the portion of risk represented by the dominant risk contributors. Because a review of the importance ranking of basic events in the PRA could identify SAMAs that may not be apparent from a review of the top cut sets, the staff also questioned whether an importance analysis was used to confirm the adequacy of the SAMA identification process. In response to the RAI, Entergy stated that importance measures were not used to identify candidate SAMAs; however, a list of dominant equipment failures and operator actions based on importance measures was provided (Entergy 2004a). The table provided in the response describes the basic event, its Fussel-Vesely and risk achievement values, whether it is in the top 100 cut sets, and which SAMAs address the basic event. For those basic events not addressed by a SAMA, a screening analysis was performed to estimate the benefit of completely eliminating the event/failure. For the failures whose elimination would have a benefit exceeding $35,000 (the approximate cost of revising a procedure), Entergy provided a discussion of the proposed modification and associated costs. Entergy concluded that none of the SAMAs would be cost-beneficial (Entergy 2004a). Based on this additional assessment, Entergy concluded that the set of SAMAs evaluated in the ER addresses the major contributors to CDF and offsite dose, and that the review of the top risk contributors does not reveal any new SAMAs.

The staff notes that the set of SAMAs submitted is not all inclusive because additional, possibly even less expensive, design alternatives can always be postulated. However, the staff concludes that the benefits of any additional modifications are unlikely to exceed the benefits of

the modifications evaluated and that the alternative improvements would not likely cost less than the least expensive alternatives evaluated, when the subsidiary costs associated with maintenance, procedures, and training are considered.

The staff concludes that Entergy used a systematic and comprehensive process for identifying potential plant improvements for ANO-2, and that the set of potential plant improvements identified by Entergy is reasonably comprehensive and therefore acceptable. This process included reviewing insights from the IPE and IPEEE and other plant-specific studies, reviewing plant improvements considered in previous SAMA analyses, and using the knowledge and experience of its personnel. While explicit treatment of external events in the SAMA identification process was limited, it is recognized that the prior implementation of plant modifications for seismic events and the absence of external event vulnerabilities reasonably justifies examining primarily the internal events risk results for this purpose.

G.4 Risk Reduction Potential of Plant Improvements

Entergy evaluated the risk-reduction potential of the 93 SAMAs that were applicable to ANO-2. The majority of the SAMA evaluations were performed in a bounding fashion in that the SAMA was assumed to completely eliminate the risk associated with the proposed enhancement. Such bounding calculations overestimate the benefit and, therefore, are conservative.

Entergy used model requantification to determine the potential benefits. The CDF and population dose reductions were estimated using the Revision 3p2 of the ANO-2 PSA. The changes made to the model to quantify the impact of SAMAs are detailed in Section E.2.3 of Attachment E to the ER (Entergy 2003) and in response to an RAI (Entergy 2004a, b). Table G-3 lists the assumptions considered to estimate the risk reduction for each of the 93 Phase 2 SAMAs, the estimated risk reduction in terms of percent reduction in CDF and population dose, and the estimated total benefit (present value) of the averted risk. The determination of the benefits for the various SAMAs is further discussed in Section G.6.

The staff has reviewed Entergy's bases for calculating the risk reduction for the various plant improvements and concludes that the rationale and assumptions for estimating risk reduction are reasonable and generally conservative (i.e., the estimated risk reduction is higher than what would actually be realized). Accordingly, the staff based its estimates of averted risk for the various SAMAs on Entergy's risk reduction estimates reported in the ER, but applied a multiplier to these values to account for benefits in external events as discussed in Section G.6.2.

Table G-3. SAMA Cost/Benefit Screening Analysis

Analysis Case and Applicable SAMAs[a]	Assumptions	% Risk Reduction CDF	% Risk Reduction Population Dose	Total Benefit[b] ($)	Cost ($)
AIR	Plant air compressor failure events are set to zero	0	0	~0	>100,000
IA-02 - Replace current air compressors with more reliable models					
ATWS1	Eliminate CDF caused by ATWS	22	0	350,000	
AT-01- Provide alternative ATWS pressure relief valves					1,000,000
AT-02 - Create a boron injection/shutdown system to backup the mechanical control rods	[Eliminate failure of borated water injection following an ATWS]			[200,000]	[412,000]
AT-03 - Provide a diverse plant protection system					3,000,000
ATWS2	Charging pumps are perfectly reliable	2	0	30,000	>100,000
CW-07 - Increase charging pump lube oil capacity					
BRKR	Eliminate all 4160-V breaker failures	1	1	15,000	35,000
AC/DC-15 - Develop enhanced procedures to repair or change out failed 4 kV breakers					
CAVITY	Eliminate CDF attributed to plant damage state IVKi	1	5	17,000[c]	
EV-15 - Create a reactor cavity flooding system					8,750,000
EV-16 - Create other options for reactor cavity flooding (drill pathways in reactor vessel support structure)					>100,000
EV-17 - Create other options for reactor cavity flooding (flood reactor cavity via systems like diesel-driven fire pumps)					>100,000
EV-31 - Remove reactor vessel cavity check valve 2BS-46 internals					>35,000

Table G-3. (contd)

