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Supplement 32

Generic Environmental Impact Statement for License Renewal of Nuclear Plants

Supplement 32

Regarding Wolf Creek Generating Station

Final Report

Office of Nuclear Reactor Regulation

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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 10 CFR Part 51. In the GEIS (and its Addendum 1), the Staff identified 92 environmental issues and reached 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 by Wolf Creek Nuclear Operating Corporation (WCNOC) to the NRC to renew the OL for Wolf Creek Generating Station, Unit 1 (WCGS) 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 WCNOC nor the Staff has identified information that is both new and significant for any issue that applies to WCGS. In addition, the Staff determined that information provided during the scoping process was not new and significant with respect to the conclusions in the GEIS. Therefore, the Staff concludes that the impacts of renewing the OL for WCGS 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 off-site radiological impacts from the fuel cycle and high-level waste and spent fuel, which were not assigned a single significance level).

We address the remaining 23 issues that apply to WCGS in this SEIS. With exceptions of groundwater quality, water use conflicts (plants with cooling ponds or cooling towers using makeup water from a small river with a low flow), and impacts to associated ecological resources, potential environmental impacts of operating license renewal would be SMALL. For groundwater quality and water use conflicts, the impact would be SMALL to MODERATE.[b] If water use conflicts occur, associated impacts in the Neosho River due to impingement and habitat reduction on aquatic organisms, including threatened and endangered species, would be

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

[b] Environmental effects are sufficient to alter noticeably but not to destabilize important attributes of the resource.

SMALL to MODERATE. The Staff also concluded that groundwater quality and water use conflicts, would experience SMALL to MODERATE cumulative impacts. In addition, due to the increased potential for impingement and habitat reduction during periods with water use conflicts, cumulative impacts on aquatic organisms, including threatened and endangered species, would be SMALL to MODERATE.

The NRC staff's recommendation is that the Commission determines that the adverse environmental impacts of license renewal for WCGS are not so great that preserving the option of license renewal for energy-planning decision makers would be unreasonable. This recommendation is based on (1) the analysis and findings in the GEIS; (2) the Environmental Report submitted by WCGS; (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 scoping process.

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Executive Summary

By letter dated September 27, 2006, Wolf Creek Nuclear Operating Corporation (WCNOC) submitted an application to the U.S. Nuclear Regulatory Commission (NRC) to renew the operating license (OL) for Wolf Creek Generating Station (WCGS) for an additional 20-year period. If the OL is renewed, State regulatory agencies and WCGS 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, which is March 11, 2025.

The NRC has implemented Section 102 of the National Environmental Policy Act of 1969, as amended (NEPA) (42 USC 4321) in Title 10 of the Code of Federal Regulations (CFR), Part 51 (10 CFR Part 51). In 10 CFR 51.20(b)(2), the Commission requires preparation of an environmental impact statement (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 WCGS 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. The Staff visited the WCGS site in September 2006, held a public scoping meeting on December 19, 2006, and conducted a site audit in March 2007. In the preparation of this supplemental environmental impact statement (SEIS) for WCGS, the Staff reviewed the WCGS Environmental Report (ER) 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 the public comments received during the scoping process. The public comments received during the scoping process are provided in Appendix A, Part 1, of this SEIS.

The Staff held public meetings in Burlington, Kansas in November 2007, to describe the preliminary 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. When the comment period ended, the Staff will considered and addressed all of the comments received. These comments are addressed in Appendix A, Part 2 of this 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,

[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.

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 purpose 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) ["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 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 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 reached 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 (that is 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 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 WCGS) and alternative methods of power generation. Based on projections made by the U.S. Department of Energy's Energy Information Administration (DOE/EIA), coal and gas-fired generation appear to be the most likely power-generation alternatives if the power from WCGS is replaced. These alternatives are evaluated assuming that the replacement power generation plant is located at either the WCGS site or some other unspecified alternate location.

WCNOC 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 WCNOC 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 WCGS that has a significant environmental impact. Therefore, the Staff relies upon the conclusions of the GEIS for all of the Category 1 issues that are applicable to WCGS.

WCGS'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 the WCGS analysis for each issue and has conducted an independent review of each issue. Two Category 2 issues are not applicable, because they are related to plant design features or site characteristics not found at WCGS. Four Category 2 issues are not discussed in this SEIS, because they are specifically related to refurbishment. WCGS has 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 as necessary to support the continued operation of WCGS for the license renewal period. In addition, any replacement of components or additional inspection activities are within the bounds of normal plant operation, and are not expected to affect the environment outside of the bounds of the plant operations evaluated in the U.S. Nuclear Regulatory Commission's 1982 *Final Environmental Statement Related to Operation of Wolf Creek Generating Station, Unit No. 1.*

Fifteen 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. Two of the Category 2 issues and environmental justice apply to both refurbishment and to operation during the renewal term and are only discussed in this SEIS in relation to operation during the renewal term. For all of the fifteen Category 2 issues and environmental justice, the Staff concludes that the potential environmental effects are of SMALL and SMALL to MODERATE significance in the context of the standards set forth in the GEIS. A SMALL to MODERATE impact was determined for groundwater quality and the potential for water-use conflicts (plants with cooling ponds or cooling towers using makeup water from a small river with low flow). If water use conflicts occur, associated impacts in the Neosho River due to impingement and habitat reduction on aquatic organisms, including threatened and endangered species, would be SMALL to MODERATE. The Staff also 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 WCGS and the plant improvements already made, the Staff concludes that WCNOC identified seven potentially cost-beneficial SAMAs. However, these SAMAs do not relate to adequate managing of the effects of aging during the period of extended operation. Therefore, they do not need to be implemented as part of the license renewal pursuant to 10 CFR Part 54. Mitigation measures were considered for each Category 2 issue for which the degree of impact was determined to be SMALL. For these issues, 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.

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, the Staff concluded that the cumulative impacts resulting from the incremental contribution of WCGS operation and maintenance of transmission line ROW would be SMALL for all resources, with the exception of some aquatic resources. The Staff concluded that groundwater quality and water use conflicts (plants with cooling ponds or cooling towers using makeup water from a small river with a low flow), would experience SMALL to MODERATE cumulative impacts. In addition, due to the increased potential for impingement and habitat reduction during periods with water use conflicts, cumulative impacts on aquatic organisms, including threatened and endangered species, would also be SMALL to MODERATE.

If the WCGS operating license is not renewed and the unit ceases operation on or before the expiration of their current operating license, then the adverse impacts of likely alternatives will not be smaller than those associated with continued operation of WCGS. 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 WCGS 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 ER submitted by WCNOC; (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 received during the scoping process.

Abbreviations/Acronyms

°	degree(s)
ac	acre(s)
AC	alternating current
ACC	averted cleanup and decontamination
AFW	auxiliary feed water
ALARA	as low as reasonably achievable
AOC	averted off-site property damage costs
AOE	averted occupational exposure costs
AOSC	averted on-site costs
APE	averted public exposure
ATWS	anticipated transient without scram
BA	biological assessment
BTU	British thermal unit(s)
C	Celsius
CAA	Clean Air Act
CCW	component cooling water
CDF	core damage frequency
CET	Containment Event Tree
CEQ	Council on Environmental Quality
CFR	*Code of Federal Regulations*
cfs	cubic foot (feet) per second
Ci	curie(s)
cm	centimeter(s)
CO	carbon monoxide
CO_2	carbon dioxide
COE	cost of enhancement
COL	Combined License
CPUE	catch-per-unit-effort
CSET	Containment Safeguards for Event Tree
CVCS	Chemical and Volume Control System
CWA	Clean Water Act
CWIS	Circulating Water Intake Structure
CWS	Circulating Water System
CWSH	Circulating Water Screenhouse

DC	direct current
DOE	U.S. Department of Energy
DSM	demand-side management
DWR	Division of Water Resources
EDG	emergency diesel generator
EIA	Energy Information Administration
EIS	environmental impact statement
ELF-EMF	extremely low frequency-electromagnetic field
EO	Executive Order
EPA	U.S. Environmental Protection Agency
EPACT2005	Energy Policy Act of 2005
EPRI	Electric Power Research Institute
ER	Environmental Report
ERS	Environmental Radiation Surveillance
ESP	Early Site Permit
ESWS	Essential Service Water System
F	Fahrenheit
F&O	Facts and Observations
FES	Final Environmental Statement
FIVE	fire-induced vulnerability evaluation
fps	foot (feet) per second
FPS	fire protection system
FR	*Federal Register*
ft	foot (feet)
ft/mi	feet per mile
FWS	U.S. Fish and Wildlife Service
GEIS	*Generic Environmental Impact Statement for License Renewal of Nuclear Plants, NUREG-1437*
GL	Generic Letter
gpm	gallon(s) per minute
HCLPF	high confidence of low probability of failure
HEPA	high efficiency particulate air
HLW	high-level waste
hr	hour(s)
HRA	Human Reliability Analysis
HVAC	heating, ventilation, and air conditioning

in.	inch(es)
IPE	individual plant examination
IPEE	individual plant examination of external events
ISLOCA	Interfacing Systems Loss of Coolant Accidents
KDHE	Kansas Department of Health and Environment
KDWP	Kansas Department of Wildlife and Parks
KEC	Kansas Energy Council
KEEP	Kansas Energy Efficiency Program
kg	kilogram(s)
kg/yr	kilograms per year
KG&E	Kansas Gas and Electric Company
km	kilometer(s)
KSA	Kansas Statutes Annotated
KSHS	Kansas State Historical Society
kV	kilovolt(s)
kW	kilowatt
KWAA	Kansas Water Appropriation Act
kWh	kilowatt hour(s)
KWO	Kansas Water Office
LCGS	Kansas Power and Light La Cygne Generating Station
LERF	Large Early Release Frequency
LLMW	low-level mixed waste
LOCA	loss of coolant accident
LOS	level of service
LPSI	low pressure safety injection
m	meter(s)
mm	millimeters
m^3	cubic meter(s)
mA	milliampere(s)
MAAP	Modular Accident Analysis Program
MACCS2	MELLCOR Accident Consequence Code System 2
MCL	maximum contaminant level
MDS	Minimum Desirable Streamflow
mg	milligram(s)
mgd	million gallons per day
mg/L	milligram(s) per liter
mi	mile(s)
mL	milliliter(s)
MMACR	Modified Maximum Averted Cost-Risk

mph	miles per hour
mrem	millirem(s)
MSL	mean sea level
MTHM	metric tonne
MTU	metric ton of uranium
MUDS	Makeup Discharge Structure
MUSH	Makeup Water Screen House
MW	megawatt
MWd	megawatt-days
MW(e)	megawatt(s) electric
MW(h)	megawatt hour(s)
MW(t)	megawatt(s) thermal
MWSF	Mixed Waste Storage Facility
NAAQS	National Ambient Air Quality Standards
NAS	National Academy of Sciences
NCP	normal charging pump
NEPA	National Environmental Policy Act of 1969, as amended
NESC	National Electric Safety Code
NGVD	National Geodetic Vertical Datum
NHPA	National Historic Preservation Act
NIEHS	National Institute of Environmental Health Sciences
NO_2	nitrogen dioxide
NO_x	nitrogen oxide(s)
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NRC	U.S. Nuclear Regulatory Commission
NSPS	New Source Performance Standards
ODCM	Offsite Dose Calculation Manual
OL	operating license
PAH	polycyclic aromatic hydrocarbon
PAYS	Pay as You Save
pCi/L	picoCuries per liter
pCi/kg	picoCuries per kilogram
$PM_{2.5}$	particulate matter, 2.5 microns or less in diameter
PM_{10}	particulate matter, 10 microns or less in diameter
ppm	parts per million
PRA	probabilistic risk assessment
PSA	probabilistic safety assessment
PWR	pressurized water reactor

radwaste	radioactive waste
RAI	request for additional information
RCP	reactor coolant pump
RCRA	Resource Conservation and Recovery Act
REMP	radiological environmental monitoring program
RLE	review level earthquake
ROI	region of influence
ROW	right-of-way
RPC	long-term replacement power costs
RRW	risk reduction worth
RWST	refueling water storage tank
s	second(s)
SAMA	severe accident mitigation alternative
SBO	station blackout
SCR	selective catalytic reduction
SECPOP	sector population, land fraction and economic estimation program
SEIS	supplemental environmental impact statement
SER	Safety Evaluation Report
SGTR	Steam Generator Tube Ruptures
SO_2	sulfur dioxide
SO_x	sulfur oxide(s)
SOP	standard operating procedure(s)
sq mi	square mile(s)
SSE	safe shutdown earthquake
Sv	person-sievert
SWS	Service Water System
TD	turbine driven
TDS	total dissolved solids
TL	total length
TMDL	Total Maximum Daily Load
UHS	ultimate heat sink
U.S.	United States
USACE	U.S. Army Corps of Engineers
USCB	U.S. Census Bureau
USD	Unified School District
USGS	U.S. Geological Survey
V	volt(s)

WCGS	Wolf Creek Generating Station
WCNOC	Wolf Creek Nuclear Operating Corporation
Westar	Westar Energy Inc.
WET	whole effluent toxicity
WOG	Westinghouse Owner's Group
YOY	young of year
yr	year(s)

1.0 Introduction

Under the U.S. Nuclear Regulatory Commission's (NRC's) environmental protection regulations in Title 10 of the Code of Federal Regulations (CFR) Part 51, which implement the National Environmental Policy Act of 1969, as amended (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 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.

Wolf Creek Nuclear Operating Corporation (WCNOC) operates Wolf Creek Generating Station (WCGS) near Burlington, Kansas under OL NPF-42, which was issued by the NRC. This OL will expire on March 11, 2025. On September 27, 2006, WCNOC submitted an application to the NRC to renew the WCGS OL for an additional 20 years under 10 CFR Part 54 (WCNOC 2006a). WCNOC 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), WCNOC submitted an Environmental Report (ER) (WCNOC 2006b) in which WCNOC 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. Following a letter submitted by NRC on November 3, 2006 (NRC 2006a), WCNOC submitted supplemental environmental information in a letter report on November 17, 2006 (WCNOC 2006c).

This report is the facility-specific supplement to the GEIS (the supplemental EIS [SEIS]) for the WCNOC 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 WCGS OL, (3) discuss the purpose and need for the proposed action, and (4) present the status of WCNOC'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 the 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 appendices. Appendix A contains public comments related to the environmental review for license renewal and Staff responses to those comments. Appendices B through G, respectively, include the following:

- the preparers of the supplement (Appendix B),
- the chronology of the NRC staff's environmental review correspondence related to this SEIS (Appendix C),
- the organizations contacted during the development of this SEIS (Appendix D),
- WCNOC's compliance status in Table E-1 (this appendix also contains copies of consultation correspondence prepared and sent during the evaluation process) (Appendix E),

- GEIS environmental issues that are not applicable to WCGS (Appendix F), and
- NRC staff evaluation of severe accident mitigation alternatives (SAMAs) (Appendix G).

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 support the thorough evaluation of the impacts of OL renewal.

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 (CEQ) terminology for "significantly" (40 CFR 1508.27, which requires consideration of both "context" and "intensity"). Using the CEQ 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.

The GEIS assigns a significance level to each environmental issue, assuming that ongoing mitigation measures would continue.

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 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; 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 were not categorized. The two issues not categorized are environmental justice and chronic effects of electromagnetic fields. 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 renewal term, and 8 apply to both refurbishment and operation during the 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) and

- 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), or

- contain an analysis of any Category 1 issue unless there is significant new information on a specific issue — this is pursuant to 10 CFR 51.23(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 WCGS OL, WCNOC developed a process to ensure that (1) information not addressed in or available during the GEIS evaluation regarding the environmental impacts of license renewal for WCGS would be properly reviewed before submitting the ER and (2) such new and potentially significant information related to renewal of the license for WCGS would be identified, reviewed, and assessed during the period of NRC review. WCNOC 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 WCGS. This review was performed by personnel from WCNOC 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*, 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, 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 where 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 WCGS. 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 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, followed by the Staff's analysis and conclusion. For Category 2 issues, in addition to the list of GEIS sections where 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. The SEIS sections that discuss 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 WCNOC license renewal application began with the publication of a notice of acceptance for docketing, notice of opportunity for a hearing, and notice of intent to prepare an EIS and conduct scoping in the Federal Register (FR) (71 FR 70997; NRC 2006b) on December 7,

2006. A public scoping meeting was held on December 19, 2006, in Burlington, Kansas. Comments received during the scoping period were summarized in the *Environmental Impact Statement Scoping Process: Summary Report – Wolf Creek Generating Station* (NRC 2006c). Comments that are applicable to this environmental review are presented in Part 1 of Appendix A of this SEIS.

The Staff followed the review guidance contained in NUREG-1555, Supplement 1 (NRC 2000). The Staff and contractor retained to assist the Staff visited the WCGS Site on September 12 through September 15, 2006, 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 consulted is provided in Appendix D. Other documents related to WCGS were reviewed and are referenced within this SEIS.

This SEIS presents the Staff's analysis that considers and weighs the environmental effects of the proposed renewal of the OL for WCGS, the environmental impacts of alternatives to license renewal, and 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 decision makers would be unreasonable.

A 75-day comment period began on the date of publication of the U.S. Environmental Protection Agency Notice of Filing of the draft SEIS to allow members of the public to comment on the preliminary results of the NRC staff's review. During this comment period, public meetings were held in Burlington, Kansas, in November 2007. During these meetings, the Staff described the preliminary 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 WCGS. The WCGS facility is located in Coffey County, in eastern Kansas, approximately 75 miles (mi) southwest of Kansas City. The plant has one Westinghouse pressurized water reactor (PWR) with a reactor core power of 3,565 megawatts thermal (MW[t]), and a design net electrical capacity of 1,165 megawatts electric (MW[e]). Plant cooling is provided by a cooling pond-based heat dissipation system that withdraws cooling water from and discharges it to a cooling pond, Coffey County Lake. The current OL for WCGS expires on March 11, 2025. By letter dated September 27, 2006, WCNOC submitted an application to the NRC (WCNOC 2006a) to renew this OL for an additional 20 years of operation (i.e., until March 11, 2045).

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) decision makers.

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, as amended 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's license.

1.5 Compliance and Consultations

WCNOC is required to hold certain Federal, State, and local environmental permits, as well as meet relevant Federal and State statutory requirements. In its ER, WCNOC provided a list of the authorizations from Federal, State, and local authorities for current operations as well as environmental approvals and consultations associated with WCGS 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 WCNOC is in compliance with applicable environmental standards and requirements for WCGS. 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."

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

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

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

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, DC.

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, DC.

Nuclear Regulatory Commission (NRC). 2006a. Letter from Ms. V.M. Rodriguez, NRC, Washington, DC, to Mr. T.J. Garrett, WCNOC regarding License Renewal Application for Wolf Creek Generating Station, Unit 1, November 3, 2006.

Nuclear Regulatory Commission (NRC). 2006b. "Notice of Acceptance for Docketing of the Application, Notice of Opportunity for Hearing, and Notice of Intent to Prepare an Environmental Impact Statement and Conduct the Scoping Process for Facility Operating License Number NPF-42 for an Additional Twenty-Year Period; Wolf Creek Nuclear Operating Corporation; Wolf Creek Generating Station, Unit 1." *Federal Register* Volume 71, pp. 70997-70999. December 7, 2006.

Nuclear Regulatory Commission (NRC). 2006c. *Environmental Impact Statement Scoping Process: Summary Report – Wolf Creek Generating Station, Burlington, Kansas*. Washington, DC.

Wolf Creek Nuclear Operating Corporation (WCNOC). 2006a. *License Renewal Application, Wolf Creek Generating Station, Docket Number 50-482, Facility Operating License Number NPF-42.* Burlington, Kansas.

Wolf Creek Nuclear Operating Corporation (WCNOC). 2006b. *Applicant's Environmental Report – Operating License Renewal Stage, Wolf Creek Generating Station. Docket Number 50-482.* Burlington, Kansas.

Wolf Creek Nuclear Operating Corporation (WCNOC). 2006c. *Supplementary Environmental Information to Support the Application for Renewed Operating License for Wolf Creek Generating Station, Docket Number 50-482.* Burlington, Kansas.

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

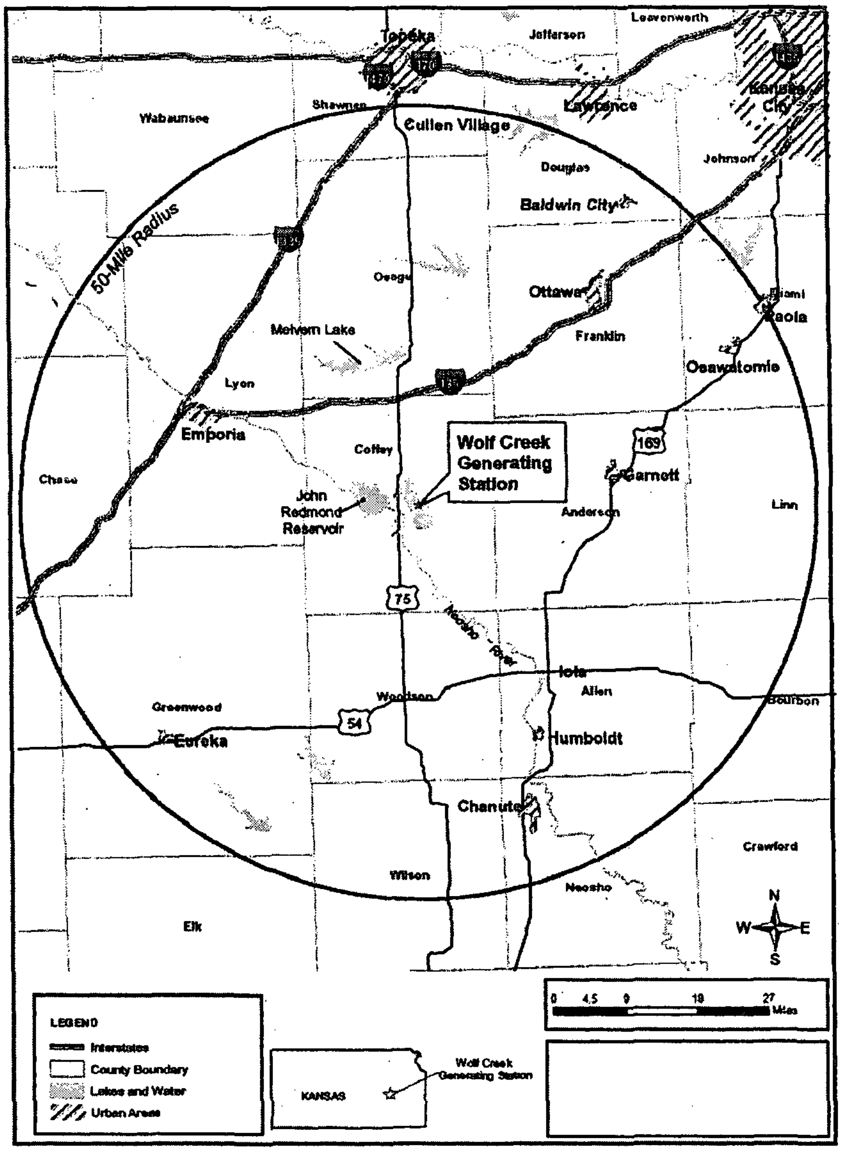
Wolf Creek Generating Station (WCGS) is located in Coffey County, Kansas, in the Neosho River Basin. The nearest large cities are Kansas City, Missouri approximately 75 miles to the northeast, and Topeka, Kansas approximately 55 miles to the north.

The facility consists of one Westinghouse pressurized water reactor (PWR) producing steam that turns a turbine to generate electricity. Facility cooling is provided by a cooling pond system utilizing Coffey County Lake, a reservoir developed specifically to provide a source of cooling water for the facility. 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 Renewal Term

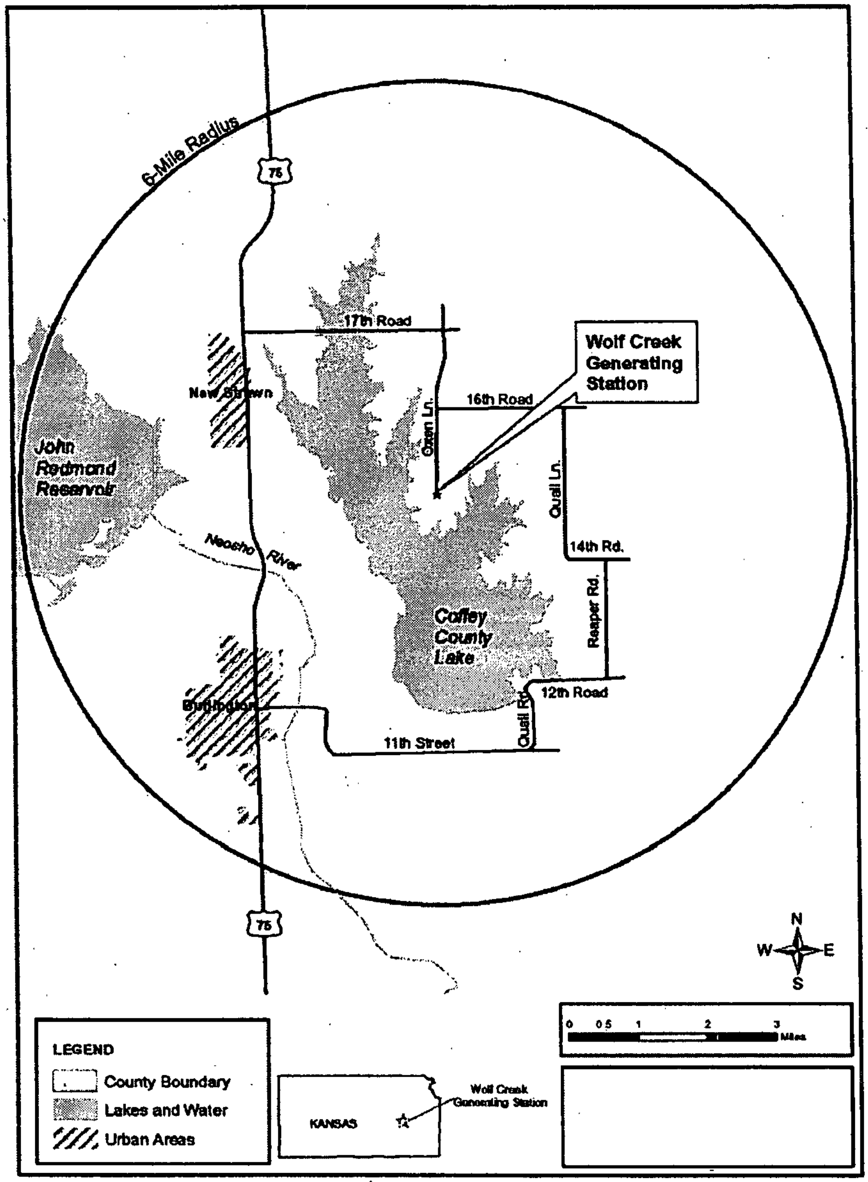
Prior to development as a power facility, the site of WCGS consisted of undeveloped agricultural land. The WCGS facility buildings and adjacent areas occupy an area of approximately 135 acres (ac) within a total area of nearly 11,300 ac owned by the Kansas Gas and Electric Company, Kansas City Power & Light Company, and Kansas Electric Power Cooperative (WCNOC 2006a). Additional site features contained within the 11,300-ac site boundary area include Coffey County Lake (5,090 ac), the dam and dikes for Coffey County Lake (60 ac), the Lime Sludge Pond (31 ac), and the Wolf Creek Environmental Education Area (500 ac) (WCNOC 2006a). The Wolf Creek Environmental Education Area, which is operated as a partnership between WCGS, private citizens, civic organizations, and local, State, and Federal governments, contains trails through a variety of natural Kansas habitats (WCNOC 2006a). The remainder of the property within the site boundary is leased as farmland and rangeland (WCNOC 2006a).

The facility is situated in an area of limited topographic relief with local elevation differences of less than 100 feet (ft) from valley floors to upland areas (WCNOC 2006a). Topographic elevations within the site boundary range from 1,020 to 1,120 ft above mean seal level (MSL) (USGS 1979). The area within a 6-mile (mi) radius of the WGCS site is located entirely within Coffey County, including the towns of Burlington and New Strawn (WCNOC 2006a). The terrain is flat to gently rolling hills. The area within a 50-mi radius of the site consists primarily of rural agricultural land. The site location and features within 6-mi and 50-mi radii are illustrated on Figures 2-1 and 2-2, respectively.



Source: WCNOC 2006a

Figure 2-1. Location of WCGS, 50-Mile Radius



Source: WCNOC 2006a

Figure 2-2. Location of WCGS, 6-Mile Radius

The WCGS site is located on the Wolf Creek drainage, within the Neosho River drainage basin, and the local topography slopes to the south and west, towards the Neosho River. The John Redmond Reservoir, also on the Neosho River, is located approximately 3 miles west of the site. The closest population center to WCGS is the town of Emporia, 28 miles west-northwest (WCNOC 2006a). The cities of Topeka and Lawrence, Kansas and Kansas City, Missouri lie just outside of the 50-mi radius (WCNOC 2006a).

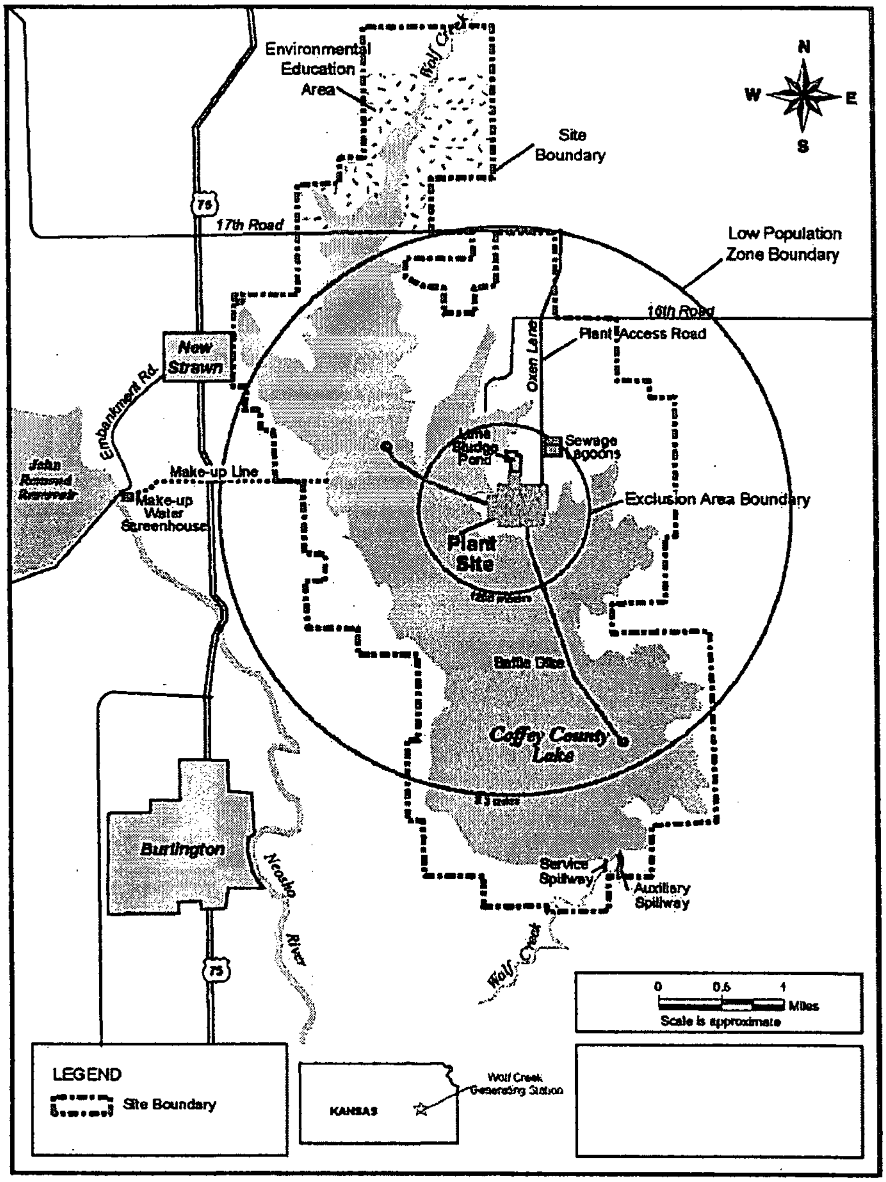
2.1.1 External Appearance and Setting

WCGS is located on Coffey County Lake, a man-made lake constructed on Wolf Creek specifically to act as a cooling water reservoir for the facility (WCNOC 2006a). The facility can be accessed from Highway 75.

The major features of the 11,300-ac WCGS site are the reactor containment building, turbine building, auxiliary building, control building, fuel handling facility, switchyard, radioactive waste building, training center, visitor's center (with associated Emergency Operations Facility and simulator), outdoor firing range, and other supporting buildings (WCNOC 2006a). The area within the site boundaries owned by WCGS includes the 500 ac Wolf Creek Environmental Education Area at the northern end of Coffey County Lake (WCNOC 2006a). The nearest residences are located within 0.5 mile west of Coffey County Lake, between Coffey County Lake and Highway 75. The closest communities are Burlington (population 2,790), located 3 miles southwest of the facility, and New Strawn (population 425), located 3 miles northwest of the facility (WCNOC 2006a). The site boundary and general facility layout are depicted on Figures 2-3 and 2-4, respectively.

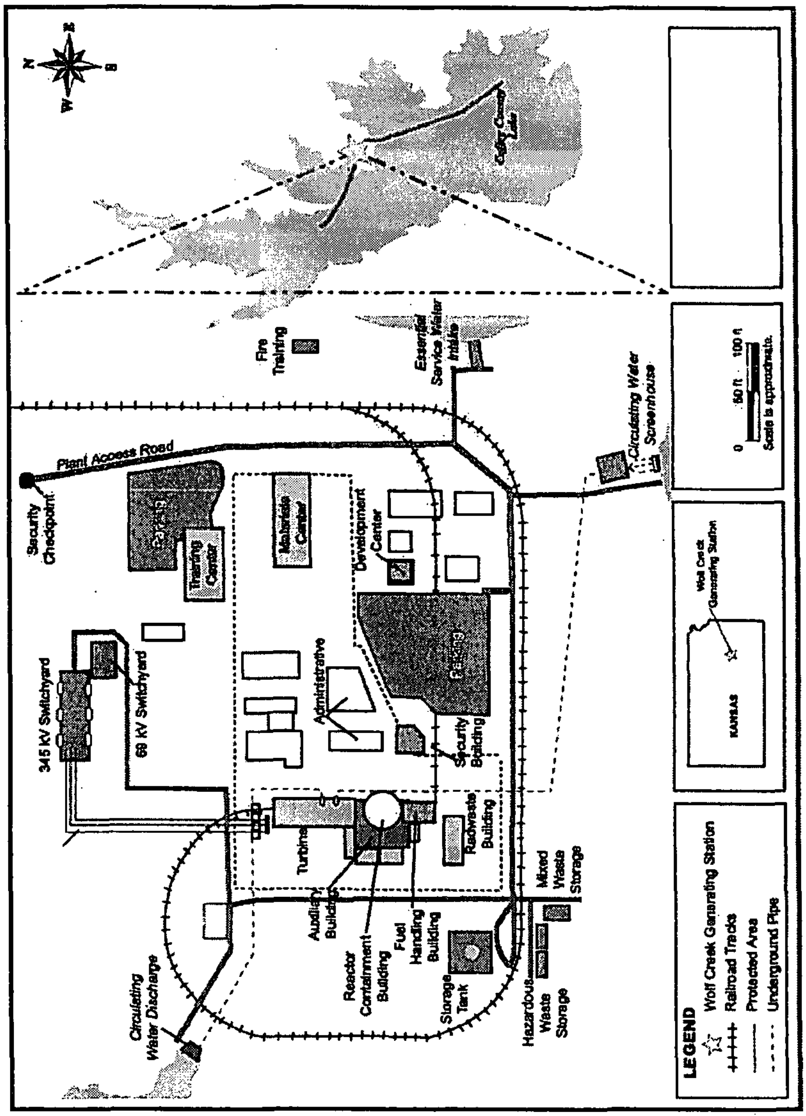
Three transmission line right-of-ways (ROWs) connect WCGS to the power grid. The 345-kilovolt (kV) lines, ROWs, and the switchyard (including the generator output breakers) are owned, operated and maintained by Westar Energy, a corporation formed by the merger of Kansas Gas and Electric and Kansas Power and Light (WCNOC 2006a). All three transmission lines occur within 150-ft wide ROW corridors (WCNOC 2006a). The ROWs are approximately 105 miles in length and cover a total area of approximately 1,900 ac (WCNOC 2006a). The corridors are primarily comprised of sparsely populated agricultural land. The transmission lines associated with WCGS are shown on Figure 2-5.

In addition to the 345-kV transmission lines, the facility is connected to two 69-kV transmission lines. One of these is a 4-mi long tap into the existing Athens-Burlington 69-kV line, and the other is a 3-mi long connection to a Kansas Electric Power Cooperative power plant in Sharpe (WCNOC 2006a).



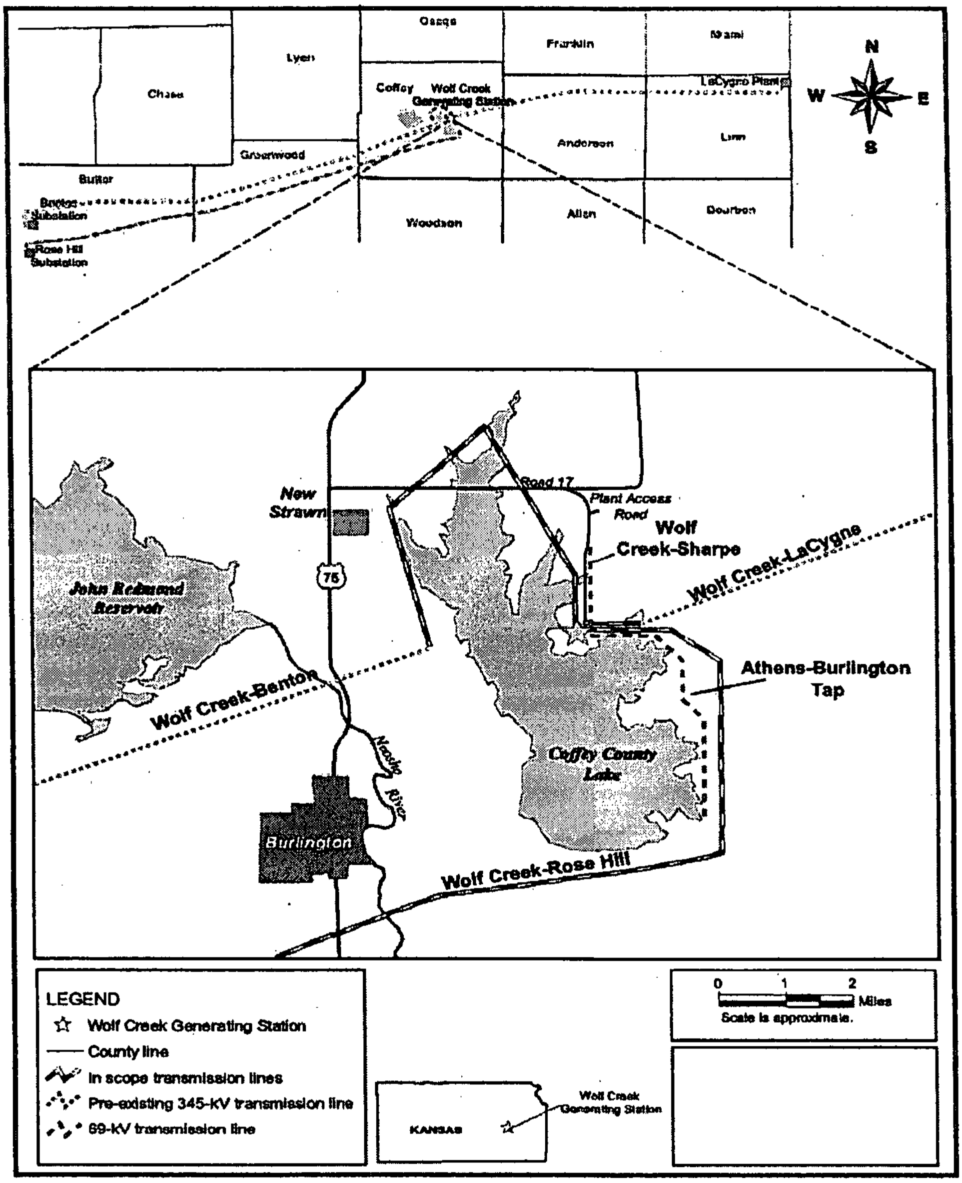
Source: WCNOC 2006a

Figure 2-3. WCGS Property Boundaries and Environs



Source: WCNOC 2006a

Figure 2-4. WCGS Facility Layout



Source: WCNOC 2006a

Figure 2-5. WCGS Transmission Lines

2.1.2 Reactor Systems

WCGS is a nuclear-powered steam electric generating facility that began commercial operation on September 3, 1985. The nuclear reactor is a Westinghouse PWR producing a reactor core power of 3,565 megawatts-thermal. The design net electrical capacity is 1,165 megawatts-electric (WCNOC 2006a).

The nuclear steam supply system at WCGS is a four-loop Westinghouse pressurized water reactor. The steam yields its energy to turn the turbines, which are connected to the electrical generator. The nuclear fuel is low-enriched uranium dioxide with enrichments of 5 percent by weight uranium-235 or less and fuel burnup levels of a batch average of approximately 48,000 megawatt-days per metric ton uranium. WCGS operates on an 18-month refueling cycle. The reactor, steam generators, and related systems are enclosed in a containment building that is designed to prevent leakage of radioactivity to the environment in the improbable event of a rupture of the reactor coolant piping. The containment building is a reinforced concrete cylinder with a slab base and a hemispherical dome. A welded steel liner is attached to the inside face of the concrete shell to insure a high degree of leak tightness. In addition, the 4-ft thick concrete walls serve as a radiation shield for both normal and accident conditions (WCNOC 2006a).

The containment building is ventilated to maintain pressure and temperatures within acceptable limits. The containment ventilation system also can purge the containment prior to entry. Exhaust from the ventilation system is monitored for radioactivity before being released to the plant vent. High efficiency particulate air (HEPA) filters can be used when needed to filter the air before releasing it. The containment building can be isolated if needed (WCNOC 2006a)

2.1.3 Cooling and Auxiliary Water Systems

The WCGS operates as a cooling pond based facility, with Coffey County Lake being the water source for the circulating water system (CWS), and auxiliary water systems, including the service water system (SWS), and essential service water system (ESWS). Figure 2-4 shows the location of these systems on the Wolf Creek property. Coffey County Lake, which was formerly known as the Wolf Creek Cooling Lake, also serves as the receiving water for the discharges from these three systems. The Neosho River is the source of makeup water for Coffey County Lake.

2.1.3.1 Intake

Condenser cooling water is withdrawn from Coffey County Lake through the circulating water intake structure (CWIS). The CWIS is located in the Circulating Water Screenhouse (CWSH), which is located in the southeast corner of the main plant area on the shore of Coffey County

Lake. The screenhouse contains the major equipment associated with the CWS and the SWS. The ESWS, described below, is located in a separate building to the northeast of the CWIS.

The CWIS sump floor is located at an elevation of 1058 ft above MSL. A steel plate is provided at the sump inlet of the CWIS as a weather protection device. This steel plate extends downward from the CWIS operating floor (1092 ft above MSL) to 1075 ft above MSL. The velocities of the circulating water and service water flow downstream of the steel plate are essentially independent of the lake water level. The circulating water and the service water flow from the lake past the steel plate and through bar grills (trash racks) into three separate bays where the traveling screens are located. The bar grills are used for removing larger debris while the traveling screens are designed to remove smaller debris.

The bar grill, located at the inlet of the intake bays, consists of 1-inch (in.)-wide vertical bars spaced at 3-in. intervals. These bars have not been cleaned throughout the history of the plant. Behind the bar grill, there are six traveling screens with two traveling screens per bay. The traveling screens are of a vertical single entry/exit type with a standard 0.375-in. mesh. The traveling water screens are operated intermittently controlled by either a timer or a high-differential-pressure sensor.

Low and high pressure sprays wash debris and organisms off the screens. Typically the low pressure wash is used to remove debris and organisms on the screens, but a high pressure wash can be activated for cleaning or heavy fouling. From the screens, debris and organisms are directed to a concrete sluiceway, then to a basket on the outside of the building. From the sluiceway, there is an approximate 2 ft drop to the basket, which has 1 x 3-in. openings. Larger debris and organisms remain in the basket until they are manually removed. Cleaning of the basket occurs every 8 hours when there is heavy loading; at other times it may be a few days until the basket is emptied. Smaller debris and biological organisms pass through the basket grates and fall approximately 3 to 4 ft to the water surface. Some service water is also discharged into the grated area.

The traveling screens are continuously turned if there are winds greater than 25 miles per hour (mph) from the south in October or November or if there is an out-of-season die-off. Records are not kept regarding the operation of the screens at Coffey County Lake or the Makeup Water Screen House (MUSH), but generally they are turned for 30 minutes every eight hours.

The CWS operates continuously during power generation, including startup and shutdown. Three one-third capacity motor-driven, vertical, wet-pit circulating water pumps pump the circulating water from the cooling lake to the main condenser. They are designed to operate through the expected range of cooling lake levels. When lake water temperatures are greater than 50 degrees (°) F, three pumps provide the design flow rate of approximately 500,000 gallons per minute (gpm). Under normal conditions, all three pumps operate at a total capacity of 1,178 cubic feet per second (cfs). Because condenser cooling is more efficient with colder intake water, only two pumps are operated with a design flow of 365,000 gpm when lake temperatures are below 50°F. At these pumping rates, design flow across the rotating screens at the point of impingement is less than 1.0 foot per second (fps).

Based on a total flow rate of 1,256 cfs (circulating water and service water combined), the average inlet water velocities are 0.87 fps (approach velocity to the CWIS), 1.06 fps (velocity through the bar grills), 1.06 fps (approach velocity to the traveling screens), and 1.95 fps (velocity through the traveling screens).

Wolf Creek Nuclear Operating Corporation (WCNOC) injects anti-scalants, dispersants, biocides, and corrosion inhibitors into the CWS to maintain the system and prevent fouling by corrosion and biological organisms. Addition of these constituents to the CWS is governed by the facility's National Pollutant Discharge Elimination System (NPDES) permit, which is described in Section 2.2.3.1.3.

2.1.3.2 Discharge

The heated water discharged from the condenser is returned to the Coffey County Lake through the CWS discharge structure. The main circulating water pipes from the CWSH to the power block and from the power block to the discharge structure have an inside diameter of 144 in. The circulating water discharge structure has a discharge well that overflows into a 40-ft wide apron and then onto the surface of the lake.

During the winter, operators may align the circulating water system to direct a fraction of the warmed discharge back to the circulating water intake structure to prevent freezing. Baffle dikes prevent short-circuiting of the discharge water to the intake.

The discharged water takes approximately 38 days to travel from the discharge to the intake structure (WCNOC 2007).

2.1.3.3 Service Water Systems

There are two independent station service water systems: the SWS and the ESWS. The SWS takes water from the circulating water intake structure and returns the warmed water to the circulating water discharge pipe. During normal plant operation, the SWS supplies water to the turbine plant auxiliary equipment, steam generator blowdown, nonregenerative heat exchanger, and the Chemical and Volume Control System (CVCS) chiller. The service water system is the normal water supply for the Demineralized Water Makeup System. The fire protection diesel and electric fire pumps also draw water from the CWS bays. During normal operation, the CWS also provides water to the ESWS. Both the SWS and the ESWS incorporate the use of oxidants such as chlorine for control of biofouling. Per the facility NPDES permit, a maximum of 1.0 milligram per liter (mg/L) total residual oxidants is allowed with up to 22 hours of continuous chlorination (Hammond 2006).

The flow rate is variable, but flow rates can be as high as 50,000 gpm. Three service water pumps are housed in the CWIS. Typically two service water pumps are operating at a total capacity of 90 cfs with one pump serving as a standby. Each service water pump is sized to deliver 25,000 gpm of service water at a discharge pressure of approximately 185 ft.

The ESWS cools several safety-class systems and provides cooling for safe shutdown during an accident. During accident conditions, the ESWS takes water from the Ultimate Heat Sink (UHS), a specially designed impoundment within Coffey County Lake, at the Essential Service Water intake structure. Discharge goes to a separate discharge structure on the UHS. An underwater dam prevents draining of the UHS in the event of failure of the lake dam.

The ESWS intake structure consists of two totally independent intake systems. Each has a forebay with the same type of bar grills as found in the CWIS; however, there are no vertical steel plates, used for ice protection, as seen in the CWIS. Each system also has a traveling screen similar to the CWIS and MUSH. Debris and organisms trapped on the traveling screens are diverted to a shared sluiceway that discharges to the outside of the building.

Similar to the CWIS, the ESWS screens can be operated automatically or manually. Some service water is diverted to the ESWS consistently to keep the system clean. Heated effluent can also be direct to the intake for ice control. The ESWS is operated infrequently. No records were provided by WCNOC regarding the duration and frequency of operation.

2.1.3.4 Makeup Water

Makeup water for Coffey County Lake is drawn from the Neosho River immediately downstream of the John Redmond Reservoir. A valve in a pipe through the dam is opened during pumping to maintain flow to the pumps. The MUSH is situated on the east bank of the river and contains three separate makeup water pumps, each with a dedicated bar grill and 3/8-in. traveling screens. Only two pumps can be used at a time. Each pump is designed to provide 60 cfs through a 54-in.-diameter supply line to Coffey County Lake. This supply line is designed for 130 cfs with an optimum rate of 120 cfs.

The design and operation of the bar grill and traveling screens is similar to the CWIS; however, there is no vertical steel plate prior to the trash racks, as seen in the CWIS. Two auxiliary raw water pumps are also available to supply the demineralizer system when service water is not operating. There are no provisions for returning fish that survive impingement to the Neosho

River. However, the design intake velocity of less than 0.5 fps at a water level of 1007.5 ft above MSL minimizes fish impingement (WCNOC 2006b).

From the MUSH, water flows through a 54-in.-diameter supply line to Coffey County Lake and discharges at the makeup water discharge structure on the western shore of the lake, immediately adjacent to the Coffey County boat ramp. The discharge structure consists of a stilling basin/sump wherein the makeup water pipeline discharges. From this sump, the makeup water flows over a weir and down a spillway to Coffey County Lake.

2.1.4 Radioactive Waste Management Systems and Effluent Control Systems

WCGS radioactive waste (radwaste) systems are designed to collect, treat, and dispose of the radioactive and potentially radioactive wastes that are byproducts of plant operations. The byproducts are activation products resulting from the irradiation of reactor water and impurities therein (principally metallic corrosion products) and fission products resulting from defective fuel cladding or uranium contamination within the reactor coolant system. Operating procedures for radwaste systems ensure that radioactive wastes are safely processed and discharged from the plant within the limits set forth in Part 20 of Title 10 of the *Code of Federal Regulations* (10 CFR Part 20), 10 CFR Part 50, the plant's technical specifications, and WCGS's *Offsite Dose Calculation Manual* (ODCM; Accession No. ML071270040).