Analysis Case and Applicable SAMAs[a]	Assumptions	% Risk Reduction CDF	% Risk Reduction Population Dose	Total Benefit[b] ($)	Cost ($)
CBPEN	Already implemented[d]				
CB-23 - Develop enhanced procedures for SBO to prevent containment bypass					
CST	Realignment of emergency feedwater (EFW) suction to alternate condensate storage tank is perfectly reliable	2	1	25,000	>100,000
FW-19 - Create ability to automatically align the EFW suction to the other condensate storage tank on low-low level of 2T-41A or 2T-41B					
DCPWR	Eliminate battery discharge and battery failure events	6	4	85,000	
AC/DC-04 - Use fuel cells in lieu of conventional lead-acid batteries					2,000,000
AC/DC-05 - Provide additional DC battery capability					>150,000
AC/DC-10 - Incorporate alternate battery charging capabilities	[Eliminate failure to align the 125-VDC buses to alternate power sources]			[71,000]	[155,000]
AC/DC-12 - Replace current station batteries with more reliable model					>150,000
AC/DC-24 - Create the ability to automatically transfer battery charger/eliminator 2D31B to an alternate power source upon demand	[Eliminate failure to align 2D01 to an alternate power source]			[49,000]	[131,000]
EDGCOOL	Emergency diesel cooling is perfectly reliable	3	3	50,000	1,700,000
AC/DC-19 - Create a back-up source for diesel cooling					
EFW	EFW system is perfectly reliable	18	13	259,000	
FW-13 - Install an independent diesel for the condensate storage tank makeup pumps	[Eliminate failure to align to the alternate condensate storage tank]			[26,000]	[314,000]
HV-05 - Create ability to switch fan power supply to station batteries in an SBO					[628,000]

Table G-3. (contd)

Analysis Case and Applicable SAMAs[a]	Assumptions	% Risk Reduction CDF	% Risk Reduction Population Dose	Total Benefit[b] ($)	Cost ($)
EFWCV FW-17 - Enhance EFW flow control in the emergency operating procedures	*Already Implemented* [4]				
ESFASRELAY CC-22 - Incorporate diversity among recirculation actuation signal and ESFAS signal actuation relays	Eliminate CDF due to common cause failure (CCF) of engineered safety feature actuation system (ESFAS) and solid state relays	2	2	38,000	>100,000
FDW	Eliminate CDF due to loss of feedwater	20	12	280,000	
CW-01 - Cap downstream piping of normally closed CCW drain and vent valves					[827,000]
FW-01 - Install a digital feedwater upgrade	*Already Implemented*[d]				
FILTER	Eliminate all CCFs of service water pump discharge filters	16	16	250,000	
CW-26 - Increase inspections of service water pump discharge filters					655,000
CW-27 - Replace current service water pump discharge filters with backwash filters	**[Reduce CCF of service water pump discharge strainers]**			**[225,000]**	**[247,000]**
HPSICV CC-19 - Provide an additional flow path from the refueling water tank to the HPSI system through a diversified suction flow path check valve	Eliminate CDF due to failure of the high-pressure safety injection (HPSI) flow path check valves	5	3	73,000	[1,000,000]
HPSIMOV CC-21 - Provide actuator diversity for the motor-operated valves (MOVs) in the HPSI system	Eliminate CDF due to common cause failure of the HPSI valves	4	2	55,000	[425,000]

Table G-3. (contd)

Analysis Case and Applicable SAMAs[a]	Assumptions	% Risk Reduction		Total Benefit[b] ($)	Cost ($)
		CDF	Population Dose		
HVAC HV-03 - Develop enhanced procedures for temporary HVAC, including use of temporary equipment	Shutdown heat exchanger room cooling is perfectly reliable	27	30	435,000	[1,200,000]
ISLOCA	Eliminate CDF due to ISLOCA events	5	36	86,000[c]	
CB-13 - Install additional instrumentation for ISLOCA sequences					2,300,000
CB-14 - Increase frequency of valve leak testing					963,000
CB-19 - Ensure all ISLOCA releases are scrubbed					>1,000,000
CB-20 - Add redundant and diverse limit switch to each containment isolation valve					1,000,000
ISLOCAHEP CB-26 - Enhance plant procedures to improve credit for human action to prevent and cope with an ISLOCA	[Eliminate ISLOCA contribution from failure of low-pressure safety injection lines and half ISLOCA contribution from RCP seal cooler tube rupture]	3	26	[27,000][c]	70,000
LBLOCA OT-07 - Provide digital large break LOCA protection	Eliminate CDF due to large LOCAs	4	3	24,000[c]	>100,000
LOCCW	Eliminate CDF due to loss of component cooling water system	13	11	190,000	
CW-15 - Install an additional CCW pump					>1,000,000
CW-22 - Improve ability to cool residual heat removal heat exchangers					565,000

Table G-3. (contd)