Radioactive wastes resulting from plant operations are classified as liquid, gaseous, or solid. Liquid radioactive wastes are generated from liquids received directly from portions of the reactor coolant system or were contaminated by contact with liquids from the reactor coolant system. Gaseous radioactive wastes are generated from gases or airborne particulates vented from reactor and turbine equipment containing radioactive material. Solid radioactive wastes are solids from the reactor coolant system, solids that came into contact with reactor coolant system liquids or gases, or solids used in the reactor coolant system or steam and power conversion system operation or maintenance (Accession No. ML0712000055).

Reactor fuel that has exhausted a certain percentage of its fissile uranium content is referred to as spent fuel. Spent fuel assemblies are removed from the reactor core and replaced with fresh fuel assemblies during routine refueling outages, typically every 18 months. Spent fuel assemblies are then stored in the spent fuel pool in the Fuel Building. WCGS also provides for on-site storage of mixed wastes, which contain both radioactive and chemically hazardous materials (Accession No. ML0712000055).

WCGS's ODCM contains the methodology and parameters used to calculate off-site doses resulting from radioactive gaseous and liquid effluents, and the gaseous and liquid effluent monitoring alarm and trip set points used to verify that the radioactive material being discharged meets regulatory limits (Accession No. ML071270040). The ODCM also contains the radioactive effluent controls and radiological environmental monitoring activities and descriptions of the information that should be included in the annual Radiological Environmental Operating Report and annual Radioactive Effluent Release Report required by Appendix I to 10 CFR Part 50, and 10 CFR 50.36a, respectively.

2.1.4.1 Liquid Waste Processing Systems and Effluent Controls

The liquid waste processing system collects, holds, treats, processes, and monitors all liquid radioactive wastes for reuse or disposal. The system is divided into several subsystems so that liquid wastes from various sources can be segregated and processed separately. Cross connections between the subsystems provide additional flexibility for processing the wastes by alternate methods. The wastes are collected, treated, and disposed of according to their conductivity and/or radioactivity (Accession No. ML0712000055).

Liquid waste is collected in sumps and drain tanks and transferred to the appropriate subsystem collection tanks for subsequent treatment, disposal, or recycle. Liquid waste is processed by a series of components mounted on a skid employing various processes specifically designed to provide maximum decontamination factors. The processing methods used include; filtration, reverse osmosis, and/or demineralization. Following treatment, the processed wastes in the waste evaporator condensate tank, waste monitor tanks, or secondary liquid waste monitor tanks are analyzed for chemical and radioactive content prior to being discharged. Any planned releases from the system are evaluated in conjunction with all other radioactive liquid releases to ensure that the total release does not exceed the ODCM limits. The liquid effluent normally discharges from the plant into the circulating water discharge piping, which dilutes the effluent and transports it to the Coffey County Lake. Liquid releases to the lake are limited to satisfy the dose objectives of Appendix I to10 CFR Part 50.

The U.S. Nuclear Regulatory Commission (NRC) staff reviewed the WCGS radioactive effluent release reports for 2002 through 2006 for liquid effluents (WCNOC 2003a, 2004a, 2005a, 2006c, 2007a). There were 50 liquid batch releases as well as continuous releases in 2006. The amount of radioactivity discharged in liquid releases, excluding gases and tritium, totaled 0.010 curies in 2006. A total of 1,380 curies of tritium were released in 2006.

Based on the liquid waste processing systems and effluent controls and performance from 2002 through 2006, similar small quantities of radioactive liquid effluents are expected from WCGS and are not expected to increase during the renewal period. These releases would result in doses to members of the public that are well below the as low as reasonably achievable (ALARA) dose objectives of Appendix I to 10 CFR Part 50, as discussed in Section 2.2.7.

2.1.4.2 Gaseous Waste Processing Systems and Effluent Controls

The gaseous radwaste processing system and the plant ventilation exhaust system control, collect, process, store, and dispose of gaseous radioactive wastes generated as a result of normal operation. The primary source of the radioactive gas is from the purge of the volume control tank with hydrogen. The operation of the system acts to reduce the fission gas concentration in the reactor coolant system which, in turn, reduces the escape of fission gases from the reactor coolant system during maintenance operations or through equipment leakage. Smaller quantities are received from the vent connections, from the reactor coolant drain tank, the pressurizer relief tank, and the recycle holdup tanks. In all buildings where there is a potential for radioactive gaseous material, the ventilation system is designed to control the release. Where needed, each building has a vent collection system for tanks and other equipment which contains air or aerated liquids. The unit vent receives input from several ventilation sub-systems; including the condenser evacuation system, reactor building, auxiliary building, and fuel building. The radwaste building has an open ventilation system, and the steam packing exhaust discharges outside the turbine building.

The vent collection system receives the discharge of vents and other equipment in the radwaste and auxiliary buildings which contain air or aerated liquids. These components contain only a small amount of fission product gases. Prior to release through the radwaste or auxiliary building ventilation system, the gases are monitored and passed through a prefilter, high efficiency particulate filter, charcoal filter, and another high efficiency particulate filter in series which reduce any airborne particulate radioactive material to very low levels. This filter system provides for a decontamination factor of at least 10 for radioactive iodines and 100 for particulates.

WCGS maintains radioactive gaseous effluents in accordance with the procedures and methodology described in the ODCM. The gaseous radwaste system is used to reduce radioactive materials in gaseous effluents before discharge to meet the ALARA dose objectives in Appendix I to10 CFR Part 50 (Accession No. ML071270040).

The NRC staff reviewed the WCGS radioactive effluent release reports for 2002 through 2006 for gaseous effluents (WCNOC 2003a, 2004a, 2005a, 2006c, 2007a). In 2006, WCGS made 68 gaseous batch releases as well as continuous releases which contained a total of 2.07 curies of fission and activation gases and a total of 53.4 curies of tritium.

These activities are typical of past years and are not expected to increase during the renewal period. See Section 2.2.7 for a discussion of the theoretical doses to the maximally exposed individual as a result of these releases.

2.1.4.3 Solid Waste Processing

The solid radwaste system is designed to collect, process, and package low-level radioactive wastes generated as a result of normal plant operation. It also is capable of storing the packaged waste until it is shipped off-site to a waste processor for treatment and/or disposal or to a licensed burial site. The solid radwaste equipment is located in the radioactive waste building. The system consists of a dry waste system, a resin handling system, a filter handling system, and a waste disposal system. Both wet and dry radioactive solid wastes are processed. Wet solid wastes include spent resins, filter cartridges, filter sludges, evaporator bottoms, waste from floor drain filters, and fuel pool filters. Dry solid wastes include contaminated rags, clothing, paper, small equipment parts, and solid laboratory wastes (Accession No. ML0712000055).

In 2006, WCGS made a total of 19 shipments of solid waste. The solid waste volumes were 623 cubic meters (m^3) of dry compressible waste, contaminated equipment, and spent resins, with an activity of 251.42 curies (WCNOC 2007a). The volumes reported are for non-compacted wastes. Volume reduction by compaction is performed by a contractor at an off-site location. No irradiated fuel shipments were made in 2006. The solid waste volumes and radioactive material activity levels are typical of annual waste shipments for WCGS and are not expected to increase during the renewal period.

2.1.5 Nonradioactive Waste Systems

WCGS generates solid, hazardous, universal, and mixed waste from routine facility operations and maintenance activities.

2.1.5.1 Nonradioactive Waste Streams

WCGS generates solid waste, as defined by the Resource Conservation and Recovery Act (RCRA), as part of routine plant maintenance, cleaning activities, and plant operations. This waste is not radioactive or hazardous and is disposed of in the Coffey County Landfill.

Hazardous waste is nonradioactive waste that is listed by the U.S. Environmental Protection Agency (EPA) as hazardous waste or that exhibits characteristics of ignitability, corrosivity, reactivity, or toxicity (40 CFR Part 261). RCRA regulates the treatment, storage, and/or disposal of hazardous waste and requires a hazardous waste permit for facilities that treat or store large quantities of hazardous waste for more than 90 days and for entities that dispose of hazardous waste at the facility. RCRA regulations are administered in Kansas by the Kansas Department of Health and Environment (KDHE).

WCGS generates a variety of hazardous waste streams including broken fluorescent lamps which contain low levels of mercury, oils, solvents, photographic chemicals, and paint waste. WCGS currently maintains a Kansas Generator classification meaning, the plant generates between 55 to 2,200 pounds of hazardous waste in a month. In 2006, WCGS generated 1,577.6 pounds of hazardous waste (WCNOC 2007a).

Universal waste is hazardous waste that has been specified as universal waste by the EPA. Universal waste, including mercury-containing equipment, batteries, lamps, and pesticides, has specific regulations (40 CFR Part 273) to ensure proper collection and recycling or treatment. WCGS generates batteries and fluorescent lamps as universal wastes from normal facility operations. The batteries and lamps are accumulated in satellite areas and then shipped off-site for disposal in accordance with universal waste regulations. In 2006, WCGS generated approximately 2,400 pounds of universal waste batteries and 240 pounds of universal waste lamps (WCNOC 2007a).

Low-level mixed waste (LLMW) is waste that exhibits hazardous characteristics and contains low levels of radioactivity. LLMW has been regulated under multiple authorities. EPA or State agencies regulate the hazardous component of LLMW through RCRA and either the U.S. Department of Energy (DOE) or NRC regulates the radioactive component.

WCGS generates LLMW from normal facility operation and maintenance. These wastes, when generated, are stored in appropriate containers and stored in the Mixed Waste Storage Facility (MWSF) in the Owens Corning Building. The MWSF meets the EPA requirements for storage of hazardous wastes and the NRC requirements for storage of radioactive wastes (WCNOC 2007a).

2.1.5.2 Pollution Prevention and Waste Minimization

Currently, WCGS has an approved site waste minimization plan in place. The plan has reduced the amount and toxicity of waste generated or reduced the volume of waste disposed of in a landfill. The plan includes a practice which recycles a large number of waste materials including the following: aluminum cans, office paper, used oil, antifreeze, scrap metal, fiberboard drums, laser printer toner cartridges and poly drums (WCNOC 2007a).

2.1.6 Facility Operation and Maintenance

Maintenance activities conducted at WCGS include inspection, testing, and surveillance to maintain the current licensing basis of the facility and to ensure compliance with environmental and safety requirements. Various programs and activities currently exist at WCGS to maintain, inspect, test, and monitor the performance of facility equipment. These maintenance activities include inspection requirements for reactor vessel materials, boiler and pressure vessel in-service inspection and testing, maintenance structures monitoring program, and maintenance of water chemistry.

Additional programs include those implemented to meet technical specification surveillance requirements, those implemented in response to the NRC generic communications, and various periodic maintenance, testing, and inspection procedures. Certain program activities are performed during the operation of the unit, while others are performed during scheduled refueling outages. WCNOC refuels WCGS on a nominal 18 month interval.

2.1.7 Power Transmission System

As presented in Table 2-1, the applicant identified three 345-kV transmission lines that were constructed in conjunction with the construction of WCGS in order to connect the facility to the electric power grid. Prior to construction of WCGS, a 345-kV transmission line ROW extended from La Cygne (located approximately 60 miles east of WCGS) to Benton (located northwest of Wichita) and traversed the site. This line was rerouted around Coffey County Lake and connected to the WCGS switchyard by constructing a 7-mi segment around the lake on the east end of what became the Wolf Creek – Benton line and a 0.7-mi segment on the west end of what became the Wolf Creek – La Cygne line (Figure 2-5). Both of these lines have 150-ft-wide ROWs that are almost entirely on WCGS property. In addition, a new 345-kV transmission line was built in conjunction with the construction of WCGS, the Wolf Creek – Rose Hill line. This line extends southwest from WCGS for 98 miles within a 150-ft-wide ROW to the Rose Hill Substation located southeast of Wichita (WCNOC 2006a).

Table 2-1. WCGS Transmission Line ROWs

Transmission Line	kV	Approximate Distance		ROW Width		ROW Area	
		km	mi	m	ft	hectares	acres
Wolf Creek to Rose Hill Substation	345	157.7	98	45.7	150	721.1	1781.8
Wolf Creek to Pre-existing Benton Line	345	11.3	7	45.7	150	51.5	127.3
Wolf Creek to Pre-existing La Cygne Line	345	1.1	0.7	45.7	150	5.1	12.7
Total		170	106			7787	1922

Based on: WCNOC 1980

The three 345-kV transmission lines listed in Table 2-1 were originally constructed for the specific purpose of connecting the plant to the transmission system. As shown in the table, these lines are contained within approximately 106 miles of 150-ft-wide ROWs that include a total area of over 1,920 ac in Coffey, Greenwood, and Butler Counties. The transmission line ROWs primarily occur within agricultural and open range lands and cross numerous county, State, and Federal highways. They do not cross any national or State parks, wildlife refuges, or wildlife management areas. The Wolf Creek – Benton line crosses over several inlets and tributaries of Coffey County Lake, and the Wolf Creek – La Cygne and Wolf Creek – Rose Hill lines cross over one inlet of the lake east of the WCGS facility. The Wolf Creek – Rose Hill line also crosses the Neosho, Verdigris, Fall, Little Walnut, and Walnut Rivers, as well as many smaller creeks. It does not cross any major lakes or ponds outside of the WCGS property.

WCGS does not own, operate, or maintain the transmission lines or the ROWs. The lines are owned and maintained by Westar Energy Inc. (Westar), which provides electricity to businesses and residents in eastern Kansas and operates and coordinates more than 33,000 miles of transmission and distribution lines (Westar 2007). The transmission lines were designed and constructed in accordance with the National Electrical Safety Code and other industry guidance applicable at the time the lines were built. The lines are subject to scheduled inspections and maintenance to ensure conformance to industry and regulatory standards.

Two 69-kV lines from the WCGS are not shown on Table 2-1 because they are not within the scope of this evaluation. One of these lines extends 4 miles to tap into the Athens-Burlington line. This line was originally constructed to provide construction power. The second 69-kV line is a 3-mi-long radial line that connects to a substation in Sharpe. Transmission lines such as these that have voltages less than 98-kV are not within the scope of the evaluation of terrestrial ecology effects of the potential for acute and chronic electromagnetic field effects in Section 4.2.

2.2 Plant Interaction with the Environment

Sections 2.2.1 through 2.2.8 provide general descriptions of the environment near WCGS as background information. They also provide detailed descriptions where needed to support the analysis of potential environmental impacts of operation during the renewal term, as discussed in Sections 3 and 4. 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

The WCGS facility occupies a 9,818 ac site, encompassing Coffey County Lake and the surrounding shoreline, within a total area of nearly 11,300 ac owned by the Kansas Gas and Electric Company, Kansas City Power & Light Company, and Kansas Electric Power

Cooperative. The largest portion of the site property (5,090 ac) is occupied by the WCGS cooling pond (Coffey County Lake), with additional site features including the dam and dikes for Coffey County Lake (60 ac), the Lime Sludge Pond (31 ac), and the Wolf Creek Environmental Education Area (500 ac). The WCGS facility buildings and adjacent areas occupy approximately 135 ac on a peninsula along the eastern shore of Coffey County Lake, at the southern end of Oxen Lane (the "Plant Access Road"). Included are the reactor containment building, turbine building, auxiliary building, control building, fuel handling facility, switchyard, radioactive waste building, training center, visitor's center, outdoor firing range, and other supporting buildings. The area in the immediate vicinity of the reactor and associated buildings is fenced to restrict human access. A management plan has been developed for the outdoor firing range, which has been in use since 1983, to address lead in ammunition fired at the range. Recommendations are made in the plan to minimize lead contamination in the soil through management practices that reduce potential soil erosion and through modification of range use procedures (WCNOC 2004b).

The remainder of the property within the site boundary is leased as farmland, for the production of soybeans, milo, corn, and wheat, and as rangeland (WCNOC 2006a). As of 2006, these leases included 1,422 ac for grazing, 540 ac for hay production, and 1,282 ac for cropland. In addition, a buffer zone of approximately 1,440 ac surrounding Coffey County Lake is maintained in native vegetation (grasses and woodland) for wildlife benefits (WCNOC 2006d). Figure 2-3 depicts the WCGS site boundary and Figure 2-4 provides the general facility layout.

The nearest residence is located 1.7 miles west of the reactor containment building, across Coffey County Lake, on Native Road SE (WCNOC 2006e). The closest communities are the cities of Burlington (population 2,790), located 3 miles southwest of the WCGS facility, and New Strawn (population 425), 2.5 miles northwest of the facility (USCB 2000).

WCGS is located in and pays property taxes to Coffey County. The site property, including the WCGS facility, is zoned A-1 Agricultural by the county.[a]

Three 150-ft-wide transmission line ROWs, containing lines built to connect WCGS to the power grid, run for a total of approximately 105 miles and cover a total area of approximately 1,900 ac. These transmission lines are described in more detail in Section 2.1.7. The ROWs traverse land that is primarily agricultural and open range, in areas that are mostly remote and have low population densities. The ROWs do not cross any State or Federal parks, wildlife refuges, or wildlife management areas (WCNOC 2006a).

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[a] Special uses allowed in the A-1 Agricultural zoning district include power plants, both conventional and nuclear fueled, for commercial production and sale of energy (Coffey County Planning Board 2000).

The Wolf Creek – Rose Hill line extends approximately 98 miles from WCGS in a southwesterly direction toward the Rose Hill substation east of Wichita, Kansas. The primary land use classifications traversed by this ROW are grazing lands (70 percent of the total ROW area) and cropland (24 percent), with the remaining area occupied by woodlands (4 percent), idle land (2 percent), and roads (0.5 percent) (WCNOC 2007c).

The portion of the LaCygne – Benton transmission line rerouted around Coffey County Lake is approximately 7.7-mi long. Land uses within the upland areas of this ROW are predominantly agricultural, including grazing land (31 percent), cropland (20 percent) and hay meadow (11 percent), and wildlife habitat (native grasses, grass-brush, and brush habitats, 16 percent). Roads, gravel areas, and WCGS yard areas occupy 8 percent of the ROW area. Woodlands cover 5 percent (WCNOC 2007c).

Section 307(c)(3)(A) of the Coastal Zone Management Act (16 USC 1456(c)(3)(A)) requires that applicants for Federal licenses to conduct an activity in a coastal zone provide to the licensing agency a certification that the proposed activity is consistent with the enforceable policies of the State's coastal zone program. WCGS does not affect a coastal zone. Therefore, the requirements of the Coastal Zone Management Act are not applicable to renewal of the WCGS license.

2.2.2 Water Use

For facility operations, WCGS uses water to supply a CWS, SWS, and ESW. The source of water for all three systems is Coffey County Lake, which was constructed and filled specifically to act as a cooling pond for the facility (WCNOC 2006a). The facility uses a cooling pond based system in which water from Coffey County Lake is withdrawn through an intake channel on the eastern shore of the lake, and heated discharge water is returned to the lake. The CWS intake structure is located on the south side of the facility and has a capacity of 500,000 gpm (WCNOC 2006a). The SWS withdraws water through the same intake channel as the CWS and has the capacity to withdraw up to 50,000 gpm (WCNOC 2006a). During normal operations, the ESWS is supplied by the SWS. However, a separate ESWS intake structure exists which is able to supply this system during accident conditions (WCNOC 2006a). All three water systems are closed systems in which the water is withdrawn from and returned to Coffey County Lake (WCNOC 2006a).

Coffey County Lake covers an area of 5,090 ac and is designed to provide an adequate supply to WCGS during a 1 in 50 year drought (WCNOC 2006a). The lake was developed in the early 1980s by construction of an earthen dam across intermittent Wolf Creek and filled by water pumped from the Neosho River (WCNOC 2006a). The drainage area captured by the impoundment is 19.5 square miles (sq mi; Haines 2000 in WCNOC 2006a).

The sources of makeup water for Coffey County Lake include natural flows within Wolf Creek upstream of the lake, and water pumped from the Neosho River from an intake immediately downstream of the John Redmond Reservoir. The facility does not use any groundwater wells for water supply, nor does it purchase water from local water systems except for potable purposes (WCNOC 2006a).

The water used to maintain the water supply in Coffey County Lake is obtained through two different administrative mechanisms: water appropriations for the use of natural flows for beneficial uses, as permitted by the Kansas Department of Agriculture, and a purchase contract with the Kansas Water Authority for stored water within the conservation pool of the John Redmond Reservoir on the Neosho River. The specific sources of water, with their respective volumes, are as follows:

- Under water appropriation file number 20,275, WCGS has access to all natural flows of Wolf Creek upstream of the Coffey County Lake Dam (State of Kansas 1977a in WCNOC 2006f). The reported average monthly stream flow in Wolf Creek prior to construction of the WCGS facility was approximately 8,100 gpm (NRC 1982).
- Under water appropriation file number 14,626, WCGS is permitted to withdraw up to 55 cfs (or 24,750 gpm) up to a maximum of 25,000 ac-ft/year (yr) of natural flow within the Neosho River (State of Kansas 1977b in WCNOC 2006b).
- Under water appropriation file number 19,882, WCGS is permitted to withdraw up to 170 cfs (76,500 gpm) up to a maximum of 57,300 ac-ft/yr of natural flow within the Neosho River (State of Kansas 1977c in WCNOC 2006f).
- Through a contract with the Kansas Water Authority (formerly the Kansas Water Resources Board), WCGS may purchase water stored within the conservation pool of the John Redmond Reservoir during times when the elevation of the reservoir is at or below the conservation pool level of 1,039 ft above MSL (State of Kansas 1976 in WCNOC 2006f).

Each of these sources of water is subject to volume restrictions based on administrative and/or physical limitations, including the amount of water actually present, the need to apportion the available water for all uses (including maintaining adequate streamflow in the Neosho River), and the physical capacities of the WCGS pumps and piping systems. Details regarding these limitations, as well as an evaluation of the potential for future water use impacts, are presented in Section 4.1.1.

The physical means of acquiring the water is through pumps located at the MUSH, on the Neosho River at the outfall of the dam. When fully operational, the three MUSH pumps combined have a maximum pumping rate of 120 cfs (54,000 gpm) for pumping the appropriations water. This is same as the maximum flow capacity of the pipeline that transports the water to the Coffey County Lake (WCNOC 2006g). The water purchase contract also has physical and administrative limitations. The contract allows a maximum withdrawal rate of 120 cfs. However, due to limitations in the flow capacity of the bypass pipe used to access the purchased water, the maximum withdrawal rate available through this mechanism is 70 cfs (31,500 gpm; WCNOC 2006g).

In addition to the cooling and service water systems, the facility obtains potable water for use by employees. This water is obtained through the Rural Water District 3, which purchases the water from two sources: the City of Burlington, which withdraws its water supply through an intake on the Neosho River; and the Public Wholesale District 12, which draws water from Melvern Lake (WCNOC 2006a). The total volume of water obtained for potable supply purposes is approximately 600,000 to 700,000 gallons per month (WCNOC 2006a). The capacity of the Burlington water system is 2.1 million gallons per day (mgd; City of Burlington 2007), and the contracted capacity of Public Wholesale District 12 is 1.5 mgd (KWO 2002). Therefore, the volume represents 1 percent or less of the normal capacity of these water supply systems.

2.2.3 Water Quality

2.2.3.1 Surface Water

The surface water bodies of interest that may potentially be impacted by WCGS operations include Coffey County Lake, Wolf Creek, and the Neosho River. Coffey County Lake receives direct discharge from the facility's cooling and service water systems. Its water quality may be affected by activation products in the cooling water, corrosion products from facility piping systems, and/or biocides and corrosion control chemicals added to the water systems. Following discharge to Coffey County Lake, these constituents may increase in concentration due to evaporation in the lake.

From Coffey County Lake, this water may migrate to Wolf Creek and the Neosho River, potentially resulting in impacts to those water bodies. Coffey County Lake water may be released to Wolf Creek through four mechanisms. These include natural flows through the service spillway and auxiliary spillway, discharge through the blowdown structure, and seepage of the lake water around the dam (WCNOC 2007d). Any of these mechanisms would result in direct release of Coffey County Lake water to Wolf Creek, which then flows to its confluence with the Neosho River approximately 5.5 miles south of the dam.

The effect of WCGS operations on surface water quality in the local area is monitored through the Radiological Environmental Monitoring Program (REMP) operated by WCGS, and the Wolf Creek Environmental Radiation Surveillance (ERS) Program operated by KDHE. In addition, more general, regional water quality monitoring studies are conducted by various Federal, State, and local agencies. Although these programs are not specifically designed to monitor the effect of WCGS operations, they provide additional data that may be useful in understanding the local environment in which WCGS operates. Subsections 2.2.3.1.1 through 2.2.3.1.4 below provide a summary of these studies and programs.

2.2.3.1.1 General and Regional Surface Water Quality Monitoring

Surface water quality in John Redmond Reservoir, the Neosho River, and other local surface water bodies has been monitored by Federal, State, and local agencies for various purposes unrelated to WCGS operations. However, these studies provide data on the quality of surface water in the area prior to and during facility operations.

Because the Neosho River and other water bodies act as a drinking water source for several communities, both the local municipalities and the KDHE conduct sampling and analysis of water obtained in this manner. The closest locations for which monitoring data exists include Public Wholesale District #12 on Melvern Lake, and the cities of Burlington and Iola on the Neosho River (KDHE 2007a). Melvern Lake is located outside of the drainages associated with WCGS. The water intake for the city of Burlington is located upstream of the confluence of the Neosho River and Wolf Creek, approximately 1.5 miles west of Coffey County Lake. The water intake for the city of Iola is located approximately 20 miles downstream of the confluence.