Analysis Case and Applicable SAMAs[a]	Assumptions	% Risk Reduction CDF	% Risk Reduction Population Dose	Total Benefit[b] ($)	Cost ($)
LOOP	Eliminate all loss of offsite power (LOOP) initiators	6	6	98,000	
AC/DC-02 - Install a combustion turbine generator					3,350,000
AC/DC-09 - Improve bus cross-tie capability					1,119,000
AC/DC-13 - Create AC power cross-tie capability across units at a multi-unit site					>1,000,000
AC/DC-20 - Use fire protection system as a backup for diesel cooling					>497,000
AC/DC-21 - Provide a connection to an alternate off-site power source					>25,000,000
AC/DC-22 - Implement underground offsite power lines					>25,000,000
LOOPREC	**[Reduce probability of failure to recover from LOOP]**	**5**	**5**	**[76,000]**	**35,000**
AC/DC-16 - Emphasize steps in plant recovery following SBO					
LOSW	Eliminate CDF due to loss of service water	32	33	505,000	
CW-09 - Provide an additional diversified service water pump					[1,158,000]
CW-13 - Replace emergency core cooling system pump motors with air cooled motors					>1,000,000
LOWSHEP		5	3		35,000
CW-06 - Proceduralize shedding CCW loads to extend the CCW heat up time	**[Reduce failure to trip reactor coolant pumps (RCPs) upon loss of CCW]**			**[46,000]**	
CW-21 - Implement procedure and operator training enhancements for support system failure sequences, with an emphasis on anticipating problems and coping	[Reduce individual support system human failure events]			[11,000]	
CW-23 - Develop enhanced procedures for loss of service water	[Eliminate failure to recover failed service]			[15,000]	

Table G-3. (contd)

Analysis Case and Applicable SAMAs[a]	Assumptions	% Risk Reduction CDF	% Risk Reduction Population Dose	Total Benefit[b] ($)	Cost ($)
RASLEVEL	Eliminate CDF due to failure of the recirculation actuation signal level transmitters	1	~0	13,000	>100,000
CC-23 - Provide an additional recirculation actuation signal level transmitter (2LT-5636-5) and change recirculation actuation logic from 2-out-of-4 to 2-out-of-5					
SEALLOCA	Eliminate all seal LOCAs	12	11	178,000	
CW-10 - Create an independent RCP seal injection system, with dedicated diesel					>1,000,000
CW-11 - Create an independent RCP seal injection system, without dedicated diesel					>1,000,000
CW-14 - Install improved RCP seals					2,500,000
CW-24 - Provide the ability to automatically trip the RCPs on a loss of CCW	[Reduce failure to trip RCPs upon loss of CCW]			[46,000]	[100,000]
SIGNAL	120 VAC buses are perfectly reliable	1	<1	13,000	35,000
AC/DC-06 - Train operations crew for response to inadvertent actuation signals					
SIMOV	Eliminate CDF due to failure of safety injection tank discharge valves	1	<1	10,000	>100,000
CC-24 - Provide bypass flow paths for all safety injection tanks					
SGTR	Eliminate all SGTRs	2	8	25,000[c]	
CB-01 - Perform 100% inspection of steam generator tubes during each refueling outage					1,500,000
CB-03 - Increase the pressure capacity of the secondary side					>1,000,000
CB-04 - Install a redundant spray system to depressurize the primary system during a SGTR					5,000,000
CB-10 - Direct steam generator flooding after a SGTR, prior to core damage	[Eliminate failure to properly handle a ruptured steam generator]			[1,000][c]	35,000

Table G-3. (contd)

Analysis Case and Applicable SAMAs[a]	Assumptions	% Risk Reduction CDF	% Risk Reduction Population Dose	Total Benefit[b] ($)	Cost ($)
SPRAYMOV EV-30 - Provide actuator diversity for MOVs in the containment spray system	Eliminate CDF due to CCF of containment spray valves	7	4	95,000	[425,000]
SUMPMOV **CC-20 - Make containment sump recirculation outlet valve MOVs 2CV-5649-1 and 2CV-5650-2 diverse from one another**	**[Remove CCF of sump suction valve operators. Reduce excess conservatism in failure to recover sump suction valves.]**	6	3	[260,000]	[425,000]
SUMPSTRAIN CC-18 - Modify the containment sump strainers to prevent plugging	Eliminate CDF due to sump strainer plugging	8	1	90,000	>1,000,000
SWMOV CW-25 - Add redundant control valve in series with 2CV-1530-1	Eliminate CDF due to service water to component cooling water isolation valve failure	2	2	25,000	>100,000
TDPUMPDC FW-08 - Provide hookup for portable generators	Eliminate turbine-driven pump dependence on DC power results	1	<1	13,000	>35,000
MAXBENEFIT	Eliminate all severe accidents	100	100	1,580,000	
CC-01 - Provide capability for diesel-driven, low pressure vessel makeup					3,000,000
CC-02 - Provide an additional high pressure injection pump with independent diesel					5,000,000
CC-07 - Extend the reactor water storage tank source	[Used analysis case SGTR to re-evaluate benefit]			[25,000][c]	[1,300,000]
CC-14 - Replace two of the four electric safety injection pumps with diesel-powered pumps					2,000,000
FW-15 - Create passive secondary side coolers					>1,000,000

Table G-3. (contd)

Analysis Case and Applicable SAMAs[a]	Assumptions	% Risk Reduction CDF	% Risk Reduction Population Dose	Total Benefit[b] ($)	Cost ($)
FW-18 - Replace current pilot operated relief valves with larger ones such that only one is required for successful feed and bleed					2,700,000
OT-02 - Create a reactor coolant depressurization system					4,600,000
OT-06 - Install secondary side guard pipes up to the main steam isolation valves	[Eliminate main steam line breaks]			[6,000][c]	1,100,000
OFFSITE	Eliminate all offsite releases	0	100	445,000	
CB-07 - Provide main steam safety valve and automatic depressurization valve scrubbing					9,500,000
EV-02 - Install automatic containment spray pump header throttle valves					[934,000]
EV-04 - Develop an enhanced drywell spray system					1,500,000
EV-05 - Provide a dedicated drywell spray system					>1,000,000
EV-07 - Install a filtered containment vent					5,700,000
EV-08 - Install an unfiltered containment vent					3,100,000
EV-09 - Create/enhance hydrogen control system with independent power supply					1,000,000
EV-10 - Create a passive hydrogen control system					800,000
EV-11 - Create a refractory-lined crucible with heat removal potential under the basemat to contain molten debris					108,000,000
EV-12 - Create a water cooled rubble bed on the pedestal					19,000,000
EV-19 - Provide a core debris control system					45,000,000
EV-21 - Provide containment inerting capability					10,900,000

Table G-3. (contd)

Analysis Case and Applicable SAMAs[a]	Assumptions	% Risk Reduction CDF	% Risk Reduction Population Dose	Total Benefit[b] ($)	Cost ($)
EV-22 - Use fire water spray pump for containment spray	[Eliminate failure to provide water to containment spray]			[72,000]	565,000
EV-23 - Install a passive containment spray system					>1,000,000
EV-25 - Increase containment design pressure					>1,000,000
EV-26 - Provide an alternative concrete composition in the reactor cavity					5,000,000
EV-27 - Provide a reactor vessel exterior cooling system					2,500,000
EV-28 - Create a vacuum building					>1,000,000
EV-29 - Add ribbing to containment shell					>1,000,000

(a) Unless noted by brackets, the assumptions, percent risk reduction, and total benefit apply to all SAMAs for a given analysis case. The information within brackets indicates revised values provided by the licensee in response to an RAI (Entergy 2004b).

(b) Values are based on Entergy averted cost estimates, but are multiplied by five to account for additional risk reduction benefits in external events, except where noted.

(c) These SAMAs either (1) relate to specific internal event initiators such as ISLOCA, large LOCA, main steam line break, or SGTR events, and would not offer substantial risk reduction in external events, or (2) in the "cavity" analysis case, only impact population dose (rather than CDF) and would offer less benefit than estimated in the ER. Thus, the internal events benefits were multiplied by two rather than five.

(d) Subsequent to the initial screening, Entergy determined that this SAMA had been previously implemented. The SAMA was not further pursued.

G.5 Cost Impacts of Candidate Plant Improvements

Entergy estimated the costs of implementing the 93 candidate SAMAs through the application of engineering judgment and review of other plants' estimates for similar improvements. The cost estimates conservatively did not include the cost of replacement power during extended outages required to implement the modifications, nor did they include recurring maintenance and surveillance costs or contingency costs associated with unforeseen implementation obstacles. The cost estimates provided in the ER did not account for inflation, but for certain SAMAs that were close to being cost-beneficial, a refined look at implementation costs did include inflation (Entergy 2004b).

The staff reviewed the bases for the applicant's cost estimates. For certain improvements, the staff also compared the cost estimates to estimates developed elsewhere for similar improvements, including estimates developed as part of other licensees' analyses of SAMAs for operating reactors and advanced light-water reactors. The staff reviewed the costs and found them to be consistent with estimates provided in support of other plants' analyses.

The staff concludes that the cost estimates provided by Entergy are sufficient and appropriate for use in the SAMA evaluation.

G.6 Cost-Benefit Comparison

Entergy's cost-benefit analysis and the staff's review are described in the following sections.

G.6.1 Entergy Evaluation

The methodology used by Entergy was based primarily on NRC's guidance for performing cost-benefit analysis (i.e., NUREG/BR-0184, *Regulatory Analysis Technical Evaluation Handbook*) (NRC 1997b). The guidance involves determining the net value for each SAMA according to the following formula:

$$\text{Net Value} = (\text{APE} + \text{AOC} + \text{AOE} + \text{AOSC}) - \text{COE}$$

where

APE = present value of averted public exposure ($)
AOC = present value of averted offsite property damage costs ($)
AOE = present value of averted occupational exposure costs ($)
AOSC = present value of averted onsite costs ($)
COE = cost of enhancement ($).

If the net value of a SAMA is negative, the cost of implementing the SAMA is larger than the benefit associated with the SAMA and it is not considered cost-beneficial. Entergy's derivation of each of the associated costs is summarized below.

Averted Public Exposure (APE) Costs

The APE costs were calculated using the following formula:

APE = Annual reduction in public exposure (Δperson-rem/year)
x monetary equivalent of unit dose ($2000 per person-rem)
x present value conversion factor ($13.05 based on a 35-year period with a 7 percent discount rate).