The 2006 analytical report for the city of Burlington shows that some violations of drinking water standards occurred. These included exceeding Maximum Contaminant Levels (MCLs) for total trihalomethanes and halocetic acids, inadequate disinfection process for total organic carbon, and a failure to monitor for the Interim Enhanced Surface Water Treatment Rule (City of Burlington 2007). No compliance issues were identified for the Iola and Melvern Lake systems and none of these issues are related to WCGS operations (KDHE 2007a).

The Neosho River and John Redmond Reservoir are sampled for general water quality parameters by the KDHE Bureau of Air and Radiation and the Watershed Management Section. Data obtained from both of these sources indicates generally high quality water in both water bodies. Two Total Maximum Daily Load (TMDL) documents have been issued for John Redmond Lake – one for siltation, and one for eutrophication (KDHE 2007b). In addition, two TMDL documents have been issued for the Neosho River downstream of WCGS – one for copper, and one for pH (KDHE 2007b). None of these issues are expected to be related to WCGS operations.[b]

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[b] Personal communication of Robert Dover, Hydrologist, for Earth Tech with Tom Stiles, Chief, Kansas Bureau of Water Watershed Planning Section discussing total maximum daily load (TMDL) documents (March 27, 2007).

2.2.3.1.2 WCGS Pre-Operational Surface Water Quality Monitoring

A surface water quality study was performed at the site prior to and shortly after operations began. This study was conducted from 1973 to 1987 and consisted of the sampling and analysis of samples from John Redmond Reservoir, the Neosho River, and Coffey County Lake (at that time called Wolf Creek Cooling Lake). The samples were analyzed for general chemistry parameters and metals during pre-operational conditions and for two years following the beginning of operations (EA 1988). The study identified variations in analytical results that were attributed to natural seasonal differences (EA 1988). The study identified a trend of increasing iron, chromium, and copper concentrations in the cooling lake, but concluded that there were no observable trends or impacts that could be attributed to the facility after 2 years of operations (EA 1988). Analyses for these metals have not been conducted or reported in the Annual Environmental Monitoring Reports that date back to 1985. Sampling by KDHE in 2005 and 2006 did include analyses for these metals, and indicate that metals concentrations have not increased during the operational period.

2.2.3.1.3 WCGS NPDES Monitoring

Pursuant to the Federal Water Pollution Control Act (also known as the Clean Water Act [CWA]), WCGS effluent discharges are regulated by a NPDES permit. The first NPDES permit for the facility (Kansas Permit No. I-NE07-PO02, Federal Permit Number KS0079057) was issued by the State of Kansas in 1977. The permit has been renewed 7 times with the latest renewal occurring on December 30, 2004 (WCNOC 2006a). The current permit expires on December 31, 2008. The quantitative effluent limitations regulated under the WCGS NPDES permit are shown in Table 2-2.

There are nine separate outfalls regulated under this permit, which fall into three main categories:

- Outfall 003X is the regulated outfall for the largest volume of water, which is the circulation water and service water discharge to Coffey County Lake. This outfall has a permitted discharge flow volume of 704 mgd.
- Outfall 004A is the outfall for the spillway of Coffey County Lake Dam into Wolf Creek. This outfall has a permitted discharge flow volume of 2.9 mgd.
- Outfalls 001A, 002, 002A, 003A, 003B, 005A, and 006A are all permitted for discharge of relatively small-volume, miscellaneous water streams to Coffey County Lake. These include the outfall for the domestic waste stabilization pond (001A), the ESWS (006A), and other low volume or rarely used systems. The total permitted flow volume of all of these outfalls into Coffey County Lake combined is 34.37 mgd.

Outfalls 002 – 006 are shown on Figure 2-6.

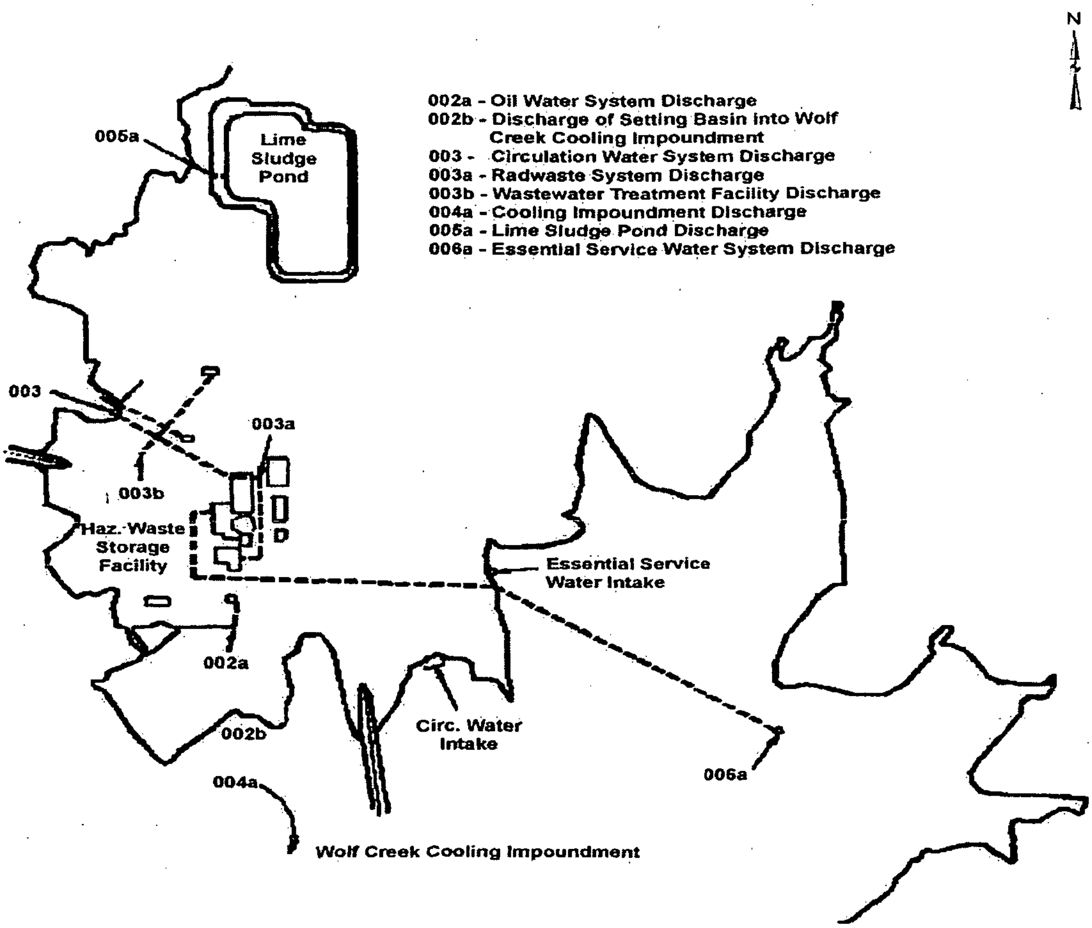
Table 2-2. Effluent Limitations - NPDES Permit for WCGS

Outfall No.(Outfall Description)	Flow (mgd)	Total Residual Oxidants (mg/L)		Total Suspended Solids (mg/L)		Oil and Grease (mg/L)		Fecal Coliform (cells/100 ml)		Biochemical Oxygen Demand (mg/L)	
		Avg. Monthly	Max. Daily	Avg. Monthly	Max. Daily	Avg. Monthly	Max. Daily	Apr. 31 to Oct. 31	Nov. 1 to Mar. 1	Avg. Monthly	Max. Daily
001A (Domestic Waste Stabilization Pond)	1.25	NA	NA	80	120	NA	NA	200	2000	30	45
002 (Storm-water runoff through oil-water separator)	0.326	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
002A (Miscellaneous wastes and draindown through power block sumps)	NA	NA	NA	30	100	10	15	NA	NA	NA	NA
003X (Circulation water and service water)	704	NA	0.2	NA	NA	NA	NA	NA	NA	NA	NA
003A (Radioactive wastewater)	0.300	NA	NA	30	100	NA	NA	NA	NA	NA	NA

Table 2-2. (cont'd)

Outfall No.(Outfall Description)	Flow (mgd)	Total Residual Oxidants (mg/L)		Total Suspended Solids (mg/L)		Oil and Grease (mg/L)		Fecal Coliform (cells/100 ml)		Biochemical Oxygen Demand (mg/L)	
		Avg. Monthly	Max. Daily	Avg. Monthly	Max. Daily	Avg. Monthly	Max. Daily	Apr. 31 to Oct. 31	Nov. 1 to Mar. 1	Avg. Monthly	Max. Daily
003B (Water treatment plant and wastewater system discharge)	0.195	NA	NA	30	100	10	15	NA	NA	NA	NA
004A (Discharge from Coffey County Lake to Wolf Creek)	2.9	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
005A (Lime Sludge Pond discharge)	5.8	NA	NA	30	100	10	15	NA	NA	NA	NA
006A (Essential Service Water System discharge)	26.5	NA	1.0	NA	NA	NA	NA	NA	NA	NA	NA

Notes: All outfalls have a pH limitation requiring the effluent pH to be between 6 and 9.
Source: KDHE 2004, in WCNOC 2006a



Source: WCNOC 2006h

Figure 2-6. WCGS NPDES Outfall Locations

The NPDES permit does not regulate the discharge of radionuclides from the facility. Supplemental Condition #7 in the permit states "All radioactive components of the discharge are regulated solely by the NRC under the requirements of the Atomic Energy Act and not by either the EPA under the CWA or the KDHE under Kansas Water Pollution Control Regulations and Statutes" (KDHE 2004 in WCNOC 2006a).

The NPDES permit also does not regulate the temperature of the discharge to Coffey County Lake. In a series of letters from December 1974 to April 1975 (KDHE 1974, Kansas Gas and Electric 1975, KDHE 1975a), KDHE concluded that construction of the facility had begun prior to the promulgation of Section 316(a) of PL 92-500 and that the facility was therefore exempt from the Federal limitation on the discharge of heat. In addition, another letter from KDHE (KDHE 1975b) concludes that Kansas Gas and Electric Company (the predecessor to WCNOC) will not be held responsible for degradation of the water quality in the cooling lake that causes the lake to become unsuitable for body contact sports or fishing. The same letter also concludes that the facility will not be held responsible for the loss of fish in the lake due to cold shock, impingement, or entrainment. However, the letter does require that the water quality in the cooling lake be maintained so that it does not adversely affect ground water quality (KDHE 1975b).

A review of recent NPDES Discharge Monitoring Reports and interviews with KDHE staff familiar with the NPDES compliance program verified that there have never been any violations or compliance issues related to the permitted discharges from WCGS. The Discharge Monitoring Reports (WCNOC 2007e) document that deficiencies are sometimes reported due to discrepancies between the weekly sampling period versus a monthly compliance period. However, these do not represent actual exceedances of parameters in the discharge. KDHE staff indicated that one issue related to the location of sampling to demonstrate compliance for pH levels was resolved in about 2000, but that no other violations or incidents of non-compliance had occurred during the facility's operating history.[c]

2.2.3.1.4 WCGS Environmental and Radiological Monitoring

Both WCNOC and the KDHE operate ongoing sampling programs to evaluate any potential impacts of facility operations on local surface water quality. Samples collected to monitor for potential releases of radionuclides to surface water include surface water samples, drinking water samples, shoreline sediment samples, bottom sediment samples, aquatic vegetation samples, and fish tissue samples. The samples are analyzed for gamma-emitting radionuclides typically released in radioactive gaseous and liquid effluents. These radionuclides include Mn-54, Fe-59, Co-58, Co-60, Zn-75, Cs-134, and Cs-137. Sampling and analysis are also

[c] Minutes for meeting on water and ecological issues held on March 14, 2007. Participants included: NRC, Earth Tech, and KDHE. (Accession No. ML072250572).

performed for radioactive iodine and tritium. The environmental samples are analyzed with sensitive radiation detection instruments capable of detecting radioactivity at very low levels in the environment.

The WCNOC program is operated in accordance with the WCGS ODCM and the results are documented within the Annual Radiological Environmental Operating Reports. The most recent report was completed in April 2007 for the calendar year 2006 (WCNOC 2007f). The components of the 2006 WCNOC monitoring program related to surface water quality are described in Table 2-3.

Table 2-3. Summary of 2006 WCNOC Surface Water Quality Monitoring Program

Sample Type	Location	Indicator or Control	Number of Samples in 2006 Program	Required by ODCM?	Analytes
Surface Water	"JRR", on John Redmond Reservoir	Control	12	Yes	Gamma isotopic (monthly), tritium (quarterly)
Surface Water	"SP", located on Coffey County Lake, near the spillway	Indicator	12	Yes	Gamma isotopic (monthly), tritium (quarterly)
Drinking Water	BW-15, Town of Burlington, from Neosho River intake.	Control	12	Yes	Gamma isotopic, I-131, gross beta (monthly), tritium (quarterly)
Drinking Water	NF-DW, Town of Neosho Falls, from Neosho River intake	Indicator	12	Yes	Gamma isotopic, I-131, gross beta (monthly), tritium (quarterly)
Drinking Water	IO-DW, Town of Iola, from Neosho River intake	Indicator	12	No	Gamma isotopic, I-131, gross beta (monthly), tritium (quarterly)

Table 2-3. (cont'd)

Sample Type	Location	Indicator or Control	Number of Samples in 2006 Program	Required by ODCM?	Analytes
Shoreline Sediment	JRR (John Redmond Reservoir)	Control	2	Yes	Gamma isotopic
Shoreline Sediment	DC (Coffey County Lake Discharge Cove)	Indicator	2	Yes	Gamma isotopic
Bottom Sediment	JRR (John Redmond Reservoir)	Control	2	No	Gamma isotopic
Bottom Sediment	DC (Coffey County Lake Discharge Cove)	Indicator	2	No	Gamma isotopic
Bottom Sediment	EEA (Environmental Education Area)	Indicator	1	No	Gamma isotopic
Bottom Sediment	MUDS (Makeup Discharge Structure)	Indicator	1	No	Gamma isotopic
Aquatic Vegetation	EEA (Environmental Education Area)	Indicator	1	No	Gamma isotopic
Aquatic Vegetation	MUDS (Makeup Discharge Structure)	Indicator	2	No	Gamma isotopic
Fish Tissue	JRR (John Redmond Reservoir)	Control	6 (3 species collected in 2 sampling events	Yes	Gamma isotopic, tritium
Fish Tissue	Coffey County Lake	Indicator	10 (5 species collected in 2 sampling events)	Yes	Gamma isotopic, tritium

Source: WCNOC 2007f

The KDHE ERS Program is similar in scope to the WCNOC annual program and the results are reported in the Reports of Radiological Environmental Monitoring of the Environs Surrounding Wolf Creek Generating Station. The latest available version of this report covers the time period from July 2005 to June 2006 (KDHE 2006a). A summary of the surface water-related components of the KDHE program is provided in Table 2-4.

Table 2-4. Summary of 2005-2006 KDHE Surface Water Quality Monitoring Program

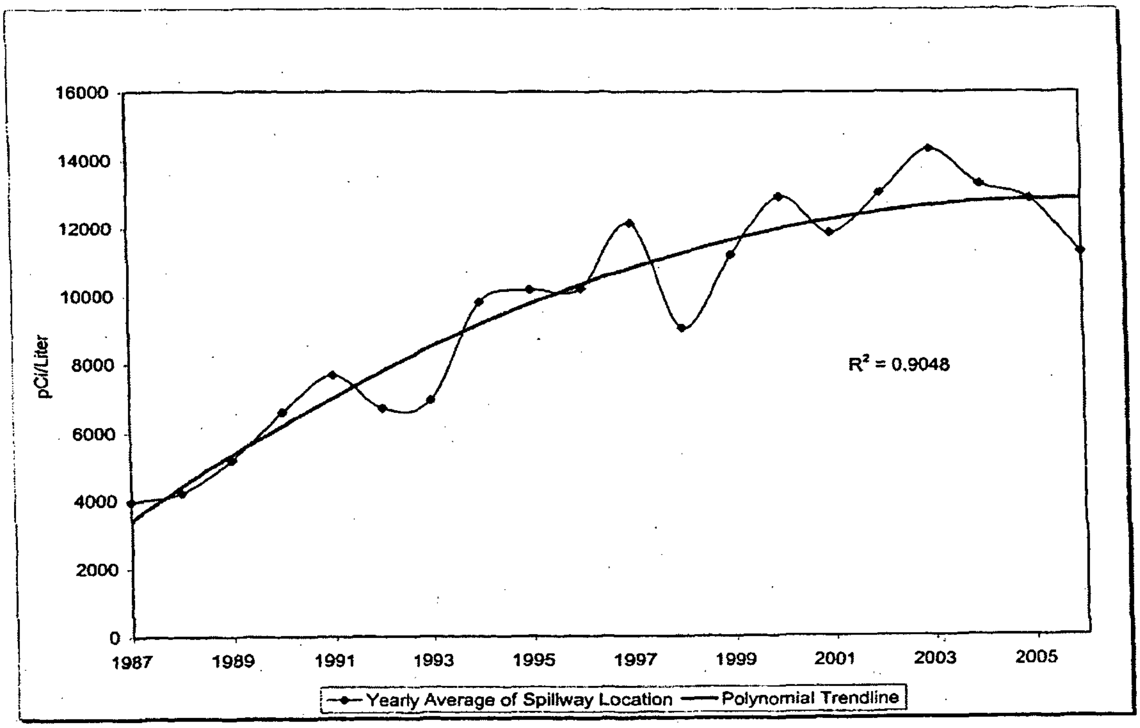
Sample Type	Location	Indicator or Control	Number of Samples in 2005-2006 Program	Analytes
Surface Water	John Redmond Reservoir, at MUSH, below dam	Control	12	Gamma isotopic, tritium.
Surface Water	Coffey County Lake, spillway	Indicator	12	Gamma isotopic, tritium.
Surface Water	Coffey County Lake, public fishing area near Makeup Discharge Structure (MUDS)	Indicator	9	Gamma isotopic, tritium.
Surface Water	Neosho River, near Leroy	Indicator	9	Gamma isotopic, tritium.
Surface Water	New Strawn City Lake	Indicator	1	Gamma isotopic, tritium.
Shoreline Sediment	John Redmond Reservoir	Control	1	Gamma isotopic
Shoreline Sediment	Coffey County Lake Discharge Cove	Indicator	1	Gamma isotopic
Shoreline Sediment	Wolf Creek	Indicator	1	Gamma isotopic
Shoreline Sediment	Makeup Discharge Structure (MUDS)	Indicator	1	Gamma isotopic
Shoreline Sediment	6 samples at Coffey County Lake (2), Neosho River (1), Neosho River Burlington (1), Neosho River South of Leroy (1), and Neosho River North of Burlington (1)	Indicator	6 random locations selected for 1 sample each	Gamma isotopic
Bottom Sediment	John Redmond Reservoir	Control	1	Gamma isotopic
Bottom Sediment	Coffey County Lake Discharge Cove	Indicator	1	Gamma isotopic
Bottom Sediment	Environmental Education Area	Indicator	1	Gamma isotopic

Table 2-4. (cont'd)

Sample Type	Location	Indicator or Control	Number of Samples in 2005-2006 Program	Analytes
Bottom Sediment	9 samples at Coffey County Lake	Indicator	9 random locations selected for 1 sample each	Gamma isotopic
Aquatic Vegetation	John Redmond Reservoir below the dam	Control	1	Gamma isotopic
Aquatic Vegetation	Coffey County Lake Makeup Discharge Structure (MUDS)	Indicator	1	Gamma isotopic
Aquatic Vegetation	Coffey County Lake Discharge Cove	Indicator	1	Gamma isotopic
Aquatic Vegetation	Environmental Education Area	Indicator	1	Gamma isotopic
Aquatic Vegetation	Wolf Creek 11th Street Bridge	Indicator	1	Gamma isotopic
Aquatic Vegetation	7 samples at Coffey County Lake West End (3), Coffey County Lake 17th Road Bridge (1), US75 near 8th Road (1), 9th and Trefoil (1), and 19th and Iris (1)	Indicator	7 random locations selected for 1 sample each	Gamma isotopic
Fish Tissue	John Redmond Reservoir, below dam on Neosho River	Control	4 (2 species collected in November sampling event, 2 species collected in May sampling event)	Gamma isotopic, tritium
Fish Tissue	Coffey County Lake Discharge Cove	Indicator	8 (4 species collected in October sampling event, 4 species collected in May sampling event)	Gamma isotopic, tritium

Source: KDHE 2006a

The primary conclusion from both the WCNOC 2006 Annual Radiological Environmental Operating Report (WCNOC 2007f) and the KDHE 2006 Report of Radiological Environmental Monitoring (KDHE 2006a) is that tritium, which is attributable to facility operations, has been detected in the surface water and fish tissue samples from Coffey County Lake. The historical trend of tritium concentrations in the Coffey County Lake surface water samples is presented in Figure 2-7. These results show that tritium concentrations in Coffey County Lake have risen



Source: WCNOC 2007e

Figure 2-7. Coffey County Lake Surface Water Tritium Data steadily since operations began in 1985. This trend is consistent with pre-operational estimates that liquid effluents would produce a tritium concentration in Coffey County Lake of approximately 23,000 picoCuries per liter (pCi/L; NRC 1975). The maximum and average tritium concentrations in Coffey County Lake surface water and fish samples from 2005 to 2006 are provided in Table 2-5.

Table 2-5. Summary of 2005-2006 Tritium Concentrations in Surface Water and Fish Samples

Sampling Program	Surface Water, Coffey County Lake picoCuries per liter (pCi/l)		Fish, Coffey County Lake picoCuries per kilogram-wet (pCi/kg-wet)	
	Maximum Tritium Concentration	Average Tritium Concentration	Maximum Tritium Concentration	Average Tritium Concentration
WCNOC	14,627	11,286	14,745[1]	9,472[1]
KDHE	12,704	10,700	12,864[2]	6,709[2]

1 – The analytical methods for the tritium analysis differ between the WCNOC and KDHE samples. WCNOC samples are analyzed for tritium content contained within the water of the fish tissue, while the KDHE samples are analyzed for tritium concentrations in both the fat and water of the tissue (KDHE 2006a). Therefore, results are not expected to be directly comparable.

2 – Results from two samples rejected because they exceeded tritium concentration in water in the lake.

Sources: WCNOC 2007f and KDHE 2006a

Both the WCNOC annual report (WCNOC 2007f) and KDHE annual report (KDHE 2006a) provide an evaluation of the risk posed to humans from exposure to tritium concentrations in the surface water and fish in Coffey County Lake. Both reports note that Coffey County Lake is not used as a drinking water source and the lake is not approved for any recreational activity other than fishing. The KDHE report provides a dose assessment for a standard man consuming 21 kilograms per year (kg/yr) of fish from Coffey County Lake and calculates that the man would receive a committed effective dose equivalent of 0.017 millirems (mrem) (KDHE 2006a). WCNOC performs a similar calculation that results in a committed effective dose equivalent of 0.019 mrem. These calculations are compared to the 100 mrem regulatory limit for a member of the public (KDHE 2006a).

With respect to other locations and other radionuclides, the KDHE report concludes that no other surface water samples from outside of the Coffey County Lake detected radionuclides attributable to WCGS operations. Similarly, none of the aquatic vegetation samples showed any radionuclides attributable to WCGS (although these samples were not analyzed for tritium). The report did conclude that sediment samples from Coffey County Lake had detected the fission product ^{137}Cs (196 picoCurie per kilogram [pCi/kg] –dry; KDHE 2006a). In the KDHE 2004 to 2005 sampling program, sediment samples were also reported to contain the activation product ^{60}Co at a concentration of 264 pCi/kg-dry (KDHE 2005).

2.2.3.2 Groundwater

The WCGS facility is located in the Central Lowland physiographic province of Kansas. The geology of the area consists of Pennsylvanian sedimentary rocks including shale, sandstone, limestone, and coal beds (WCNOC 2006a). Groundwater in the area occurs in three different types of aquifers including:

- Alluvial aquifers contained within unconsolidated Quaternary and Tertiary sand and gravel deposits along rivers and streams, including the Neosho River;
- Weathered bedrock aquifers occurring within a weathered zone on the surface of the sedimentary rock units; and
- Consolidated bedrock aquifers occurring within unweathered sandstones and limestones.

In general, groundwater quantity and flow rates are highest within the alluvial aquifer. Near the facility, the width of alluvium adjacent within the Neosho River valley ranges from 1 to 10 miles and is approximately 20 ft thick (WCNOC 2006a). Yield from wells within this aquifer are up to 100 gpm (WCGS 1980). The alluvial sands and gravels are hydraulically connected to the Neosho River, so water levels and water quality within the aquifer are directly tied to those within the river (WCNOC 2006a).

The weathered bedrock aquifer may be up to 40 ft thick and wells may yield up to 10 gpm (NRC 1975). This aquifer is hydraulically connected to the alluvial aquifer and local streams (WCNOC 2004c, in WCNOC 2006a).

The consolidated bedrock aquifers are found within the sandstone and limestone units. These aquifers may yield from 1 to 10 gpm. Because of the interbedding of the sandstones and limestones with shales, vertical recharge to these aquifers may be limited and recharge may only occur in area where the units crop out (WCNOC 2004c, in WCNOC 2006a). At the facility, test holes drilled to evaluate the hydrogeology of the site identified a possible aquiclude at a depth of 40 ft (NRC 1975).

Regional and local groundwater flow directions in all three aquifer units are southwest towards the Neosho River (NRC 1975).