As stated in NUREG/BR-0184 (NRC 1997b), it is important to note that the monetary value of the public health risk after discounting does not represent the expected reduction in public health risk due to a single accident. Rather, it is the present value of a stream of potential losses extending over the remaining lifetime (in this case, the renewal period) of the facility. Thus, it reflects the expected annual loss due to a single accident, the possibility that such an accident could occur at any time over the renewal period, and the effect of discounting these potential future losses to present value. For the purposes of initial screening, Entergy calculated an APE of approximately $45,000 for the 35-year period, which assumes elimination of all severe accidents.

Averted Offsite Property Damage Costs (AOC)

The AOCs were calculated using the following formula:

AOC = Annual CDF reduction
x offsite economic costs associated with a severe accident (on a per-event basis)
x present value conversion factor.

For the purposes of initial screening which assumes all severe accidents are eliminated, Entergy calculated an annual offsite economic risk of about $3400 based on the Level 3 risk analysis. This results in a discounted value of approximately $44,200 for the 35-year period.

Averted Occupational Exposure (AOE) Costs

The AOE costs were calculated using the following formula:

AOE = Annual CDF reduction
x occupational exposure per core damage event
x monetary equivalent of unit dose

x present value conversion factor.

Entergy derived the values for averted occupational exposure from information provided in Section 5.7.3 of the regulatory analysis handbook (NRC 1997b). Best estimate values provided for immediate occupational dose (3300 person-rem) and long-term occupational dose (20,000 person-rem over a 10-year cleanup period) were used. The present value of these doses was calculated using the equations provided in the handbook in conjunction with a monetary equivalent of unit dose of $2000 per person-rem, a real discount rate of 7 percent, and a time period of 35 years to represent the license renewal period. For the purposes of initial screening, which assumes all severe accidents are eliminated, Entergy calculated an AOE of approximately $3300 for the 35-year period.

Averted Onsite Costs (AOSC)

The AOSC include averted cleanup and decontamination costs and averted power replacement costs. Repair and refurbishment costs are considered for recoverable accidents only and not for severe accidents. Entergy derived the values for AOSC based on information provided in Section 5.7.6 of the regulatory analysis handbook (NRC 1997b).

Entergy divided this cost element into two parts: (1) the Onsite Cleanup and Decontamination Cost, also commonly referred to as averted cleanup and decontamination costs, and (2) the replacement power cost.

Averted cleanup and decontamination costs (ACC) were calculated using the following formula:

ACC = Annual CDF reduction
x present value of cleanup costs per core damage event
x present value conversion factor.

The total cost of cleanup and decontamination subsequent to a severe accident is estimated in the regulatory analysis handbook to be 1.5×10^9 (undiscounted). This value was converted to present costs over a 10-year cleanup period and integrated over the 35-year period. For the purposes of initial screening, which assumes all severe accidents are eliminated, Entergy calculated an ACC of approximately $101,000 for the 35-year period.

Long-term replacement power costs (RPC) were calculated using the following formula:

RPC = Annual CDF reduction
x present value of replacement power for a single event
x factor to account for remaining service years for which replacement power is required
x reactor power scaling factor.

For the purposes of initial screening, which assumes all severe accidents are eliminated, Entergy calculated an RPC of approximately $122,000 for the 35-year period.

Using the above equations, Entergy estimated the total present dollar value equivalent associated with completely eliminating severe accidents from internal events at ANO-2 to be about $316,000. To account for additional risk reduction in external events, Entergy doubled this value to $632,000.

Entergy's Results

The total benefit associated with each of the 93 SAMAs was evaluated by Entergy. These values were determined based on the above equations for the various averted costs together with estimated annual reductions in CDF and person-rem dose. As a result, all SAMAs that were evaluated were eliminated because the cost was expected to exceed the estimated benefit.

As described below, the staff applied a multiplier of five to the averted cost estimates for each SAMA to account for the potential impact of external events, except for SAMAs that are related to specific internal event initiators, such as ISLOCA and SGTR, or to the "cavity" analysis case, for which a multiplier of two was retained. As a result, 15 of the SAMAs appeared to be potentially cost-beneficial, and several additional SAMAs appeared to be within a factor of two of being cost-beneficial. Entergy performed a more detailed assessment of each of these SAMAs to more realistically estimate the risk reduction and/or implementation costs for each SAMA. The revised values are denoted by brackets in Table G-3. Based on this assessment, two of the SAMAs are cost-beneficial, and two of the SAMAs are within a factor of two of being cost-beneficial. These SAMAs are highlighted in **BOLD** in Table G-3.

G.6.2 Review of Entergy's Cost-Benefit Evaluation

The cost-benefit analysis performed by Entergy was based primarily on NUREG/BR-0184 (NRC 1997b) and was executed consistent with this guidance.