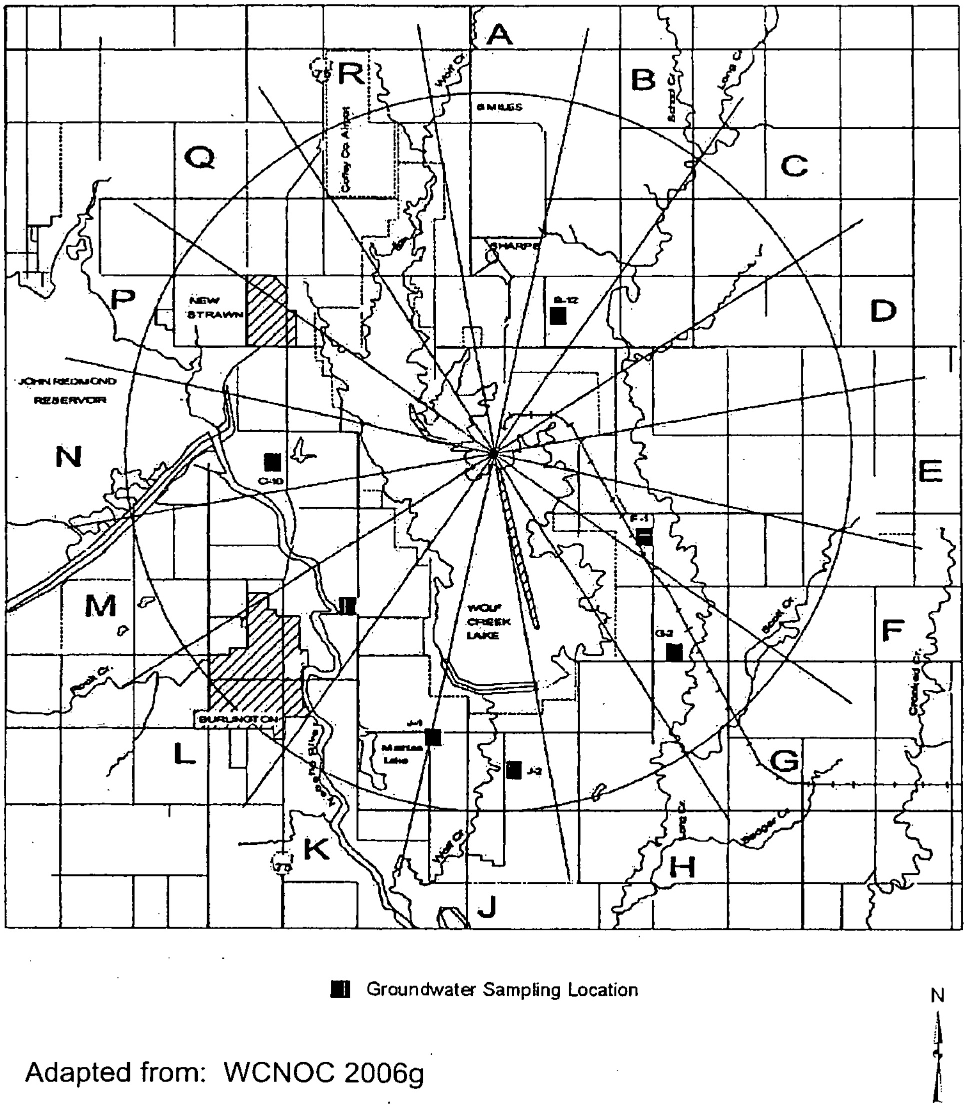
The use of groundwater within the local area is limited. The WCGS facility does not use groundwater for any purpose (WCNOC 2006a). None of the municipalities or public water supply systems within the local area use groundwater as a source of water (EPA 2005). A pre-construction well inventory conducted in 1973 identified 198 wells within 5 miles of the facility. These wells are used mostly for domestic water supply and livestock purposes (WCNOC 2006a). A review of the Kansas Geological Survey well location database identified a total of 92 wells located within 2 miles of the facility and/or located between Coffey County Lake and the Neosho River (KGS 2007). Most of these wells appear to have been installed by WCNOC for investigation of the facility prior to construction, or they are monitoring wells associated with a Coffey County Landfill southwest of Coffey County Lake. The wells include the following:

- 47 wells installed between 1977 and 1980, in the area of the facility and Coffey County Lake dam, that appear to have been installed as part of the investigation process for facility construction;
- 8 dewatering wells installed by WCNOC in 1991;
- 24 monitoring wells installed by Coffey County;
- 5 former domestic wells that are listed as plugged;
- 1 domestic well installed in 2001, as used for lawn and garden purposes only;
- 1 domestic well installed in 2002, listed as used for a closed-loop heat pump system; and
- 1 domestic well installed in 1975 and possibly still used for domestic purposes.

A groundwater quality study was performed at the site prior to and shortly after operations began. This study was conducted from 1973 to 1987 and consisted of the sampling and analysis of a total of 12 wells within 5 miles of WCGS (EA 1988). All sampled wells were pre-existing, shallow wells for which no construction or depth data were provided. This study concluded that there were no observable impacts on groundwater quality after Coffey County Lake was filled or for 2 years after WCGS began operations (EA 1988).

As discussed in Section 2.2.3.1, both WCNOC and the KDHE operate ongoing sampling programs to evaluate any potential impacts of facility operations on the local environment. Both of these programs include periodic sampling of groundwater wells to evaluate any potential impacts to groundwater quality from facility operations. A map showing the locations of the wells included in both programs is provided in Figure 2-8.

The WCNOC sampling program is described in the Annual Radiological Environmental Operating Report. The most recent of report was completed in April 2007 for the calendar year 2006 (WCNOC 2007f). The components of the 2006 WCNOC monitoring program related to groundwater quality are described in Table 2-6.



Adapted from: WCNOC 2006g

Figure 2-8. Groundwater Sampling Location Map

Table 2-6. Summary of 2006 WCNOC Groundwater Quality Monitoring Program

Sample Type	Location	Indicator or Control	Number of Samples in 2006 Program	Required by ODCM?	Analytes
Groundwater	B12 (2 miles northeast)	Control	4	Yes	Gamma isotopic, I-131, tritium
Groundwater	C10 (3 miles west)	Indicator	4	Yes	Gamma isotopic, I-131, tritium
Groundwater	C49 (3 miles southwest)	Indicator	8 (4 quarterly samples, and 4 duplicate samples labeled L-49)	Yes	Gamma isotopic, I-131, tritium
Groundwater	J1 (4 miles south)	Indicator	4	Yes	Gamma isotopic, I-131, tritium
Groundwater	F1 (2 miles southeast)	Indicator	4	Yes	Gamma isotopic, I-131, tritium
Groundwater	G2 (3 miles southeast)	Indicator	4	Yes	Gamma isotopic, I-131, tritium
Groundwater	J2 (4 miles south)	Indicator	4	Yes	Gamma isotopic, I-131, tritium

Source: WCNOC 2007f

A summary of the groundwater-related components of the 2005 to 2006 KDHE monitoring program is provided in Table 2-7.

Table 2-7. Summary of 2005-2006 KDHE Groundwater Quality Monitoring Program

Sample Type	Location	Indicator or Control	Number of Samples in 2005-2006 Program	Analytes
Groundwater	B12 (2 miles northeast)	Control	1	Gross alpha, beta, gamma isotopic, tritium
Groundwater	C10 (3 miles west)	Indicator	1	Gross alpha, beta, gamma isotopic, tritium

Table 2-7. (cont'd)

Sample Type	Location	Indicator or Control	Number of Samples in 2005-2006 Program	Analytes
Groundwater	L49 (not clear, but apparently the same as C-49, 3 miles southwest)	Indicator	1	Gross alpha, beta, gamma isotopic, tritium
Source: KDHE 2006a				

The primary conclusion from both the WCNOC 2006 Annual Radiological Environmental Operating Report (WCNOC 2007f) and the KDHE 2006 Report of Radiological Environmental Monitoring (KDHE 2006a) is that there has been no release of radionuclides attributable to facility operations identified.

In 2006, three existing wells on the WCGS site were sampled: one located within the auxiliary building and two dewatering wells located near the Essential Service Water line[d] (KDHE 2006a). The results from these wells indicated tritium concentrations in groundwater of approximately 1,400 pCi/L (WCNOC 2007g). This concentration is interpreted to indicate that the effluent line is not leaking. The elevated tritium concentration in the water is attributed either to use of Coffey County Lake water for fire fighting exercises or infiltration of Coffey County Lake water to the groundwater[d]. These wells have been added to the KDHE monitoring program for 2006 to 2007 (KDHE 2006b). Additional groundwater monitoring is currently being planned and is to be completed by early 2008 [d].

2.2.4 Air Quality

WCGS is located in the southeastern portion of Kansas, approximately 50 miles south of Topeka, in Coffey County. The climate is continental, characterized by rapid changes in temperature. The topography of the area is undulating with no particularly significant terrain features to cause orographic effects with respect to seasonal rainfall. Also, there are no large bodies of water in the vicinity to significantly influence the climate (WCNOC 2006a). This area is near the geographical center of the United States, in the middle of the temperate zone. Several rivers flow in an easterly direction to the Mississippi River in this rolling prairie upland. In the transitional spring and fall seasons, the numerous days of fair weather are interspersed with short intervals of stormy weather. Strong, blustery winds are quite common in late winter and spring. Autumn is characteristically a season of warm days, cool nights, and infrequent

[d] Minutes on meeting discussing tritium in surface and groundwater held on March 13, 2007. Participants included: NRC, Earth Tech, WCNOC, and others. (Accession No. ML072250572).

precipitation, with cold air invasions gradually increasing in intensity as the season progresses (NOAA 2004)

The State of Kansas is generally characterized as having cold winters and warm summers. The weather can change suddenly with violent blizzards, thunderstorms, and tornadoes. The mass of the North American continent drives the climate on local scales, with air temperatures to the south being less extreme than those to the north. For example, northern Kansas experiences colder temperatures than southern Kansas, but the differences are often slight. Cold air from the north moves across the flat American plains, moderating as it travels southward. The north part of the State has average January temperatures below 26°F, while the south is at 32°F. Hot winds from the south give the State warm summers, with the northwest having milder summer temperatures. The northwest part of the State has average July temperatures below 78°F, while the south is generally above 80°F. The highest temperature ever recorded in the State was 121°F at Fredonia on July 18, 1936 and on July 24, 1936 at Alton. The lowest recorded temperature, -40°F, occurred at Lebanon on February 13, 1905 (NOAA 2007a).

More specifically to the portion of Kansas where in the WCGS is located, the summers are hot with low relative humidity and persistent southerly winds. Oppressively warm periods with high relative humidity are usually of short duration. Winter temperatures average about 45° cooler than the summer. Cold spells are seldom prolonged. Only on rare occasions do daytime temperatures fail to rise above freezing. The average annual temperature at Topeka is 55°F with a high monthly average of 79°F in July and a low monthly average of 28°F in January. Individual summers show wide departures from average conditions. While the hottest summers may produce temperatures of 100°F or higher on more than 50 days, 25 percent of the summers pass with two or fewer 100°F days (NOAA 2004).

Precipitation amounts vary throughout the State of Kansas. The southeast usually gets 40 in. of rain a year and the western boundary of the State receives only 18 in. Snowfall in the State averages about 17 in. a year (NOAA 2007b). For the Topeka / WCGS area precipitation has shown a wide range for June, July, and August, varying from under 3 in. to more than 27 in. during the three summer months. Winter precipitation is often in the form of snow, sleet, or glaze. Storms of such severity that prevent normal movement of traffic or interfere with scheduled activity are not common. Seventy percent of the annual precipitation normally falls during the six crop-growing months of April through September. The rains of this period are usually of short duration, predominantly of the thunderstorm type. They occur more frequently during the nighttime and early morning hours than at other times of the day. Excessive precipitation rates may occur with warm-season thunderstorms. Rainfall accumulations over 8 in. in 24 hours have occurred in Topeka.

Severe weather and tornadoes have occurred in the area on several occasions causing major damage. A comparison of the tornado wind speed estimates for nuclear power plants within the

United States shows that WCGS is among those with the highest potential wind speed for a given probability. For example, the range of wind speeds for tornadoes having a 1-in.-10^{-5} probability of striking a 200-ft long building at all nuclear power plants in the United States ranges from less than 65 to 168 mph. The predicted wind speed at WCGS is 167 mph with only 3 facilities having a higher projected wind speed of 168 mph (NRC 2007).

The prevailing winds in southeast Kansas are likely to be from the north in the winter and spring, and tend to be more southerly the remainder of the year (NOAA 2004).

Coffey County, in which WCGS is located, is part of the Southeast Kansas Interstate Air Quality Control Region. Kansas, including Coffey County, is currently in attainment for all pollutants, including ozone, carbon monoxide, lead, nitrogen dioxide, sulfur dioxide, and particulate (including PM_{10} and $PM_{2.5}$) (KDHE 2006a). Under the Clean Air Act, the EPA established National Ambient Air Quality Standards (NAAQS) for specific concentrations for the above mentioned pollutants. Areas having monitored air quality as good or better then these standards (i.e., lower than the NAAQS) were designated attainment areas for the various pollutants. Areas having monitored pollutant levels greater then these standards were designated as non-attainment areas.

The counties of Johnson and Wyandotte (Kansas City) located 49 and 67 miles, respectively, from WCGS, were previously designated as maintenance areas for the 1-hour ozone standard. A maintenance area is an area that was once designated as non-attainment and has been subsequently re-designated as attainment upon meeting the standards. On April 15, 2004, the EPA administrator implemented designation for areas of the country with respect to the more recent ozone 8-hour standard (69FR23858). The EPA rule for implementing the 8-hour ozone standard called for areas that were previously classified as maintenance under the 1-hour ozone standard (i.e., Kansas's Johnson and Wyandotte Counties) and were attainment for the 8-hour ozone standard to put in place a plan to maintain the 8-hour ozone standard for a ten year period. Thus, Kansas was required to develop a plan to maintain the 8-hour ozone standard for these two counties; essentially, classifying them as maintenance areas under the 8-hour ozone standard (WCNOC 2006a). The ozone monitoring results for 2004 showed that the nine ozone monitor sites in Kansas were well below the 1-hour ozone standard. A few of the sites were fairly close to, but still below, the 8–hour ozone standard (KDHE 2006a).

There are no designated Class I Federal areas within a 50-mi radius of the WCGS. The closest non-attainment area for particulate ($PM_{2.5}$) and the 8-hour ozone standard is St. Louis, Missouri, approximately 235 miles from WCGS (WCNOC 2006a). WCGS operates under an Air Emission Source Class II Operating Permit issued by KDHE, Source ID No. 0310021. The facility operates an auxiliary boiler, an emergency fire pump, and a series of engine/generator sets used to produce electricity during emergency conditions only. Temporary boilers and internal combustion engines are operated at the facility on an "as needed" basis. This permit regulates the emissions of nitrogen oxides (NOx) and sulfur dioxides (SO_2). No exceedances have occurred during the operational life of the facility.

2.2.5 Aquatic Resources

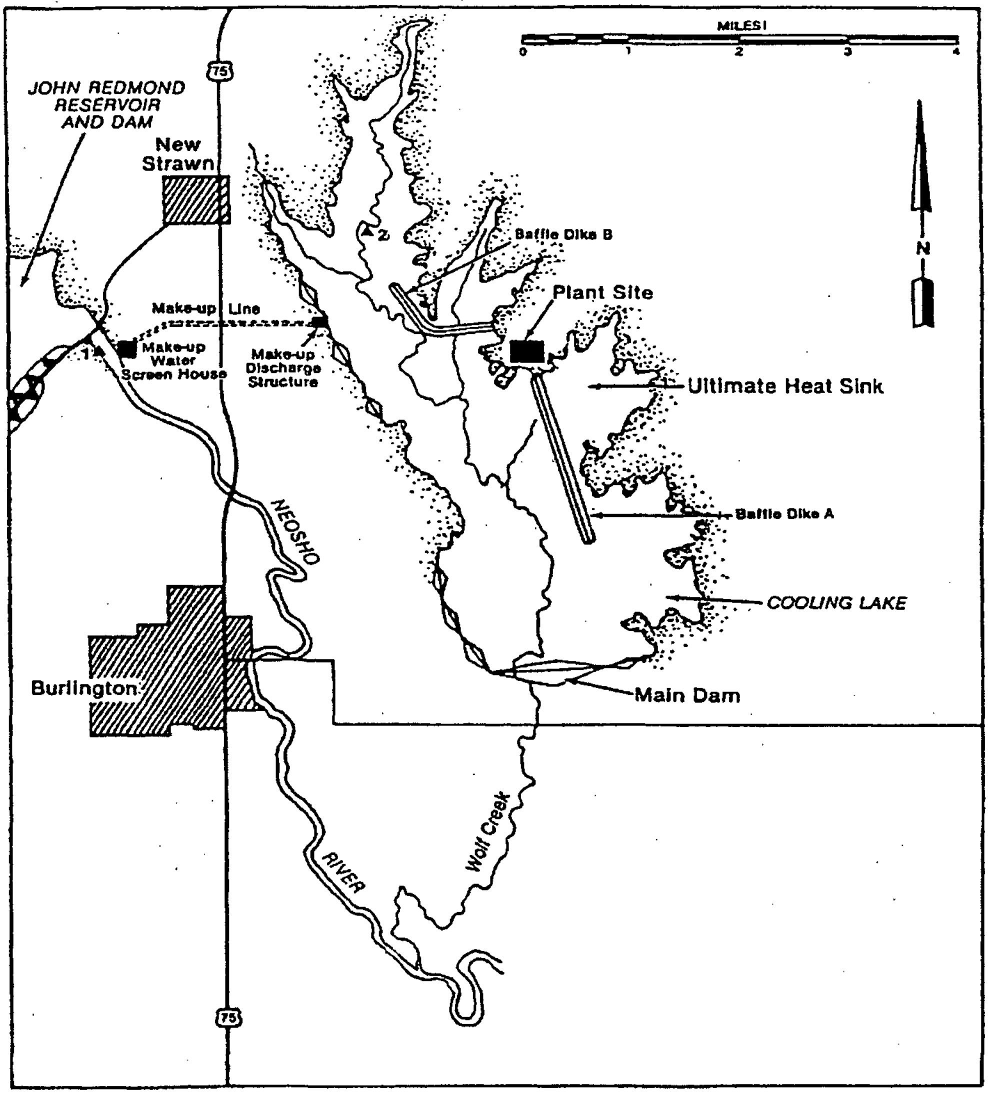
The aquatic resources relevant to the operation of WCGS are those within the Neosho River Basin that are associated with Coffey County Lake and the transfer of water between it and the Neosho River and John Redmond Reservoir. The spatial relationships of these water bodies are shown in Figure 2-9. This section provides a description of the aquatic resources potentially affected by the operations of the WCGS.

2.2.5.1 Water Body Characteristics

2.2.5.1.1 Wolf Creek and Coffey County Lake

Wolf Creek is a small intermittent tributary of the Neosho River that begins to the north of Coffey County Lake (the "cooling lake") approximately 0.75 mile southwest of Halls Summit (WCGS 1974). WCGS (1980) reported Wolf Creek as having a drainage area of approximately 27.4 sq mi above the Coffey County Lake and including the lake itself in the 1980 "operating stage" Environmental Report. The total drainage area reported in the 1974 WCGS ER was 35 sq mi while the amount of drainage area downstream of the lake is approximately 8 sq mi. The gradient of Wolf Creek downstream of the lake is approximately 3.7 feet per mile (ft/mi; WCGS 1974).

Prior to construction of the lake, the creek's substrate was described as a mixture of silt, clay, sand, and gravel and often covered by leaf litter (Ecological Analysts, Inc. 1981). No information is available on the current creek substrate downstream of the dam. Wolf Creek is subject to brief periods of high flow following snowmelt or stormwater runoff and long periods of low or zero flow that may leave only pools of water (Ecological Analysts, Inc. 1981). Wolf Creek gains some water from the groundwater system, but the quantities are small because of the low permeability of the bedrock strata (WCGS 1974). The extreme changes in stream flows significantly affect water chemistry and temperature. The quality of water in Wolf Creek was generally poor during pre-construction monitoring conducted from 1976 to 1980 (Nalco Environmental Sciences 1976 to 1978, Hazelton Environmental Sciences 1979 -1980). The total annual flow for Wolf Creek is approximately 12,985 ac-ft or 18 cfs (WCNOC 2006a). Wolf Creek contributes approximately one percent of the 1,865 cfs average Neosho River water flow measured at Iola (Putnam and Schneider 2005), which is downstream of the confluence of Wolf Creek with the Neosho River.



Adapted from: EA 1988

Figure 2-9. Surface Water Bodies Associated with WCGS

Coffey County Lake was created by erecting an earthen dam across Wolf Creek approximately 6 miles upstream from its confluence with the Neosho River (NRC 1975). The dam, along with five perimeter saddle dams, serves to impound Wolf Creek approximately 5 miles upstream from its confluence with the Neosho River (KG&E 1986). Filling of Coffey County Lake (then known as Wolf Creek Cooling Lake) began in October 1979 and was completed in June 1982 using water from John Redmond Reservoir (EA 1988).

The tops of the dams are at an elevation of 1,100 ft above MSL to allow for sufficient freeboard. Service and auxiliary spillways with ogee crests of 1,088 ft above MSL and 1,090.5 ft above MSL were constructed on the east abutment of the main dam to prevent overtopping of the dams by the probable maximum flood and wind and wave action. The normal operating elevation of Coffey County Lake is 1,087 ft above MSL. At this elevation the lake has a capacity of 111,280 ac-ft and covers 5,090 ac (WCNOC 2007c), with a maximum depth of 60 ft (KDWP 2007a) and an average depth of 21.5 ft (KG&E 1986). At this pool level, the lake is designed to provide adequate cooling water to the plant during a 1-in-50-year drought.

The water level in the Lake is normally maintained by the watershed; however, during dry months, it is sometimes necessary to pump water to the lake from the Neosho River just below the John Redmond Reservoir dam. As previously discussed in Section 2.2.2, water is pumped from an intake in the Neosho River immediately downstream of John Redmond Reservoir when additional water is required to maintain adequate levels in Coffey County Lake. If the flow rate within the Neosho River is below 250 cfs downstream of the intake, then water may be purchased from the conservation pool within John Redmond Reservoir using a bypass pipe that can withdraw 70 cfs (WCNOC 2006a).

WCGS has several dominant structures on Coffey County Lake including the CWS, UHS, Baffle Dikes A and B, and the dams on the south side of Coffey County Lake. The CWS is the most influential of these structures (KG&E 1986). This system is capable of dissipating facility operating heat using a transfer of up to 1,114 cfs of lake water through the system (KG&E 1986). The resulting maximum increase in discharged water temperature is 30°F, but the normal temperature increase ranges from 0.8°F to 7.6°F.

Within the impoundment, two baffle dikes and two canals having inverts at 1,070 ft above MSL were built to prevent short circuiting of the water flowing from the circulating water discharge to the CWIS. The impoundment canals are 215 ft wide with slopes of the canal sides at 1 ft vertical per 3 ft horizontal. The volumetric flow rates in these canals are assumed to be 1,256 cfs at a water velocity of 0.87 fps when the impoundment water level is at 1,087 ft above MSL.

The UHS lies to the southeast of WCGS and is an approximate 100-ac basin within Coffey County Lake that is confined by an armored, submerged dam (KG&E 1986). The UHS is designed to retain the water essential to station cooling in the event of a failure of the CWS or the main dam (KG&E 1986).

During times of flooding, service and auxiliary spillways provide for controlled release of lake water to prevent overtopping of the Coffey County Lake dam. Although the dam has provisions for releasing water to Wolf Creek (blowdown for chemistry control), such release is infrequently performed.

The service spillway and auxiliary spillway are on the east abutment of the main dam. The service spillway is an uncontrolled concrete ogee-crested semicircular spillway. Crest length is 100 ft and crest elevation is 1,088 ft. This concrete service spillway is approximately 14 ft high and discharges water via a concrete chute to a stilling basin.

The blow down structure is located near the west abutment of the main dam. The outlet is provided with a 60-in. diameter outlet pipe. A 30-in. diameter blowdown pipe branches from the outlet pipe. This blowdown system is designed to blow down water to regulate the water quality of Coffey County Lake.

A strong north wind causes waves to break over the spillways, thus causing a release of water to Wolf Creek. Per the facility's NPDES permit, sampling must be conducted whenever a discharge occurs. Discharge occurs relatively infrequently. In 1997, there were six separate discharge events, 34 in 1988, 19 in 1999, three in 2000, one in 2001, none in 2002 to 2004, seven in 2005, and two in 2006.

The main dam on Coffey County Lake is classified as a high hazard, based on a new dam classification system for the State of Kansas. High hazard dams are to be inspected by the State every 3 years. As a result of the implementation of this classification system, every 3 years a registered professional engineer would inspect the dam for the WCNOC and submit a report of findings to the State.

The plant also evaluates the degree of seepage through the dam on a regular basis. Measurements are taken at a seepage weir below the dam. These measurements are collected quarterly and recorded. Over the last four years (2002 to 2006), the measured seepage rate has been determined to be less than 0.01 cfs. According to plant personnel, Coffey County Lake is not routinely dredged in association with plant operations. The UHS has been dredged at least once since the plant went on-line. Dredging has occurred in association with the county-operated boat ramp on the west side of the lake.

2.2.5.1.2 Neosho River and John Redmond Reservoir

The Neosho River rises northwest of WCGS in Morris County and flows generally southeasterly approximately 450 miles across Kansas and Oklahoma to its confluence with the Arkansas River near Fort Gibson, Oklahoma. The Neosho River Basin in Kansas encompasses approximately 6,300 sq mi within 18 counties in southeastern Kansas (KWO 2004). The Neosho River has one major tributary in Kansas, the Cottonwood River, that originates in Marion County and flows east to join the Neosho River near Emporia, Kansas.