In response to an RAI, Entergy provided the fire CDF (based on a summation of the unscreened fire zones' CDF values) based on the latest fire analysis. The fire CDF for ANO-2 is approximately 8.3×10^{-5} per year which is about a factor of 12 higher than the internal events CDF of 7.2×10^{-6} per year. Because of the relatively large contribution from fire events, the staff asked Entergy to justify their approach of doubling the internal events CDF to account for the fire events CDF, and to assess the impact on the initial and final screenings if the internal events risk reduction estimates were increased by a factor that would bound the risk from fire and seismic events. In response to the RAI, Entergy stated that the doubling of the benefit to account for external events provides bounding results because the fire analysis was done as a

screening analysis only and not as a determination of the fire CDF at ANO-2 (Entergy 2004a). Additionally, Entergy stated that since the fire zone CCDP is calculated by failing all equipment in the fire zone, a SAMA that reduces internal events CDF may not reduce the fire CDF for a zone, thus the resulting benefit value is inflated and, therefore, is overly conservative. Entergy's position is that given the conservative nature of the analysis, there is reasonable assurance that the risk associated with a fire would be bounded by increasing the benefit by a factor of two.

As discussed in Section G.2.2, it is the staff's view that the multiplier of two used by Entergy could be justified if the external event and internal event CDFs are comparable. For ANO-2, this would imply that the fire CDF from the screening analysis would have to be conservative by a factor of 12. The staff agrees that the ANO-2 fire analysis contains numerous conservatisms and that a more realistic assessment could result in a substantially lower fire CDF. However, the staff believes that the information provided by Entergy is not sufficient to support a reduction of a factor of 12, and that a more realistic fire CDF may be closer to a factor of two to three less than the screening value. Given a factor of three reduction, the resulting fire CDF would be about 2.8×10^{-5} per year, which is four times higher than the internal events CDF. This would justify use of a multiplier of five to the averted cost estimates (for internal events) to represent the additional SAMA benefits in external events. Consideration of uncertainties would result in further increases in this multiplier.

In view of the large relative contribution to risk from fire events at ANO-2, the staff applied a multiplier of five to the averted cost estimates for internal events to obtain a baseline estimate of the benefits for each SAMA, except for SAMAs that are related to specific internal event initiators, such as ISLOCA and SGTR or to the "cavity" analysis case (see Table G-3) for which a multiplier of two was retained. This implicitly assumes that each SAMA would offer the same percentage reduction in external event CDF and population dose as it offers in internal event CDF and population dose. As a result, 15 of the SAMAs appeared to be potentially cost-beneficial, and several additional SAMAs appeared to be within a factor of two of being cost-beneficial. Entergy performed a more detailed assessment of each of these SAMAs to more realistically estimate the risk reduction and/or implementation costs for each SAMA, and revised the estimated averted costs and implementation costs accordingly. The benefit values are shown in Table G-3 for the 93 SAMAs. For those SAMAs that were re-evaluated by Entergy, revised assumptions, benefit values, or costs are indicated in brackets (these revised values also reflect a multiplier of five or two, depending on the event initiator).

As shown in Table G-3, the benefits exceed the estimated implementation costs for two of the SAMAs (AC/DC-16 and CW-06).

- SAMA AC/DC-16 involves a procedural change to emphasize the steps in plant recovery following SBO. A benefit of $17,000 was initially calculated for this SAMA (for internal events) assuming that the procedure change would result in "instantaneously" recovering

onsite equipment during a loss of offsite power. When a multiplier of five is included, the benefit increases to $85,000. Because the cost of a procedure revision and training is estimated to be $35,000, this SAMA would be cost-beneficial. In response to a staff RAI, Entergy re-evaluated the SAMA by reducing the probability of failure to recover from loss of offsite power, rather than assuming instantaneous recovery of onsite equipment (Entergy 2004b). Entergy noted that a more in-depth review of the proposed SAMA revealed that steps in plant recovery are already emphasized within the current operations training cycle. Specifically, standard post-trip actions direct operators to assess plant conditions and enter the SBO emergency operating procedure (EOP) if at least one 4160-V vital bus is not energized. The SBO EOP delineates steps in plant recovery following an SBO event. As part of the standard post-trip actions, the instructions are repeatedly addressed during classroom training and simulator exercises. Based on Entergy's re-evaluation, the benefit was reduced from $85,000 to $76,000 (including a multiplier of five for external events). Accordingly, the staff concludes that this SAMA would still be cost-beneficial.

- SAMA CW-06 involves a procedural change to shed CCW loads to extend the CCW heat-up time on loss of essential raw cooling water. This would increase the time before RCP seal failure during loss of service water sequences. A benefit of $12,500 was initially calculated for this SAMA based on internal events. When a multiplier of five is included, the benefit increases to $62,500. Because the cost of a procedure revision and training is estimated to be $35,000, this SAMA would be cost-beneficial. In response to a staff RAI, Entergy re-evaluated the SAMA by reducing the failure to trip RCPs upon loss of component cooling water (Entergy 2004b). This results in a slightly reduced benefit of $46,000 (including a multiplier of five for external events). Accordingly, this SAMA would still be cost-beneficial. Entergy noted that adding procedural steps to shed CCW loads may adversely impact the probability of successful completion of other steps critical to event mitigation, and that the benefit of this SAMA is small enough that its implementation is not warranted in light of the potential detrimental impact on operator performance. The staff agrees that the benefits of this SAMA are only slightly greater than the estimated implementation costs, and that the risk reduction provided by the SAMA would be relatively small. However, given the potential risk reduction and the modest implementation costs, further evaluation of this SAMA by Entergy appears warranted. Any potential for this procedural enhancement to adversely impact other procedural steps could be assessed as part of this evaluation, and factored into the decision regarding implementation.