Several city and county lakes and three Federal water reservoirs (Council Grove, Marion, and John Redmond), authorized by the Flood Control Act of 1950 and built in the 1960s (USACE 2007a,b,and c), occur within the Neosho River Watershed in Kansas. The reservoirs were built to provide flood relief and to serve as water supply reservoirs, but also provide important fish and wildlife habitat and create recreational opportunities. Council Grove Reservoir is a 3,310-ac impoundment on the northern portion of the Neosho River (KDWP 2007b) approximately 65 river-mi upstream of the Neosho River-Wolf Creek Confluence. Marion Reservoir is a 6,160-ac impoundment on the Cottonwood River (KDWP 2007c) approximately 105 river-mi upstream of the Neosho River-Wolf Creek confluence. John Redmond Reservoir is a 9,400-ac impoundment on the Neosho River (KDWP 2007d) 3.5 miles west of WCGS and approximately 8 river-mi upstream of the Neosho River-Wolf Creek confluence. All three reservoirs are managed by the U.S. Army Corp of Engineers (USACE).

The John Redmond Reservoir was created by the construction of John Redmond Dam approximately 3 miles north and 1 mile west of Burlington, Kansas. The dam and reservoir were completed for full flood control in September 1964 (USACE 2007b). John Redmond Reservoir has a surface area of 9,400 ac with an average depth of 6 ft and a maximum depth of 12 ft (KDWP 2007d). The reservoir contains three types of water storage, separated by zones from the top to the bottom of the lake. The upper zone provides flood control storage and is empty until a flood event. The intermediate zone is the conservation pool that is used for water supply storage. The lowest zone designated for inactive storage is currently filled with sediment (USACE 2002). The current water supply conservation pool of John Redmond Reservoir is now at 1,039-ft national geodetic vertical datum (NGVD; USACE 2007b). The amount of water-supply storage in the conservation pool has been reduced by unplanned sedimentation (USACE 2002).

The reservoir bottom is shallow and flat, which allows for a rapid vegetative response when water is lowered (Jirak 2005). Management of John Redmond Reservoir currently involves a drawdown to 1,037 ft above MSL to encourage vegetation growth and a raise to 1,041 ft above MSL in the fall for waterfowl (Jirak 2005).

The wide channel of the Neosho River as it enters John Redmond Reservoir contributes to the creation of a mudflat near the entrance. (USACE 2005). The mudflat has allowed for the collection of a logjam of woody debris (USACE 2005). This logjam has been accumulating at the entrance of the Neosho River into John Redmond Reservoir and is now estimated to be 1.5 miles long from John Redmond Reservoir upstream (USACE 2005). It is possible that this logjam may represent an impediment to fish movement between the river and John Redmond Reservoir (USACE 2002). However, rapid removal of the logjam could lead to increased sedimentation of the John Redmond Reservoir conservation pool. A Feasibility Study is currently being conducted to evaluate the ecosystem restoration of John Redmond Reservoir and will include evaluation of sediment deposition in John Redmond Reservoir, potential remediation of the Neosho River logjam, and alternatives to manage the excessive nutrient loads currently entering the reservoir (USACE 2007d).

The Neosho River in the 180-mi reach from below the John Redmond Dam to the Kansas-Oklahoma State line is characterized by a meandering channel with a bed that typically consists of a combination of bedrock, cobble, gravel, sand, and silt (Juracek and Perry 2005). The gravel bottom of the Neosho River is an essential component of the in-stream habitat required for the survival of the threatened Neosho madtom (*Noturus placidus*).

The channel slope of the Neosho River in this 180-mi reach below John Redmond Reservoir averages about 1.2 ft/mi. The riverbank height varies from about 15 to 30 ft with a channel bank that consists of mostly cohesive silt and clay and is typically covered partially or completely by mature trees (Juracek and Perry 2005). Changes in the downstream flow from the John Redmond Dam have included a decrease in the magnitudes of peak flows and an increase in the magnitudes of low flows (Studley 1996).

A study conducted by M. Wildhaber, *et al.* (2000) on the Neosho River, found that the water temperature was cooler, turbidity was higher, and the fredle index (a standard to evaluate the reproductive potential of spawning gravel) was marginally lower above the dam than below the dam. Dissolved oxygen increased downriver of the dam, but conductivity, alkalinity, and hardness were all higher above the dam.

Streamflow gauging stations are operated on the Neosho River above and below WCGS by the U.S. Geological Survey. Annual mean flows for the Neosho at the gauging station at Americus, Kansas (28 miles upstream of John Redmond Reservoir) from 1964 to 2007 have ranged from 28.2 to 1,106 cfs with the average flow being 322 cfs (USGS 2008). Average flows at the Neosho River gauging station near Burlington, Kansas (approximately 5 miles below the John Redmond Dam) from 1964 to 2007 ranged from 190 to 4,982 cfs and averaged 1,604 cfs for the same period (USGS 2008). Flow at the Burlington station has been regulated since the installation and operation of the John Redmond Dam (Putnam and Schneider 2005). The annual mean flow at Iola, Kansas (the next station downstream of the Burlington station, approximately 50 river-mi from the Burlington station) from 1964 to 2007 ranged from 267 to 6,351 cfs and averaged 2,129 cfs (USGS 2008).

The minimum desirable streamflow for the Iola station is 40 cfs during all times of the year (USGS 2007). A minimum flow of 40 cfs in the Neosho River at Iola during the months of July to March, 60 cfs in April, and 200 cfs in May and June is required by the Kansas Water Appropriation Act (Kansas Statutes Annotated [KSA] 82a-703c 2004). These volumes were established as the minimum flows allowable to avoid adverse impacts to the Neosho River instream and riparian habitats (WCNOC 2006a). The notably higher flows in the stations downstream of John Redmond Reservoir reflect the contribution of the Cottonwood River that merges with the Neosho River south of the Americus station and approximately 25 miles northwest of John Redmond Reservoir.

The annual precipitation in the Neosho River basin ranges from 30 in. in the western-most part to 42 in. in the southeastern portion of the basin (KWO 2004). The monthly flow data for the Neosho River basin reflects the seasonal pattern of precipitation that is heaviest between April and September. Stream flows at stations within the Neosho River basin are highest over the April to July period and lowest during the November to February period (Putnam and Schneider 2005).

2.2.5.2 Chemical Contaminants near WCGS

Contaminant concentrations in the aquatic environment at WCGS are monitored on an ongoing basis by WCNOC and KDHE. These agencies operate sampling programs to evaluate any potential impacts of facility operations to surface water, sediment, and aquatic life. Samples collected to monitor for potential releases of radionuclides to surface water include surface water samples, drinking water samples, shoreline sediment samples, bottom sediment samples, aquatic vegetation samples, and fish tissue samples. A summary of surface water and sediment quality, including a description of contaminants detected in surface water and sediment, is presented in Section 2.2.3. The results of analyses of plant and fish tissue and results from toxicity tests on water samples collected at WCGS are summarized below. In addition, the data for those radionuclides related to WCGS operations that were detected in surface water, sediment, soil, and tissue samples are evaluated below to assess the risks they pose to ecological receptors.

2.2.5.2.1 Surface Water Toxicity Testing

As part of the NPDES permit requirements, acute whole effluent toxicity (WET) testing of surface water is conducted on a regular basis at various outfalls associated with WCGS. WET tests are conducted using the water flea (*Ceriodaphnia dubia*) and the fathead minnow

(*Pimephales promelas*). Results are available from November 2000 through June 2006 (WCNOC 2000, 2001, 2002, 2003b, 2004c, 2005b, 2005c, 2006h).

In November 2000, an effluent sample was collected from the point of discharge for outfall 003. At the time the sample was collected, the circulating water was being brominated and wastewater was being released from outfall 003A (radioactive wastewater discharge) and outfall 003B (water treatment plant and wastewater system discharge). The test results are thus an indicator of the cumulative effects of these three events on the test species without consideration of mixing or dilution. The acute WET test was performed using 100 percent effluent and a series of dilutions for an exposure duration of 48 hours. Acute toxicity was defined by statistically significant mortality of at least one of the two species. Significant mortality was not observed for either the water flea or fathead minnow exposed to 100 percent effluent (WCNOC 2000).

Subsequent acute WET tests were conducted in April 2001, June 2002, May 2003, May 2004, June 2005, and June 2006. These acute tests were conducted in generally the same manner as the November 2000 test with some differences in the details. During the April 2001 test, the effluent sample was collected at outfall 003 while the circulating water was treated with a non-oxidizing biocide (Calgon H-130M) and wastewater was released from outfalls 003A and 003B (WCNOC 2001). In June 2002, the effluent sample was collected from outfall 003 while a copper corrosion inhibitor was added to the circulation water and wastewater was released from outfall 003B only (WCNOC 2002). During the May 2003 event, effluent samples were collected from two outfalls: 003 and 006 (ESWS discharge). At the time of sample collection at outfall 003, the biocide Calgon H-130M was added to the circulation water (WCNOC 2003b). In May 2004, an effluent sample was collected from outfall 003 while the biocide Calgon H-130M was added to the circulation water and wastewater was being released from outfalls 003A and 003B (WCNOC 2004c). The June 2005 and June 2006 acute WET tests were performed using an effluent sample collected from the outfall 003X (circulation water and service water discharge) point of discharge, which included three commingled discharges: disinfection of the circulation water system with an oxidizing biocide; release of steam generator blowdown from outfall 003A; and treatment of the fire protection system with the molluscicide Calgon EVAC (WCNOC 2005b, 2006g). Results from the acute WET tests conducted from April 2001 through June 2006 indicated no significant mortality in any of the 100 percent effluent or dilution samples.

In July 2005, a chronic WET test was performed on an effluent sample collected from outfall 004A, the point of discharge from Coffey County Lake to Wolf Creek. This chronic WET test consisted of a 7-day static renewal larval survival and growth test on the fathead minnow and a 7-day static renewal survival and reproduction test on the water flea. As with the acute WET tests, the chronic test was conducted using 100 percent effluent and a series of dilutions. Test results indicated that the 100 percent effluent had no significant effect on larval survival or growth of the fathead minnow or survival or reproduction of the water flea (WCNOC 2005c).

In summary, the acute and chronic WET tests conducted using effluent samples from outfalls 003, 004, and 006 identified no significant toxicity to either of the two test species (water flea and fathead minnow) exposed to 100 percent effluent collected during events such as treatment of the circulation water and discharge of wastewater from outfalls 003A and 003B.

2.2.5.2.2 Radionuclide Concentrations in Tissue Samples

Radionuclide levels in fish and aquatic vegetation are generally monitored on a semiannual basis by WCNOC and KDHE. As discussed in Section 2.2.3.1.4, WCGS Environmental and Radiological Monitoring, the monitoring programs for the two agencies are similar in scope. Tables 2-3 and 2-4 in Section 2.2.3.1.4 summarize the sample locations, number of samples collected, analyses conducted, and additional information for the 2006 WCNOC monitoring program and 2005-2006 KDHE monitoring program, respectively.

Fish samples for both monitoring programs were collected from Coffey County Lake (indicator samples) and from the Neosho River below John Redmond Reservoir (control samples). In the 2006 WCNOC study, five indicator species (channel catfish [*Ictalurus punctatus*], common carp [*Cyprinus carpio carpio*], freshwater drum [*Aplodinotus grunniens*], smallmouth bass [*Micropterus dolomieu*], and smallmouth buffalo [*Ictiobus bubalus*]) were collected in May 2006 and five indicator species (channel catfish, common carp, smallmouth buffalo, white bass [*Morone chrysops]*, and wiper [*Morone saxatilis* x *M. chrysops]*) were collected in October 2006 in Coffey County Lake. Control species included three species (channel catfish, common carp, and white crappie [*Pomoxis annularis*]) collected in May 2006 and three species (channel catfish, largemouth bass [*Micropterus salmoides*], and smallmouth buffalo) collected in November 2006 in the Neosho River below John Redmond Reservoir (WCNOC 2007f). Water samples extracted from edible portions of the fish tissue samples were analyzed for gamma emitting radionuclides and tritium.

Similar species were collected and analyzed for the KDHE report (KDHE 2006a). Four indicator species (channel catfish, common carp, walleye, and white bass) were collected in October 2005 and four indicator species (smallmouth bass, common carp, smallmouth buffalo, and channel catfish) were collected in May 2006 from Coffey County Lake. Two control species were collected during each of two sampling events on the Neosho River below John Redmond Reservoir. Channel catfish and common carp were collected in November 2005, and white crappie and common carp were collected in May 2006. Fish tissue samples consisted of edible portions of the fish. Gamma isotopic analysis was conducted on the water from the fish tissue, and tritium analysis was performed on the fat and water content of the fish tissue.

KDHE and WCNOC results of the fish tissue sampling indicated that the only radionuclide related to WCGS operation detected in fish from the Coffey County Lake discharge cove was tritium. The maximum tritium concentration in fish tissue reported by KDHE was 12,864 pCi/kg-wet, reported in terms of the 95% upper confidence limit by KDHE (KDHE 2006a). WCNOC reported a maximum detected concentration of 14,745 pCi/kg-wet, which was the actual maximum concentration detected (WCNOC 2007f). These results are presented in Table 2-5. Tritium concentrations in control samples ranged from non-detected values to 1,928 pCi/kg-wet (KDHE 2006a, WCNOC 2007f). The gamma isotope ^{40}K was detected in all fish samples analyzed by WCNOC; however, these levels were considered naturally-occurring and not related to WCGS operations (WCNOC 2007g).

Aquatic vegetation indicator samples for KDHE were collected (when available) from various locations in Coffey County Lake and from Wolf Creek below the Coffey County Lake dam. Control samples were collected from John Redmond Reservoir. KDHE samples were collected between July and September 2005 and April and June 2006 (KDHE 2006a). Indicator taxa collected were arrowhead (*Sagittaria* spp.), pondweed (*Potamogeton* spp.), cattails (*Typha* spp.), bulrush (*Scirpus* spp.), spikerush (*Eleocharis* spp.), American lotus (*Nelumbo lutea*), and naiad (*Najas* spp.). Algae samples were collected as the control (KDHE 2006a). WCNOC indicator samples (pondweed and naiad) were collected in May and November 2006 from two locations in Coffey County Lake. No WCNOC control samples were collected (WCNOC 2007f).

Aquatic vegetation samples were analyzed for gamma emitting radionuclides for both WCNOC and KDHE samples. Two isotopes, ^{7}Be and ^{40}K, were detected in the majority of the samples; however, these isotopes are naturally-occurring and are common in the environment. No isotopes related to WCGS operation were detected in any aquatic vegetation samples (KDHE 2006a, WCNOC 2007f).

In summary, the only radionuclide attributable to WCGS detected in tissue samples was tritium (detected in fish). The KDHE report concluded that the levels of radionuclides detected in the various media near WGCS are below regulatory levels and are generally small when compared with levels of naturally-occurring radionuclides (KDHE 2006a).

2.2.5.2.3 Ecological Risk From Radionuclides

In order to evaluate the existing risks posed to ecological receptors from radionuclides in the environment that are related to WCGS operations, a conservative ecological risk screening was performed. The radionuclides detected in the surface water (^{3}H), sediment (^{60}Co and ^{137}Cs), and tissue (^{3}H) samples described above were evaluated. Soil samples also are analyzed for radionuclides in conjunction with the radiological monitoring programs, and the radionuclide levels detected in soil (^{137}Cs) were included in the ecological risk screening.

As noted in the previous section, tritium was the only radionuclide detected in tissue samples by the monitoring programs – it was detected in all of the indicator fish species collected from Coffey County Lake in 2006, with the maximum concentration (14.7 pCi/g) occurring in the muscle tissue of a white bass. In addition to fish tissue, tritium also was detected in a sample of muscle tissue from a bald eagle (*Haliaeetus leucocephalus*) that was a resident at Coffey County Lake. No other radionuclides potentially related to WCGS operations were detected in samples of bald eagle muscle or bone. The adult female eagle, which was killed in May 2007 when struck by a vehicle, had been a resident at the lake for many years.

Given the increasing concentration of tritium in Coffey County Lake since WCGS began operation, the potential for exposures of fish and wildlife to tritium in surface water, and the detection of tritium in tissues of exposed biota, tritium is a focus of this ecological risk screening. Accordingly, a conceptual model of the behavior of tritium in the environment is included here based on descriptions of its chemical and radiological characteristics. The tritium atom contains one proton and two neutrons and is the only radioactive isotope of hydrogen. Tritium is naturally produced in very small amounts (approximately 10^{-16} percent of ordinary hydrogen) by cosmic radiation in the upper atmosphere, where it is incorporated into water and falls to the earth as rain (ANL 2005). Tritium is produced artificially for a variety of uses, as a result of nuclear weapons testing, and as a byproduct of nuclear power plants (ANL 2005, EPA 2007). The majority of tritium in the environment is present in the form of tritiated water (tritium oxide). Tritiated water consists of a water molecule that has one hydrogen atom replaced by a tritium atom. The chemical properties of tritium are nearly identical to those of ordinary hydrogen. Tritium has a half-life of 12 years, emits ionizing radiation in the form of a low-energy beta particle, and emits no gamma radiation. The beta particle does not travel far in air and does not penetrate deeply into tissue. Therefore, tritium poses a health hazard only from internal radiation exposure after being taken in by an organism. Tritiated water is nearly indistinguishable from normal water and behaves the same way in the environment and biota. Tritium most often is ingested in the form of tritiated water, which is quickly and almost completely absorbed into body fluids, organs, and other tissues. The biological half-life of tritium is 10 days, and it does not bioaccumulate. However, cell damage occurs as a result of its beta emissions (ANL 2005).

This ecological risk screening of radionuclides is based on a DOE technical standard, *A Graded Approach for Evaluating Radiation Doses to Aquatic and Terrestrial Biota* (DOE 2002). The DOE approach utilizes radiation dose limits for the protection of ecological receptors from the National Council on Radiation Protection and Measurements and the International Atomic Energy Agency. These agencies identified dose limits below which adverse effects from ionizing radiation on populations of animals and plants have not been observed. NCRP and IAEA concluded that a chronic dose of no greater than 1 rad/day to the maximally exposed individuals in a population of aquatic organisms would not adversely affect the population (DOE 2002). IAEA concluded that a chronic dose of 1 rad/day also would be protective of terrestrial plant populations and that a chronic dose of 0.1 rad/day would be unlikely to cause observable effects on terrestrial animal populations (DOE 2002). These dose limits are considered by DOE to be applicable to the protection of all terrestrial and aquatic organisms on DOE sites (DOE

2002). Accordingly, the dose limits of 1 rad/day for aquatic animals and 0.1 rad/day for terrestrial animals are used as effects benchmarks in this screening.

The concentrations of tritium in bald eagle and fish tissues and the concentrations of tritium and other radionuclides in the abiotic environmental media (surface water, sediment, and soil) were used in evaluating ecological risks through a conservative screening approach. For the tissue concentrations, the screening involved the calculation of absorbed radiation doses from tritium to the eagle and fish, respectively (Table 2-8). The absorbed dose was calculated as the product of the maximum detected tissue concentration of tritium and an internal dose coefficient for tritium from DOE (2002). The absorbed dose was divided by the relevant dose benchmark to calculate a hazard quotient (HQ) for each receptor. An HQ greater than one would indicate potential risk to the receptor due to the dose exceeding the benchmark. The HQs calculated in Table 2-8 for tritium in the tissues of the bald eagle and fish are approximately six orders of magnitude below their respective dose benchmarks. These results indicate that the tritium concentrations in the environment at WCGS to which the bald eagle and fish have been exposed do not pose risk to either individuals or populations of these receptors.

Although the screening above based on tissue concentrations provides a relatively accurate estimation of internal dose to two receptors, the data for radionuclides in other media provide a basis for assessing risk to additional receptors from both internal and external dose. The potential for tritium and other radionuclides (^{60}Co and ^{137}Cs) in abiotic media (surface water, sediment, and soil) to pose ecological risk was evaluated in Table 2-9 by comparing their maximum detected concentrations to Biota Concentration Guides (BCGs) from DOE (2002). The BCGs are nuclide-specific benchmark concentrations that were derived to be conservative and protective of a maximally exposed individual within populations of four broad classes of receptors – aquatic animals, riparian animals, terrestrial animals, and terrestrial plants. BCG derivation was based on the dose limits discussed above (1 rad/day for aquatic animals and 0.1 rad/day for terrestrial animals), the maximal potential internal and external exposure factors for the relevant receptors, and the internal and external radiation doses from each radionuclide that may be experienced by each receptor type.

Conservative assumptions used in the dose calculations were employed to maximize the dose to reproductive tissues, which were considered the radiation-sensitive tissues of most concern in BCG derivation (DOE 2002). In Table 2-9, the maximum detected concentration of each radionuclide in each medium was divided by the BCG for the appropriate receptor type to calculate an HQ (for soil, the terrestrial animal BCG was used because it was lower than the plant BCG). The largest HQ was 0.01 for a terrestrial animal exposed to ^{137}Cs in soil. The HQs for tritium in surface water, ^{60}Co in bottom sediment, and ^{137}Cs in shoreline and bottom sediments were approximately five to six orders of magnitude less than one. These results indicate that the concentrations of tritium, ^{60}Co, and ^{137}Cs in the environment at WCGS do not pose risk to animal or plant populations in Coffey County Lake or its environs.

Table 2-8. Ecological Risk Screening – Tissue Concentrations

Receptor Radionuclide	Concentration in Tissue [(1)] (pCi/g)	Internal Dose Coefficient [(2)] (rad/d per pCi/g)	Absorbed Dose [(3)] (rad/d)	Dose Benchmark [(4)] (rad/d)	Hazard Quotient [(5)]
Bald Eagle					
^{3}H	3.1	2.9×10^{-7}	9.1×10^{-7}	0.1	9×10^{-6}
Fish					
^{3}H	14.7	2.9×10^{-7}	4.3×10^{-6}	1	4×10^{-6}

(1) Tritium activity measured in muscle tissue (based on wet weight of tissue):
Bald eagle was an adult female that had been a long-term resident at Coffey County Lake.
Fish tissue concentrations is the maximum detected concentration detected in fish tissue samples from
Coffey County Lake in 2006 and was measured in a boneless sample from a white bass (KDHE 2006, WCNOC 2007).

(2) From Table 2.4 of DOE (2002) (based on wet weight of tissue)

(3) Absorbed dose (rad/d) = tissue concentration (pCi/g) x internal dose coefficient (rad/d per pCi/g)

(4) Dose benchmark from DOE (2002).

(5) Hazard quotient = absorbed dose / dose benchmark

Table 2-9. Ecological Risk Screening – Abiotic Media Concentrations

Medium Radionuclide	Maximum Detected Concentration [(1)]		Animal Receptor Type	Biota Concentration Guide [(2)]		Hazard Quotient [(3)]
Surface Water						
^{3}H	14,267	pCi/L	aquatic	5×10^{9}	pCi/L	3×10^{-6}
Shoreline Sediment						
^{137}Cs	0.029	pCi/g	riparian	3×10^{3}	pCi/g	1×10^{-5}
Bottom Sediment						
^{137}Cs	0.22	pCi/g	aquatic	5×10^{4}	pCi/g	4×10^{-6}
^{60}Co	0.14	pCi/g	aquatic	2×10^{4}	pCi/g	7×10^{-6}
Soil						
^{137}Cs	0.28	pCi/g	terrestrial	2×10^{1}	pCi/g	1×10^{-2}

(1) Maximum detected concentrations from KDHE (2006) and WCNOC (2007). Concentrations presented for shoreline sediment and soil are the 95% upper confidence limit of the mean, as reported in KDHE (2006).

(2) Biota Concentration Guide (BCG) values from DOE (2002)

(3) Hazard Quotient = maximum detected concentration / BCG

This ecological risk screening of current radionuclide concentrations in the environment at WCGS provides a conservative assessment of the potential risks posed to a wide range of ecological receptors. The screening of abiotic media concentrations using BCGs indicated essentially no risk from radionuclides in surface water and sediment to fish and other aquatic animals in Coffey County Lake. The BCGs were derived to account for potential bioaccumulation of radionuclides in food webs, so predators also are not considered to be at risk. In addition to the BCGs based on modeling of radionuclide intakes, tissue concentrations also were available for use in the evaluation of risks to predators (raptors and fish). The calculation of internal dose from tissue concentrations reduces uncertainty in dose estimation because the measured data prevent the need to model exposure and uptake, a process that is inherently uncertain. Although dose estimates based on tissue residues do not account for external dose, this is not a factor in the assessment of tritium because it emits only low-energy beta particles that contribute minimally to dose from external sources.

The screening of the maximum detected fish tissue concentration of tritium resulted in an HQ of $4x10^{-6}$, which was very similar to the HQ of $3x10^{-6}$ from the BCG screening for aquatic animals. The screening of the bald eagle tissue concentration of tritium resulted in an HQ of $9x10^{-6}$ and confirmed that this top predator was not at risk from radiation exposure. Although the eagle fed on the aquatic food web, as well as the terrestrial food web, in the area of Coffey County Lake over a long period of time, tritium was the only radionuclide related to WCGS detected in its tissues, and the tritium concentration was well below a level that would pose a health risk to an individual eagle. Given the food chain exposures of the bald eagle and the continuous immersion of fish in the tritiated water of Coffey County Lake, their lack of risk is also indicative of a negligible potential for risk to other wildlife in the area, such as waterfowl, water birds, and mammals, which would be unlikely to have greater exposures or sensitivities to radionuclides.