The staff also considered the impact that further increases in the contribution from analysis uncertainties would have on the estimated costs and benefits. Entergy currently does not have an uncertainty analysis for the ANO-2 PSA. In response to an RAI regarding uncertainty analyses, Entergy stated that there is sufficient conservatism throughout the SAMA analysis to account for uncertainty in the estimation of CDF (Entergy 2004a). Some of the areas that contain conservatism include calculation of the 2040 population, performance of sensitivity cases, performance of bounding calculations for the benefits, and estimation of costs (Entergy

2004a). Entergy included an additional conservatism by calculating averted cost over a 35-year period (from 2003 until the end of the period of extended operation), as indicated in Section G.6.10. Entergy states that the expense to perform a proper uncertainty analysis is not commensurate with the estimated benefits of the study and that the conclusions of the SAMA analysis are not expected to change as a result of a quantitative analysis of uncertainty. Based on the staff's review of previous plants' ERs, the ratio of 95th confidence level CDF value to the mean CDF value vary from two to five. The staff considered the impact if the benefits were altered by a factor of two to account for uncertainties. Two SAMAs, CW-27 and CC-20, have estimated benefits within a factor of two of the estimated implementation costs.

- SAMA CW-27 involves the installation of backwash filters in place of the existing strainers, thereby reducing the probability of CCF of service water discharge filters. This would reduce the failure frequency of the service water system. A benefit of $50,000 was initially calculated for this SAMA based on internal events. When a multiplier of five is included, the benefit increases to $250,000. The cost of implementation was estimated to be $247,000. In response to a staff RAI, Entergy re-evaluated the SAMA by reducing the CCF of the service water pump discharge filters (Entergy 2004b). This results in a slightly reduced benefit of $225,000 (including a multiplier of five for external events). Thus, this SAMA is close to being cost-beneficial, and could be cost-beneficial when uncertainties are taken into account. Although not a commitment related to managing the effects of aging during the period of extended operation, Entergy indicates that this SAMA is currently undergoing evaluation as a potential future modification at ANO-2.

- SAMA CC-20 involves replacing either containment sump valve 2CV-5649-1 or 2CV-5650-2 with an air-operated valve, thereby reducing the probability for CCF. In response to an RAI regarding peer review comments, Entergy states that a sensitivity analysis showed this SAMA to be potentially cost-beneficial. In response to an RAI regarding the estimated cost and benefit of this SAMA, Entergy re-evaluated the SAMA by removing the CCF of the sump suction valve operators and reducing the excess conservatism in the basic event (failure to recover sump suction valves). This results in a benefit of $260,000 (including a multiplier of five for external events). Implementation costs are estimated to be $425,000. Thus, this SAMA is within a factor of two of being cost-beneficial, and could be cost-beneficial when uncertainties are taken into account.

The staff notes that several additional SAMAs were marginally within a factor of two of being cost-beneficial, but that the implementation costs for these SAMAs are clearly underestimated (e.g., SAMAs AC/DC-05, AC/DC-12, and CW-13), or the benefits are substantially overestimated (e.g., SAMAs CC-01, CC-14, FW-15, FW-18, and EV-10). Accordingly, these SAMAs were not further evaluated.

Finally, three SAMAs were included within the 93 SAMAs listed in Table G-3, that were, in retrospect, determined by Entergy to have been previously implemented at ANO-2.

Specifically, SAMAs FW-17 and CB-23 were identified in the IPE and implemented in early 1993, while SAMA FW-01 was addressed by a feedwater upgrade installed during the late 1990s (Entergy 2004a). These SAMAs were not further evaluated.

The staff reviewed the SAMAs analyzed by Entergy to determine if lower cost alternatives had been evaluated, including the use of portable battery chargers and a direct-drive diesel auxiliary feedwater (AFW) pump. ANO-2 already has a third non-safety-related AFW pump. Therefore, this alternative has already been implemented. Entergy also evaluated the use of temporary connections such as portable generators to power the turbine-driven emergency feedwater pump controls after station batteries are depleted (see SAMA FW-08). The estimated benefit of this SAMA is approximately $15,000 which is significantly less than the cost that would be incurred for such a modification. In SAMA AC/DC-10, Entergy assessed the use of a portable diesel-driven battery charger. The estimated benefit associated with this SAMA is around $100,000, which is less than the cost that would be incurred for such a modification. The staff considers the evaluation and estimation of these lower cost alternatives reasonable and acceptable for purposes of the SAMA evaluation.

Entergy also performed sensitivity analyses that addressed variations in the discount rate. The use of a 5-percent real discount rate (rather than 7 percent used in the baseline) results in an increase in the maximum attainable benefit of approximately 9 percent. The results of the sensitivity study are bounded by the staff's averted cost estimates, which applied a multiplier of five or two to the internal events benefits to obtain a baseline estimate for each SAMA.