The potential for future risks to ecological receptors to occur during the license renewal period also was considered. As discussed in Section 2.2.3.1.4, tritium levels in Coffey County Lake have been gradually increasing since 1987 and may eventually reach a concentration of approximately 23,000 pCi/L. Division of this concentration by the tritium BCG for aquatic animals as in Table 2-9 would result in an HQ of $4.6x10^{-6}$. Although slightly larger than the current maximum tritium HQ, this HQ indicates that tritium in Coffey County Lake will not pose risk to fish or other animals under foreseeable future conditions.

2.2.5.3 Aquatic Biological Communities

2.2.5.3.1 Wolf Creek and Coffey County Lake

Fish Community

A total of 25 fish species was collected in Wolf Creek prior to the operation of WCGS in 1976 (Hazelton Environmental Sciences 1979). Fish species recorded in Wolf Creek prior to building of the Coffey County Lake Dam are provided in Table 2-10.

After completion of Coffey County Lake, WCGS embarked on a program to stock Coffey County Lake with a diverse population of predator fish. Fish species added to the lake included largemouth bass, smallmouth bass, channel catfish, blue catfish (*Ictalurus furcatus)*, bluegill (*Lepomis macrochirus*), black crappie (*Pomoxis nigromaculatus)*, walleye, and wiper hybrids (*Morone saxatilis* x *M. chrysops*) (WCNOC 2007). Gizzard shad (*Dorosoma cepedianum)*,

Table 2-10. Fish Species Occurring in the Wolf Creek Drainage

Family / Common Name	Scientific Name	Wolf Creek [1]	Coffey County Lake [2]
Atherinopsidae			
Brook silverside	*Labidesthes sicculus*		X
Catostomidae			
River carpsucker	*Carpiodes carpio*	X	X
Smallmouth buffalo	*Ictiobus bubalus*	X	X
Bigmouth buffalo	*Ictiobus cyprinellus*		X
Centrarchidae			
Green sunfish	*Lepomis cyanellus*	X	X
Orangespotted sunfish	*Lepomis humilis*	X	X
Bluegill	*Lepomis macrochirus*	X	X
Longear sunfish	*Lepomis megalotis*	X	X
Smallmouth bass	*Micropterus dolomieu*		X
Largemouth bass	*Micropterus salmoides*	X	X
White crappie	*Pomoxis annularis*	X	X
Black crappie	*Pomoxis nigromaculatus*		X
Clupeidae			
Gizzard shad	*Dorosoma cepedianum*	**X**	X
Cyprinidae			
Central stoneroller	*Campostoma anomalum*	X	
Common carp	*Cyprinus carpio carpio*	X	X
Red shiner	*Cyprinella lutrensis*	X	X
Redfin shiner	*Lythrurus umbratilis*	X	
Golden shiner	*Notemigonus crysoleucas*	X	X
Ghost shiner	*Notropis buchanani*	X	X
Rosyface shiner	*Notropis rubellus*	X	
Suckermouth minnow	*Phenacobius mirabilis*	X	
Bluntnose minnow	*Pimephales notatus*	X	

Table 2-10. (cont'd)

Family / Common Name	Scientific Name	Wolf Creek [1]	Coffey County Lake [2]
Fathead minnow	*Pimephales promelas*	X	X
Slim minnow	*Pimephales tenellus*	X	
Bullhead minnow	*Pimephales vigilax*	X	
Fundulidae			
Blackstripe topminnow	*Fundulus notatus*	X	X
Ictaluridae			
Black bullhead	*Ameiurus melas*	X	X
Yellow bullhead	*Ameiurus natalis*		X
Blue catfish	*Ictalurus furcatus*		X
Channel catfish	*Ictalurus punctatus*	X	X
Flathead catfish	*Pylodictis olivaris*		X
Moronidae			
White bass	*Morone chrysops*		X
Striped bass	*Morone saxatilis*		X
Wiper (white bass X striped bass hybrid)	*Morone saxatilis* x *M. chrysops*		X
Percidae			
Bluntnose darter	*Etheostoma chlorosoma*	X	
Orangethroat darter	*Etheostoma spectabile*	X	
Logperch	*Percina caprodes*	X	
Walleye	*Sander vitreus*		X
Poeciliidae			
Mosquitofish	*Gambusia affinis*	X	X
Sciaenidae			
Freshwater drum	*Aplodinotus grunniens*		X

(1) An "X" indicates a species identified in Wolf Creek in 1976, prior to construction of Coffey County Lake. Adapted from Hazelton Environmental Sciences 1979.
(2) An "X" indicates a species identified in Coffey County Lake, post-construction of Coffey County Lake. Adapted from WCNOC 2000.

white bass, and white crappie larvae were inadvertently introduced to the lake during the filling of the lake with water from the Neosho River, resulting in populations of these fish in Coffey

County Lake (WCNOC 2007). WCGS continues to actively manage Coffey County Lake to maintain a healthy gamefish population and to control gizzard shad numbers (WCNOC 2007).

Coffey County Lake is a popular fishing lake that is managed by the Coffey County Sheriff's Office. Table 2-10 presents a list of the fish species known to occur in Coffey County Lake. Table 2-11 presents a summary of some of the fisheries monitoring data (expressed as catch-per-unit-of-effort [CPUE]) collected from Coffey County Lake since 1983. Predator species that are considered important at WCGS to control impingement of gizzard shad include species that are also important for recreational purposes. These include channel catfish, white bass, wiper hybrids, smallmouth bass, largemouth bass, white crappie, and walleye. The following are descriptions of these fish species that are considered important to Coffey County Lake.

Channel catfish (*Ictalurus punctatus*)

Channel catfish are found in all large rivers in Kansas and are stocked in most reservoirs and ponds (KansasFishes.com 2007a). Channel catfish feed primarily from sundown until midnight on insects, crayfish, mollusks, and other fishes as well as scavenging for dead animals and parts of plants (KansasFishes.com 2007a). Spawning activity occurs from May through July when water temperature reaches 75 °F (KansasFishes.com 2007a). Channel catfish build nests or use other structures for nests (Etnier and Starnes 1993). Channel catfish deposit eggs in nests preferring obscure areas beneath rock overhangs, deeply cut banks, and hollow logs (KansasFishes.com 2007a). Males will tend to the eggs until the young hatch, but will often devour the eggs when disturbed (KansasFishes.com 2007a).

White bass (*Morone chrysops*)

White bass are common to reservoirs in Kansas (Colvin 1993 in WCNOC 2006b). They prefer pelagic (open water) habitats, are highly mobile, and are common in the vicinity of the circulating water intake (WCNOC 2006b). Their statewide population has increased because of stocking and habitat creation through the damming of major rivers for the creation of reservoirs (KansasFishes.com 2007b). White bass breed in the spring. Adults form schools and meet other schools at their spawning areas in tributaries of river or lakes or choppy water near shorelines (KansasFishes.com 2007b). Spawning takes place over a hard bottom of sand, gravel, or rubble (KansasFishes.com 2007b). Eggs are demersal and adhesive (Etnier and Starnes 1993). Newly hatched larvae also tend to hug the bottom (Etnier and Starnes 1993).

Survival rates for Coffey County Lake white bass were unavailable, but average survival in regional reservoirs ranged from 21 to 52 percent and averaged 35 percent (Colvin 1993 in WCNOC 2006b). White bass forage in the early morning, late afternoon, and sometimes after dark (KansasFishes.com 2007b). Young white bass eat insect larvae and larval fish, and adults feed on insect larvae and a wide array of fishes (KansasFishes.com 2007b). Growth rates in

Coffey County Lake, as well as regionally (Colvin 1993 in WCNOC 2006b), indicate that white bass take approximately three years to reach 12 in. (305 millimeters [mm]) total length (TL), which is the current minimum length for recreational harvest.

Table 2-11. Catch-per-unit-of-effort (CPUE) of Selected Fish Species in Coffey County Lake

	Gizzard Shad	Gizzard Shad (YOY)	White Bass	Wiper	Smallmouth Bass	Largemouth Bass	White Crappie	Walleye
1983	(2) 7	-	(2) 23	(2) 15	-	(3) 24.5	(4) 0	(2) 4
1984	25	-	18	11	-	45.0	6	29
1985	3	-	6	22	-	45.3	5	26
1986	32	-	25	14	(3) 1.3	34.5	5	9
1987	10	-	18	21	8.5	18.8	12	16
1988	12	-	28	26	10.5	22.0	9	19
1989	18	-	17	23	14.8	32.3	4	22
1990	10	-	34	12	12.0	14.0	5	13
1991	14	-	45	22	20.5	5.5	4	19
1992	19	-	17	9	10.8	8.3	6	22
1993	11	-	52	8	15.0	5.0	5	12
1994	9	-	61	11	12.5	2.0	4	23
1995	25	-	29	11	6.3	2.0	5	16
1996	9	(5) 22.9	19	3	10.8	0.3	9	20
1997	19	77.0	60	8	5.5	1.3	4	28
1998	18	39.9	45	6	10.5	1.5	3	16
1999	15	9.9	37	4	11	3.3	6	14
2000	18	29.4	36	13	21.5	3.0	(6) 9	28
2001(1)	-	-	-	-	-	2.0	-	-
2002	11	3.5	32	4	2.0	1.0	6	8
2003	10	1.9	54	9	8.0	2.0	7	14
2004	12	5.5	33	6	34	0.8	-	20
2005	11	0.3	37	4	16	0.0	13	9

(1) Fall gill net, Fyke net, and electrofishing data were not collected in 2001 due to the September 11 events.
(2) Data from fall standard gill netting. Units equal number per gill-net-complement-night > or = stock size.
(3) Data from spring electrofishing. Units equal number per hour shocked > or = stock size. Shocking efforts starting in 2004 targeted prime habitats rather than standard locations as completed during prior years.
(4) Data from spring Fyke netting. Units equal number per trap-net-night > or = stock size.
(5) Data from smallmesh gill net. Units equal number per net complement of one 0.5 and one 0.75 mesh net.
(6) Data beginning in 2000 were from fall Fyke netting. Netting not completed during 2004 due to adverse weather. Units equal number per trap-net-night > or = stock size.
\- Not collected
Adapted from: WCNOC 2006b

Wiper hybrids (*Morone* sp.)

Wiper hybrids are striped bass (*Morone saxatilis*) and white bass (*Morone chrysops*) crosses (Daniels 2007). Other common names for wipers include sunshine bass, white rocks, rocket bass, or stripers. The hybrid is distinguishable from the striped bass by the broken horizontal lines that run along the sides of its body (Daniels 2007). Hybridization produces fish with a greater tolerance to extremes in temperature and dissolved oxygen than either of its parents (Daniels 2007). Most wipers are hatchery spawned and their densities are controlled by WCNOC stocking, which was based on shad control needs (WCNOC 2006b).

Smallmouth bass (*Micropterus dolomieu*) and largemouth bass (*Micropterus salmoides*)

Both the smallmouth bass and largemouth bass utilize nests for spawning (Etmier & Starnes 1993). Smallmouth bass naturally inhabit clear, cool, rocky streams and have not bred well outside of this habitat (Kansas Fishes 2007c), though they have been introduced to reservoirs (Cross and Collins 1995). In lakes and reservoirs, they typically occur in moderately deep water and along undercut banks and rocky ledges (Tomelleri and Eberle 1990). In Coffey County Lake, smallmouth bass have been found to be the dominant shoreline predator and to be abundant along areas of riprap (Haines 1998).

Largemouth bass occur in lakes, reservoirs, and ponds and also are native to rivers in eastern Kansas. They are more tolerant of warm, slightly muddy water than is the smallmouth bass, and they prefer muddy rather than rocky bottoms (Cross and Collins 1995). Largemouth bass have experienced a long-term decline in Coffey County Lake (WCNOC 2006b) that is typical of aging reservoirs (Kimmel and Groeger 1986, Willis 1986 in WCNOC 2006b).

White crappie (*Pomoxis annularis*)

White crappie is an important recreational species, but it is not a species sought after for consumption because it has a low creel limit (WCNOC 2006b). White crappie is one of the most common fishes in Kansas and its numbers are increasing due to construction and stocking of lakes and ponds (KansasFishes.com 2007e). In lakes, white crappie usually occur in schools in moderately deep water offshore entering shallow, brushy areas before spawning in spring, and again as the water cools in autumn (KansasFishes.com 2007e). O'Brien *et al.* (1984 in WCNOC 2006b) determined that crappie 80 to 170 mm (3 to 7 in.) TL were wholly pelagic, preferring deeper, open waters similar to those adjacent to the WCGS cooling water intake (WCNOC 2006b). This preference makes white crappie more susceptible to impingement.

White crappie utilize nests for spawning (Etnier and Starnes 1993) and these nests are found in relatively large "beds" (KansasFishes.com 2007e). White crappie have very high reproductive potential, which often leads to overpopulation and stunting in small lakes and impoundments

(KansasFishes.com 2007e). Crappie feed mostly on small crustaceans and insects as young, and then, at approximately six in. in length, their diet changes to mostly fishes (KansasFishes.com 2007e). Gizzard shad is a major forage item for white crappie (Cross and Collins 1995, Muoneke *et al.* 1992 in WCNOC 2006b), making it an important species for Coffey County Lake (WCNOC 2006b).

Annual survival rates for the white crappie were found to range from 23 to 29 percent in three Kansas reservoirs after length limits were instituted (Mosher 2000 in WCNOC 2006f) and the rate was 46 percent for Lake Carl Blackwell in north-central Oklahoma (Muoneke 1992 in WCNOC 2006b). Annual survival rates for Coffey County Lake have not been calculated, but the large, longer-lived crappie present in Coffey County Lake suggest that the survival rate is likely to be high (WCNOC 2006b).

Walleye (*Sander vitreus*)

The walleye is an important species both for WCGS operations and recreation (WCNOC 2006b). Walleye spawn at night over rock, rubble, gravel, and similar substrates (KansasFishes.com 2007f). Walleye eggs are dispersed upon release and are adhesive before water hardening but non-adhesive after hardening (Etnier and Starnes 1993). Walleyes prefer to feed on other fish, such as yellow perch (*Perca flavescens*), shad, and minnows, as well as insects, and will consume snails, frogs, and small mammals if other resources are scarce (KansasFishes.com 2007f). Catch curve regressions, developed from fisheries monitoring data on Coffey County Lake for 2003 and 2004, indicate total annual survival estimates for walleye adults of 41 and 17 percent, respectively (WCNOC 2006b) and includes natural fishing, and power-plant-related mortality.

Gizzard shad (*Dorosoma cepedianum*)

Gizzard shad are the primary forage for the majority of large, lake-dwelling, predator species in Kansas (KansasFishes.com 2007g). Large schools of shad can be observed schooling near the water surface in state lakes and reservoirs as they roam eating plankton (KansasFishes.com 2007g). Shad spawn in shallow bays, coves, or sloughs with no care given to the young, but growing to 4 in. in length during the first year of life (KansasFishes.com 2007g). Eggs are simply dispersed throughout the water column (Etnier and Starnes 1993). Gizzard shad are susceptible to sudden changes in water temperature. Large "kill offs" of gizzard shad can be observed in Kansas in the fall season as cold fronts invade the State and cause drastic water temperature changes (KansasFishes.com 2007g).

Invertebrates

Macroinvertebrate communities in Wolf Creek were monitored near WCGS from 1973 through 1978 (Hazelton Environmental Sciences 1979). Wolf Creek exhibited the greatest benthic species diversity of any of the water bodies near WCGS. This diversity was attributed to the variety of microhabitats, substrates, and current velocities (NRC 1975). The primary benthic macroinvertebrate taxa collected in Wolf Creek were from the family Chironomidae (non-biting widges) and the class Oligochaeta (aquatic worms), with significant but occasional contributions from the families Sphaeridae (pill clam) and Simuliidae (black fly). Oligochaeta (aquatic earthworms) were represented by Naididae and Tubificidae (WCGS 1980). The most abundant Chironomids were *Hydrobaenus*, *Chironomus*, *Plypedilum*, and *Procladius* (WCGS 1980). These genera indicate poor water quality (Platkin *et al.* 1989).

Benthic macroinvertebrates collected in Coffey County Lake during early operation of WCGS (1981 to 1987) indicated lower species richness than that of the Neosho River (70 taxa versus the 179 in the Neosho River), which is typical of midwestern reservoirs (EA 1988). Aquatic midges (Diptera) accounted for 41 percent of all the taxa identified for the Coffey County Lake benthos. The oligochaete families Naididae and Tubificidae contributed 10 and 17 percent of the taxa identified, respectively (EA 1988). Quantitative dissimilarities of the fauna detected at the different sample locations reflected differences in sampling depths, substrate composition, and organic matter content (EA 1988). Data collected by EA (1988) indicate poor water quality during the 1980s, however these data are approximately 20 years old and may not reflect current biological conditions. Although macroinvertebrate abundance declined after the initial filling of Coffey County Lake, these declines were attributed to the maturing of the lake and not to the operation of WCGS (EA 1988).

Several species of freshwater shellfish (mollusks and crustaceans) may occur in Wolf Creek, including fingernail clams (*Musculium transversum* and *Sphaerium* spp.) (EA 1988).

Plankton

Baseline monitoring of the phytoplankton community in Wolf Creek was conducted quarterly from 1973 to 1975 and bimonthly from1976 to1978 (Hazelton Environmental Sciences 1979). Wolf Creek has intermittent flows that require sampling of isolated pools of water during low water periods. Each of these shallow pools represents a distinct habitat with unique physicochemical characteristics (Hazelton Environmental Sciences 1979). Annual mean phytoplankton density ranged from 1,104 to 14,156 units/milliliter (ml; reporting units were cells or groups of cells, depending on the taxa being counted) from 1973 to 1978 (Hazelton Environmental Sciences 1979). Pennate diatoms and flagellated algae, particularly cryptomonads (*Cryptomonas*) and euglenoids (*Euglenas* and *Trachelomonas*) were common (WCGS 1980). Other algal groups that were seasonally abundant included centric diatoms

(*Stephanodiscus* and *Cyclotella*), green algae (Chlorophyta), and rarely blue-green algae (Oscillatoria) (WCGS 1980). Identification of periphyton populations indicated 237 taxa representing 62 genera in samples collected from Wolf Creek and the Neosho River (NRC 1982). The diatoms of genera *Diploneis*, *Gomphonema*, and *Gyrosigma* and the species *Navicula symmetrica*, *Nitzschia dissipata*, and *Suriella ovata,* as well as blue-green algae, were common only in Wolf Creek (NRC 1982).

Zooplankton populations in Wolf Creek were monitored from 1973 to 1978 (WCGS 1980). Maximum seasonal densities of 829,746 organisms/m^3 of zooplankton were measured for Wolf Creek in 1976 when annual precipitation was low and the minimum annual population of 15,600 organisms/m^3 was measured in 1974 when annual precipitation was high (WCGS 1980). Hazelton Environmental Sciences (1979) reported dominant zooplankton taxa collected in Wolf Creek included copepod nauplii, cyclopoid copepodites, *Trococyclops prasinus mexicanus*, *Diaptomus siciloides*, and the genera *Keratella*, *Synchaeta*, and *Brachionus*.

In Coffey County Lake, phytoplankton, carbon fixation rates, and zooplankton biomass were monitored bimonthly from 1981 to 1987 (EA 1988). Average annual chlorophyll concentrations declined by 30 percent from 1981 to 1982, remained stable from 1982 to 1984, and returned to levels close to initial 1981 levels from 1985 to 1986 (EA 1988). The annual value in 1987 declined by approximately 35 percent to 6.6 milligrams (mg)/m^3 and was below the historical range of 7.5-11 mg/m^3 (EA 1988). Some temporal and spatial patterns of phytoplankton were noted, but were not consistent throughout the study period (EA 1988). Generally, chlorophyll concentrations were higher in the late summer or early autumn and lower in the deepwater area near the main dam (EA 1988). Carbon fixation rates were strongly influenced by the phytoplankton crop and ambient conditions, such as temperature (EA 1988).

Zooplankton dry weight biomass declined from 1981 to 1984, increased in 1985 and 1986, and declined again in 1987 (EA 1988). The average annual dry weight in 1987 of 123 mg/m^3 was less than that observed during lake filling in 1981, but greater than the 66 mg/m^3 minimum of 1984 (EA 1988). Spatial and temporal trends were not consistent during the 1981 to 1987 sampling period. The plankton studies indicated conditions typical of a new lake with the increases in plankton from 1985 to 1986 attributed to natural factors and the start-up effects of WCGS operations that altered lake circulation (EA 1988).

An invasive species, the Asiatic clam (*Corbicula fluminea*) was first detected in Coffey County Lake in 1991 (Hammond 2006). Since that time WCGS has had a monitoring program to determine the population density and distribution of the clam in Coffey County Lake. As recently as 2006, another invasive bivalve, the zebra mussel (*Dreissena polymorpha*) was not detected in Coffey County Lake. However, the zebra mussel was observed in a lake approximately 70 miles from WCGS in 2003 (Hammond 2006).

2.2.5.3.2 Neosho River and John Redmond Reservoir

Fish Community

WCNOC conducted pre-operational and operational monitoring studies of Neosho River fish populations from 1973 to 1987 (EA 1988). These studies were conducted from the tailwaters of John Redmond Reservoir to below the confluence with Wolf Creek (EA 1988). These studies identified 52 species representing 12 families (EA 1988). A list of the fish species found in the Neosho river is presented in Table 2-12. Thirteen species were reported consistently for each year of study sampling. These 13 species included gizzard shad,

Table 2-12. Fish Species Occurring in the Neosho River [(1)]

Family / Common Name	Scientific Name
Atherinopsidae	
Brook silverside	*Labidesthes sicculus*
Catostomidae	
River carpsucker	*Carpiodes carpio*
Quillback	*Carpiodes cyprinus*
Blue sucker	*Cycleptus elongatus*
Smallmouth buffalo	*Ictiobus bubalus*
Bigmouth buffalo	*Ictiobus cyprinellus*
Black buffalo	*Ictiobus niger*
Golden redhorse	*Moxostoma erythrurum*
Shorthead redhorse	*Moxostoma macrolepidotum*
Centrarchidae	
Green sunfish	*Lepomis cyanellus*
Orangespotted sunfish	*Lepomis humilis*
Bluegill	*Lepomis macrochirus*
Hybrid sunfish	*Lepomis macrochirus* x *L. megalotis*
Longear sunfish	*Lepomis megalotis*
Spotted bass	*Micropterus punctulatus*
Largemouth bass	*Micropterus salmoides*
White crappie	*Pomoxis annularis*
Clupeidae	
Gizzard shad	*Dorosoma cepedianum*

Table 2-12. (cont'd)

Family / Common Name	Scientific Name
Cyprinidae	
Central stoneroller	*Campostoma anomalum*
Goldfish	*Carassius auratus auratus*
Red shiner	*Cyprinella lutrensis*
Common carp	*Cyprinus carpio carpio*
Gravel chub	*Erimystax x-punctatus*
Redfin shiner	*Lythrurus umbratilis*
Golden shiner	*Notemigonus crysoleucas*
Ghost shiner	*Notropis buchanani*
Rosyface shiner	*Notropis rubellus*
Sand shiner	*Notropis stramineus*
Suckermouth minnow	*Phenacobius mirabilis*
Bluntnose minnow	*Pimephales notatus*
Fathead minnow	*Pimephales promelas*
Slim minnow	*Pimephales tenellus*
Bullhead minnow	*Pimephales vigilax*
Fundulidae	
Blackstripe topminnow	*Fundulus notatus*
Ictaluridae	
Black bullhead	*Ameiurus melas*
Yellow bullhead	*Ameiurus natalis*
Channel catfish	*Ictalurus punctatus*
Stonecat	*Noturus flavus*
Freckled madtom	*Noturus nocturnus*
Neosho madtom	*Noturus placidus*
Flathead catfish	*Pylodictis olivaris*
Lepisosteidae	
Longnose gar	*Lepisosteus osseus*
Shortnose gar	*Lepisosteus platostomus*
Moronidae	
White bass	*Morone chrysops*
Wiper (white bass X striped bass hybrid)	*Morone saxatilis* x *M. chrysops*

Table 2-12. (cont'd)

Family / Common Name	Scientific Name
Percidae	
Bluntnose darter	*Etheostoma chlorosoma*
Orangethroat darter	*Etheostoma spectabile*
Logperch	*Percina caprodes*
Slenderhead darter	*Percina phoxocephala*
Walleye	*Sander vitreus*
Poeciliidae	
Mosquitofish	*Gambusia affinis*
Sciaenidae	
Freshwater drum	*Aplodinotus grunniens*

(1) Species identified in the Neosho River from 1973 to 1987. Adapted from EA 1988.

common carp, golden shiner (*Notemigonus crysoleucas*), ghost shiner (*Notropis buchanani*), red shiner (*Cyprinella lutrensis*), river carpsucker (*Carpiodes carpio*), smallmouth buffalo, channel catfish, white bass, green sunfish (*Lepomis cyanellus*), orangespotted sunfish (*Lepomis humilis*), white crappie, and freshwater drum (EA 1988). The shorthead redhorse (*Moxostoma macrolepidotum*), blue sucker (*Cycleptus elongatus*), flathead catfish (*Pylodictis olivaris*), and mosquitofish (*Gambusia affinis*) were collected each year after electrofishing was initiated in 1977, while the Neosho madtom (*Noturus placidus*) was encountered each year except 1978 after kick seining at a location immediately downstream of the Neosho River/Wolf Creek confluence (EA 1988). In all years, collections were dominated by Cyprinids (minnows and common carp) and Clupeids (gizzard shad; EA 1988). Relative abundance of fish species and other groups, such as Ictalurids, Catastomids, and Centrarchids, showed relatively no change in abundance from the preoperational period of 1977 to 1982, to the operational period of 1985 to 1987 (EA 1988). Changes that were noted in the abundance of fish populations in the Neosho River were attributed to changes in water flow of the river determined by the amount and timing of precipitation received (EA 1988).