The staff concludes that the costs of all of the SAMAs assessed would be higher than the associated benefits, with the exception of the SAMAs discussed above. Improvements realized as a result of the IPE and IPEEE processes and resolution of seismic outliers would minimize the likelihood of identifying further cost-beneficial enhancements.

G.7 Conclusions

Entergy compiled a list of 192 SAMA candidates using the SAMA analyses as submitted in support of licensing activities for other nuclear power plants, NRC and industry documents discussing potential plant improvements, and insights from the IPE, IPEEE, and current PSA. A qualitative screening removed SAMA candidates that (1) were not applicable at ANO-2 due to design differences, (2) had already been implemented at ANO-2, or (3) were sufficiently similar to other SAMAs and, therefore, combined with another SAMA. A total of 99 SAMA candidates were eliminated based on the above criteria, leaving 93 SAMA candidates for further evaluation.

Using guidance in NUREG/BR-0184 (NRC 1997b), the current PSA model, and a Level 3 analysis developed specifically for SAMA evaluation, an MAB of about $316,000K, representing the total present dollar value equivalent associated with completely eliminating severe accidents

at ANO-2, was derived. For the 93 remaining SAMA candidates, a more detailed assessment and cost estimate were developed. To account for external events, Entergy doubled the estimated averted costs from the internal events analysis. Entergy concluded in the ER that none of the candidate SAMAs evaluated would be cost-beneficial for ANO-2 because their implementation costs would exceed their estimated benefits.

The staff reviewed the Entergy analysis and concluded that the methods used and the implementation of those methods were sound. The unavailability of a seismic and fire PRA model precluded a detailed quantitative evaluation of SAMAs specifically aimed at reducing risk of these initiators. However, in view of the large relative contribution to risk from fire events indicated from the ANO-2 fire analysis, the staff applied a multiplier of five to the averted cost estimates for each SAMA to account for the potential impact of external events (except for SAMAs that are related to specific internal event initiators, such as ISLOCA and SGTR, for which a multiplier of two was retained.) As a result, 15 of the SAMAs appeared to be potentially cost-beneficial, and several additional SAMAs appeared to be within a factor of two of being cost-beneficial. Entergy performed a more detailed assessment of each of these SAMAs to more realistically estimate the risk reduction and/or implementation costs for each SAMA, and revised the estimated averted costs and implementation costs accordingly. Based on this reevaluation, two of the SAMAs appear to be cost-beneficial. Additionally, two SAMAs could become cost-beneficial when uncertainties are taken into account. These SAMAs are highlighted in **BOLD** in Table G-3.

Based on its review of the Entergy SAMA analysis, the staff concurs that none of the candidate SAMAs are cost-beneficial, except as noted above. This is based on conservative treatment of costs and benefits. This conclusion is consistent with the low residual level of risk indicated in the ANO-2 PSA and the fact that ANO-2 has already implemented all of the plant improvements identified from the IPE and IPEEE processes. Given the potential risk reduction and the relatively modest implementation costs of the four SAMAs identified in this appendix, the staff concludes that further evaluation of these SAMAs by Entergy is warranted. However, these SAMAs do not relate to adequately managing the effects of aging during the period of extended operation. Therefore, they need not be implemented as part of license renewal pursuant to 10 CFR Part 54.

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Docket No. 50-368

11. ABSTRACT *(200 words or less)*

This final supplemental environmental impact statement (SEIS) has been prepared in response to an application submitted to the US Nuclear Regulatory Commission (NRC) by Entergy Operations, Inc. (Entergy) to renew the operating license (OL) for Arkansas Nuclear One, Unit 2 for an additional 20 years under 10 CFR Part 54. This final SEIS includes the NRC staff's analysis that considers and weighs the environmental impacts of the proposed action, the environmental impacts of the alternatives to the proposed action, and mitigation measures available for reducing or avoiding adverse impacts. It also includes the staff's recommendation regarding the proposed action and responses to the draft SEIS.

The NRC staff's recommendation is that the Commission determine that the adverse environmental impacts of license renewal for Arkansas Nuclear One, Unit 2 are not so great that preserving the option of license renewal for energy planning decision makers would be unreasonable. The recommendation is based on (1) the analysis and findings in the GEIS; (2) the Environmental Report submitted by Entergy; (3) consultation with Federal, State, and local agencies; (4) the staff's own independent review; and (5) the staff's consideration of public comments.

12. KEY WORDS/DESCRIPTORS *(List words or phrases that will assist researchers in locating the report.)*

Arkansas Nuclear One, Unit 2
Supplement to the Generic Environmental Impact Statement
GEIS
National Environmental Policy Act
NEPA
License Renewal
ANO-2

13. AVAILABILITY STATEMENT

unlimited

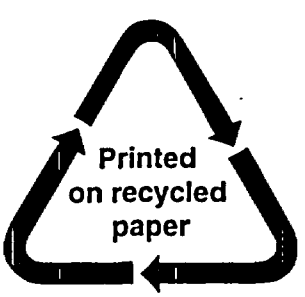
14. SECURITY CLASSIFICATION

(This Page) unclassified

(This Report) unclassified

15. NUMBER OF PAGES

16. PRICE



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