Fish communities in the Neosho River and Wolf Creek differed, and likely still do differ, because of flow characteristics. Stormwater runoff is the primary water source for Wolf Creek and discharges from John Redmond Reservoir provide the majority of the flow in the Neosho River (WCGS 1980). Gizzard shad accounted for almost 20 percent of the Neosho River seine catch versus 3 percent of the Wolf Creek catch (WCGS 1980). Likewise, orangespotted sunfish accounted for 17 percent of the Wolf Creek catch versus less than 1 percent of the Neosho River catch (WCGS 1980).

More recently in the John Redmond Reservoir, the principal species of fish identified have included white crappie, white bass, channel catfish, flathead catfish, and various sunfish species (USACE 2007b). The sportfish population is typical of a turbid, high-flow-through impoundment (Jirak 2005). Rough fish, such as carp and buffalo, dominate the total biomass in the lake (Jirak 2005). John Redmond Reservoir has a very poor crappie fishery (Jirak 2005). Crappie populations did well during the early 1980s when John Redmond Reservoir water levels were managed more aggressively, but have declined since the water-level management ceased in the late 1980s (Jirak 2005). White bass populations in John Redmond Reservoir may be hindered by the logjam at the entrance of John Redmond Reservoir, particularly if water flows are low in the spring during spawning runs (Jirak 2005). Channel catfish populations for John Redmond Reservoir are average for the nature of the reservoir (Jirak 2005). John Redmond Reservoir has a good population of flathead catfish of all sizes (Jirak 2005). Wipers in John Redmond Reservoir appear to be large and anglers report good catches (Jirak 2005).

Invertebrates

In the Neosho River, 179 macroinvertebrate taxa were identified in samples collected from the Neosho River during preconstruction and early operation of WCGS (1973 to1987). Sampling indicated a dominance of midges (Diptera), mayflies (Ephemeroptera), aquatic worms (Oligochaeta), and caddisflies (Trichoptera; EA 1988). No long-term patterns or empirical or statistical differences were found suggesting a change to the benthos in the Neosho River resulting from the construction and/or operation of WCGS (EA 1988).

In 1986, immature Asiatic clams (*Corbicula fluminea*) were collected in a sample from the Neosho River for the first time since monitoring began in 1974 (EA 1988). Surveys of *C. fluminea* in the Neosho River near WCGS indicated that it remains established below the dam at Burlington, Kansas (EA 1988). Distribution of this mussel further upstream appears to be limited by inhabitable substrate types (EA 1988). Another invasive bivalve, the zebra mussel (*Dreissena polymorpha*) has not yet been detected in the Neosho River (Haines 2006). However, the zebra mussel was observed in a lake approximately 70 miles from WCGS in 2003 (Hammond 2006).

Several species of native freshwater mussels may occur in the Neosho River Basin. Several of these species are State-listed. These species include: butterfly (*Ellipsaria lineolata*), deertoe (*Truncilla truncata*), fat mucket (*Lampsilis siliquoidea*), fawnsfoot (*T. donaciformis*), flutedshell (*Lasmigona costata*), Neosho mucket (*Lampsilis rafinesqueana*), Ouachita kidneyshell (*Ptychobranchus occidentalis*), rabbitsfoot (*Quadrula cylindrica*), round pigtoe (*Pleurobema sintoxia*), spike (*Elliptio dilatata*), creeper (*Strophitus undulatus*), Wabash pigtoe (*Fusconaia flava*), washboard (*Megalonaias nervosa*), wartyback (*Quadrula nodulata*), yellow sandshell (*Lampsilis teres*); fingernail clams (*Musculium transversum)* and *Sphaerium transversum)*, giant floater (*Anodonta grandis)*, and pocketbook (*Lampsilis ovata)* (EA Engineering, Science, and Technology, Inc. 1988, Obermeyer 2000).

In John Redmond Reservoir, the benthic macroinvertebrate community included as dominant genera *Limnodrilus*, *Coelotanypus*, *Chironomus*, *Procladius*, and *Tanypus* (WCGS 1980). In the benthic community of the John Redmond Reservoir tailwaters, Chironmidae was the most numerous and diverse group (NRC 1982). *Cricotopus*, *Procladius*, and *Polypedilum* were dominant genera (NRC 1982).

Plankton

The phytoplankton community of the Neosho River immediately downstream of John Redmond Reservoir is strongly influenced by releases from John Redmond Reservoir (EA 1988). During moderate to high flows, chlorophyll concentrations immediately upstream and downstream of the confluence with Wolf Creek were very similar to those observed in the tailwaters of.John Redmond Reservoir (EA 1988). During low flow conditions, chlorophyll and carbon fixation rates were often different at a location immediately upstream of Wolf Creek than those observed at other locations (EA 1988). Chlorophyll concentrations in the Neosho River near WCGS ranged from less than 1 to almost 144 mg/m^3 for sampling conducted between 1973 and1987 (EA 1988). The annual mean density of phytoplankton in the Neosho River near WCGS ranged from 1,973 to12,063 units/ml from 1973 to 1978 (Hazelton Environmental Sciences 1979). The annual mean carbon fixation rates ranged from 0 to 226 mg C/m^3 for sampling conducted between 1973 and 1987 (EA 1988).

Centric diatoms (predominately *Stephanodiscus astraea, S. hantzschii, S. minutus, Cyclotella atomus, C.a meneghiniana* and *Thalassiosira pseudonana)*, green algae (predominately *Dictyosphaerium, Ankistrodesmus, Oocystis, Chlamydomonas, Crucigenia,* and *Tetrastrum*), and cryptomonads (predominately *Cryptomonas, Rhodomonas,* and *Chroomonas*) dominated the phytoplankton of the Neosho River from 1973 through 1978 (Hazelton Environmental Sciences 1979). Large populations of centric diatoms are generally associated with reservoirs and lake environments (Hazelton Environmental Sciences 1979). Pennate diatoms (predominately *Nitzschia* and *Navicula*) were also frequently seen in the Neosho River samples (Hazelton Environmental Sciences 1979). Pennate diatoms are associated with shallow river-reservoir systems (Hazelton Environmental Sciences 1979). Other algal divisions of seasonal importance included chloromonads, euglenoids, and chrysophytes (Hazelton Environmental Sciences 1979). Blue-green algae were usually insignificant constituents in the reservoir tailwater and river phytoplankton communities (Hazelton Environmental Sciences 1979).

Identification of periphyton populations from 1975 to1978 indicated 237 taxa representing 62 genera in samples collected from Wolf Creek and the Neosho River (NRC 1982). The diatoms

Navicula tripunctata and *S.* spp., and two green algae were dominant in the Neosho River (NRC 1982).

Zooplankton densities in the Neosho River were related to John Redmond Reservoir zooplankton densities, the volume of John Redmond Reservoir releases, and seasonal factors (Hazelton Environmental Sciences 1979). Major taxa included immature copepods, *Bosmina logirostris* and *Diaptomus siciloides*, and rotifers *Keratella, Polyarthra*, *Synchaeta*, and *Brachionus* (Hazelton Environmental Sciences 1979).

2.2.5.4 Rare Aquatic Species

Table 2-13 presents aquatic species that are Federally or State-listed as endangered or threatened (or are candidates for listing) in counties within which WCGS (Coffey County) and its associated transmission lines (Coffey, Butler, and Greenwood Counties) are located. As discussed in Section 2.1.7, of the three transmission lines evaluated in this Supplemental Environmental Impact Statement (SEIS), two are located almost entirely on WCGS property and cross only portions of Coffey County Lake: the 7-mi line from Wolf Creek to the pre-existing Benton line and the 0.7-mi line from Wolf Creek to the pre-existing La Cygne line. Thus, only the 98-mi Wolf Creek-Rose Hill line crosses the Neosho River and other water bodies that may support rare species. Only this line is discussed below. The species included in Table 2-13 are those that meet the following criteria:

- The species has a Federal or State legally protected status of threatened or endangered in Coffey, Greenwood, or Butler Counties, based on its listing status from the U.S. Fish and Wildlife Service (FWS) and Kansas Department of Wildlife and Parks (KDWP); and
- Records maintained by the FWS and KDWP indicate that the species has been recorded as occurring currently or historically in at least one of these counties.

Listed aquatic species that meet these criteria include two fish, five mussels, and one snail (Table 2-13). The two Federally listed aquatic species and one species that is a candidate for Federal listing are discussed below. None of these species have Federally designated critical habitat in the vicinity of the study area.

2.2.5.4.1 Topeka Shiner

The Topeka shiner (*Notropis topeka*) is a small, stout-bodied minnow 3 in. or less in length. It was listed by the FWS in 1998 as endangered and by the State of Kansas in 1999 as threatened. Although historically this species was common in small prairie streams in the prairie region of the central United States, it has experienced major reductions in distribution and numbers throughout its historic range and is now restricted to a few headwater tributaries of the

Table 2-13. Protected Aquatic Species Potentially Occurring in the Vicinity of WCGS and the Associated Transmission Line ROWs

Scientific Name[a]	Common Name[a]	Federal Status[b]	State Status[c]
Fish			
Notropis topeka	Topeka shiner	LE	T
Noturus placidus	Neosho madtom	LT	T
Mollusks			
Cyprogenia alberti	western fanshell mussel	--	E
Lampsilis rafinesqueana	Neosho mucket mussel	C	E
Lasmigona costata	flutedshell mussel	--	T
Pleurocera acuta	sharp hornsnail	--	T
Ptychobranchus occidentalis	Ouachita kidneyshell mussel	--	T
Quadrula cylindrica	rabbitsfoot mussel	--	E

(a) Species listed are those that (1) have Federal or State legally protected status of threatened or endangered in Coffey, Butler, or Greenwood Counties; and (2) have been recorded as occurring currently or historically in at least one of these counties.

(b) Federal legal status in Kansas -- definitions:

LE Listed endangered

LT Listed threatened

C Candidate (not legally protected)

(c) State legal status definitions:

E Endangered: any species of wildlife whose continued existence as a viable component of the State's wild fauna is determined to be in jeopardy.

T Threatened: any species of wildlife which appears likely, within the foreseeable future, to become an endangered species.

SNC Species in need of conservation: any nongame species deemed to require conservation measures in an attempt to keep the species from becoming a threatened or endangered species.

Sources: KDWP 2004c and 2007e; FWS 2007a, 2007b, and 2007c

Missouri and Mississippi Rivers in portions of Minnesota, Iowa, Missouri, South Dakota, Nebraska, and Kansas. The FWS has attributed the decline of this species primarily to habitat loss and degradation resulting from a variety of factors, such as climate change, intensive cultivation, pollution, impoundments, and highway construction, as well as increased predation and competition from introduced fish species (Mammoliti 2004).

In Kansas, the Topeka shiner exists almost exclusively in small headwater streams in, or very near, the Flint Hills. These include a number of tributaries of the Cottonwood River, Big Blue River, Lower Kansas River, and Smoky Hill River (Mammoliti 2004). The Cottonwood River is a tributary of the Neosho River. Topeka shiner populations in the Cottonwood/Neosho drainage in Butler, Chase, and Greenwood Counties are more than 40 miles upstream of WCGS in small streams that are unaffected by WCGS operations.

The preferred habitats of the Topeka shiner typically are small, low-order, prairie streams with good water quality, relatively cool water temperatures, and low fish diversity. These streams usually have perennial flow influenced by groundwater or springs, but they may become intermittent during summer (Mammoliti 2004). Such habitats are not present in John Redmond Reservoir, Coffey County Lake, Wolf Creek or the Neosho River, and the Topeka shiner has not been found in these water bodies.

Critical habitats for the Topeka shiner have been Federally designated in Iowa, Minnesota, and Nebraska (FWS 2004). The State of Kansas has designated critical habitats for the Topeka shiner in several counties, including Butler and Greenwood Counties. The critical habitats in these counties are all within the Cottonwood River watershed. All of these critical habitats are upstream of WCGS and could not be affected by the operation of the facility (WCNOC 2006a). The Wolf Creek – Rose Hill transmission line ROW within Greenwood and Butler Counties traverses the Verdigris, Fall, and Walnut River watersheds, but not the Cottonwood River watershed to the north. No populations of the Topeka shiner are known to occur within Coffey County and it contains no critical habitats for this species (KDWP 2004a). In addition, the Topeka shiner has not been found in studies of other streams traversed by the Wolf Creek – Rose Hill transmission line (KDWP 2006). Thus, the Topeka shiner is not expected to occur in John Redmond Reservoir, Coffey County Lake, Wolf Creek, the Neosho River, or any of the water bodies within the transmission line ROW.

2.2.5.4.2 Neosho Madtom

The Neosho madtom (*Noturus placidus*), a small catfish usually less than 3 in. long, is listed as threatened by both the FWS and the KDWP. Its typical habitat is riffles and sloping gravel bars with moderate to swift currents in relatively clear rivers of moderate size (KDWP 2004b). It prefers a substrate of fine gravel but has been reported in areas with bottoms that have large stones and cobbles or are sandy. It feeds on aquatic insects and has a lifespan of 3 to 4 years (FWS 1991).

The Neosho madtom is native to the Neosho River Basin of Kansas, Oklahoma, and Missouri, including its tributaries the Cottonwood and Spring Rivers. The largest populations are believed to be those of the Neosho and Cottonwood Rivers in Kansas. Smaller populations are found in the Spring River in Kansas and in adjacent areas of Oklahoma (Ottawa and Craig Counties) and Missouri (Jasper County). Within this limited range, the Neosho madtom has experienced population declines resulting from factors such as drought-related habitat degradation, removal of gravel bars, and water pollution from feedlot runoff. Habitat loss also has resulted from the construction of mainstream impoundments in Kansas and Oklahoma that inundated Neosho madtom habitat (FWS 1991).

KDWP has designated portions of the Neosho, Cottonwood, and Spring Rivers as critical habitat for the Neosho madtom, including the main stem of the Neosho River from its point of discharge from the John Redmond Reservoir to the Kansas-Oklahoma border (KDWP 2004b). This is the only portion of the Neosho madtom critical habitat that is crossed by the Wolf Creek – Rose Hill transmission line ROW.

Researchers from the FWS and U.S. Geological Survey (USGS; Wildhaber et al. 2000) compared densities of the Neosho madtom and several other catfish species from the family Ictaluridae at locations upstream and downstream of John Redmond Reservoir. The study utilized data from an 8-year period (1991 to 1998) to assess the effects of the dam and reservoir on population trends as well as habitat, hydrology, and water quality. The study found that Neosho madtom densities (fish per 100 square meters) were significantly higher above John Redmond Reservoir than below the dam, and it concluded that the lower downstream densities may result from the decreased turbidity and increased substrate size created by the operation of the dam and flood control reservoir (Wildhaber et al. 2000).

In addition to the removal of particulates, the study found that the presence of John Redmond Dam and Reservoir changed annual flow regimes below the dam, resulting in lower minimum flows, more frequent low-flow events, lower short-term (1-day and 3-day) maximum flows, reduced variability in flow rates, increased winter flows, increased long-term (30-day and 90-day) maximum flows, increased length and variability in duration of high-flow events, and a later date of maximum annual flow below the dam. Thus, the Neosho River below John Redmond Reservoir has become characterized by lower minimum flows, lower short-term flows, and higher long-term flows as a result of management of the reservoir to maintain water levels in the reservoir and minimize downstream flooding. The study results suggested that minimum flows and their timing are critical to the reproductive success of the Neosho madtom and may be critical to its overwinter survival. Certain minimum flows and the timing of the spring water rise appeared to be critical to reproduction and certain minimum flows in late-summer and fall appeared to improve overwinter survival of young-of-the-year madtoms. The FWS and USGS researchers recommended that additional data be collected on changes in water quality and habitat downstream of the dam and, in order to test their hypotheses about the effects of the flow regime, they also recommended that populations be monitored for several years while flows below the John Redmond Dam are increased during critical periods (Wildhaber *et al.* 2000).

In the 1970s, biologists conducting baseline surveys for WCGS occasionally collected Neosho madtoms in kick-seine samples from the Neosho River upstream and downstream of the Wolf Creek-Neosho River confluence. After WCGS became operational in 1985, Neosho madtoms continued to be collected in Neosho River kick-seine samples. Over the period from 1985 to 1991, a total of 110 Neosho madtoms was collected (and released unharmed) from Neosho River monitoring stations. In 1992, flooding hindered seining and no Neosho madtoms were collected. In 1993, WCGS discontinued its monitoring of fish in the Neosho River (WCNOC 2006a).

2.2.5.4.3 Neosho Mucket Mussel

The Neosho mucket (*Lampsilis rafinesqueana*) is a freshwater, riverine mussel (family Unionidae) that has been a candidate for Federal listing since 1984 and has been designated as an endangered species by the State of Kansas since 1992 (FWS 2005, Obermeyer 2000). The Neosho mucket generally is larger than other mussel species in its habitat, with a shell that is light to dark brown and approximately 4 in. long. Its typical habitat is characterized by shallow, clean, flowing water in riffles and runs with fine to medium gravel substrates (KDWP 2004c, Obermeyer 2000). Potential host fish for the parasitic larval life stage (glochidia) of the Neosho mucket in southeast Kansas include largemouth, smallmouth, and spotted basses (Obermeyer 1999). The Neosho mucket has been found only in the Illinois, Neosho, and Verdigris River basins of Kansas, Oklahoma, Missouri, and Arkansas. The species has disappeared from approximately 62 percent of its historic range, with the worst losses in the Kansas and Oklahoma portions of its range. Its range and habitat have been reduced by factors such as sedimentation, pollutants (for example, nutrients, pesticides, and metals from mining), sand and gravel mining in rivers and floodplains, and the impoundment of rivers by dams (FWS 2005). The Neosho mucket once was found in streams across eastern Kansas but now is largely restricted to the Neosho and Verdigris Rivers and their tributaries and a short segment of the Spring River in Cherokee County in the southeast corner of Kansas (KDWP 2004c, Obermeyer 2000). KDWP has designated sections of these rivers as critical habitat for the species, including the Neosho River from John Redmond Dam downstream to the Kansas/Oklahoma border (Obermeyer 2000). This is the only portion of the Neosho mucket critical habitat that is crossed by the Wolf Creek – Rose Hill transmission line ROW.

2.2.5.4.4 Other State-listed Species

In addition to the three species that are both Federally and State-listed, five of the protected aquatic species potentially occurring in the vicinity of WCGS or the Wolf Creek – Rose Hill transmission line ROW are mollusks that are State-listed as endangered or threatened (Table 2-11). The Ouachita kidneyshell (*Ptychobranchus occidentalis*), rabbitsfoot (*Quadrula cylindrica cylindrica*), and western fanshell (*Cyprogenia aberti*) are freshwater, riverine mussels that are State-listed as endangered species. KDWP has designated critical habitat for these mussels in sections of several rivers, including the Neosho River from John Redmond Dam downstream to the Kansas/Oklahoma border (Obermeyer 2000). The flutedshell mussel (*Lasmigona costata*) is a State-listed threatened species for which KDWP has designated critical habitat in the

Neosho River beginning at Kansas State Highway 57, which is downstream of the Wolf Creek confluence, and extending downstream to Neosho County (KDWP 2004c). The sharp hornsnail (*Pleurocera acuta*) does not have designated critical habitat in Kansas. Although Butler County is in its known historic range, the sharp hornsnail is not currently known to occur in lakes or streams in the Wolf Creek – Rose Hill transmission line ROW (KDWP 2004c).

2.2.5.4.5 Summary

Of the two Federally-listed species and one Federal candidate species in Table 2-11, two species (Neosho madtom and Neosho mucket mussel) have been confirmed in the vicinity of WCGS or along the associated transmission line ROWs. The Neosho madtom and the Neosho mucket mussel occur in the Neosho River both upstream and downstream of its confluence with Wolf Creek. Species that are State-listed as threatened or endangered and have State-designated critical habitat in the Neosho River downstream of John Redmond Dam are the Ouchita kidneyshell, rabbitsfoot, western fanshell, and flutedshell mussels. With the exception of these six species, no aquatic species that is Federally or State-listed as threatened or endangered is known to occur or to have designated critical habitat in the vicinity of the WCGS site or along the associated transmission line ROW. None of these Federally or State-listed species are likely to occur in Coffey County Lake.

2.2.6 Terrestrial Resources

2.2.6.1 Terrestrial Upland Plant Communities

2.2.6.1.1 WCGS Property

The lands on WCGS property outside the immediate area surrounding the station facilities are managed to achieve a balance between agricultural production and conservation. Some land areas have been reserved for educational purposes and maintained as natural communities for wildlife habitat, including a strip around the shoreline of Coffey County Lake. The remaining land has been leased for grazing, hay, and crop production. In 2005, approximately 1,422 ac were leased for grazing, 508 ac were leased for hay production, and 1,282 ac were leased for crops such as soybeans, milo, corn, and wheat. WCNOC's agricultural leases require conservation practices such as contour plowing, construction and/or maintenance of terraces to reduce soil erosion, and at harvest, leaving grain around field edges for wildlife (WCNOC 2006d).

Grazing restrictions, pasture rotation, and controlled burning are used to ensure continued health of the native rangeland on WCGS property (WCNOC 2005a). Fire has always been an essential part of prairie communities, and prescribed burning is used on grasslands at WCGS to control woody brush invasion, control less desirable cool-season grasses or weeds, increase wildlife value, and increase prairie vigor and production. Controlled burning was completed on approximately 1,197 ac in 2005. Most grassland units at WCGS are scheduled to be burned once every 3 years (WCNOC 2006d).

A 200- to 400-ft wide strip surrounding the Coffey County Lake shoreline has been managed since 1980 as a buffer zone of natural vegetation between the lake and the agricultural areas. Agricultural activities are not allowed in this area and previously cultivated lands have been allowed to advance through the stages of natural succession. Native grasses have been re-established in some portions of the lakeside buffer zone. Land management activities here include controlled burning, tree and brush control in native grass prairie areas, and noxious weed control (WCNOC 2006d). Native prairie at WCGS is categorized as "bluestem prairie" and is typically composed of tall grasses and many species of forbs (NRC 1975). Most forested areas on WCGS property are in lowlands and riparian areas upstream and downstream of Coffey County Lake. The characteristics of these lowland/riparian forests are described below in Section 2.2.6.2 (WCNOC 2007c).

The Wolf Creek Environmental Education Area covers approximately 500 ac near the north end of the site property. It includes five trails that guide visitors through a variety of habitats, including native tall grass prairie, native and planted forests, wetlands, and wildlife food plots. In addition to the natural areas, there are shelterbelts, planted trees, restored native grasses, developed wetlands, and planted winter food plots for wildlife. The Wolf Creek Environmental Education Area is the result of a partnership between private citizens, civic organizations, local, State and Federal governments, and WCGS (WCNOC 2006a).

The area surrounding the WCGS property consists mainly of rangeland and farmland, with occasional forested areas in bottomlands along the Neosho River and other streams. The rangeland is vegetated, mostly by native and tame (introduced) grasses, mixed grass-brush, and managed pastures. There are no Federally designated or proposed critical habitats for threatened or endangered terrestrial species in the vicinity of WCGS or its associated transmission lines (WCNOC 2006a).

2.2.6.1.2 Transmission Line ROWs

The transmission lines included in this assessment are those with voltages exceeding 98 kV that were originally constructed for the specific purpose of connecting WCGS to the existing transmission system. These lines are described in more detail in Section 2.1.7. These transmission lines extend approximately 106 miles and their ROWs cover a total area of approximately 1,922 ac. The ROWs cross land that is primarily agricultural or open range and the areas are mostly remote with few human residents. The lines also cross numerous county, State, or U.S. highways. ROWs that pass through farmland generally are used as farmland. The ROWs do not cross any State or Federal parks, wildlife refuges, or wildlife management areas. State and Federal lands in the vicinity of the WCGS transmission line ROWs are associated with the John Redmond Reservoir to the west: the John Redmond Wildlife Area, which is managed by the KDWP, and the Flint Hills National Wildlife Refuge, an 18,500-ac refuge located on the upstream portion of John Redmond Reservoir on land owned by the U.S. Army Corps of Engineers and managed by the FWS (WCNOC 2006d).

Wolf Creek – Rose Hill Transmission Line

The Wolf Creek – Rose Hill 345-kV line extends approximately 98 miles from WCGS in a southwesterly direction to the Rose Hill substation east of Wichita. The ROW is 150 ft in width, which results in a total of approximately 1,782 ac within the ROW. Land uses in the area traversed by this ROW include cropland (402 ac, 24 percent of the total ROW area), grazing lands (1,187 ac, 70 percent), woodlands (63 ac, 4 percent), idle land (27 ac, 2 percent), and roads (9 ac, 0.5 percent). It should be noted that the land use acreages and percentages above were calculated in pre-construction studies, which estimated that the length of the Wolf Creek – Rose Hill line would be 93 miles. The Wolf Creek–Rose Hill line passes approximately 6 miles south of the John Redmond Wildlife Area and 9 miles south of the Flint Hills National Wildlife Refuge (WCNOC 2007c).

La Cygne – Benton Transmission Line (rerouted portion)

The portion of the La Cygne – Benton 345-kV transmission line that was rerouted around Coffey County Lake, which includes sections of the Wolf Creek – Benton line and the Wolf Creek – La Cygne line, is approximately 7.7-mi long. Most of this line was constructed on WCGS property. The ROW is 150-ft wide and covers nearly 140 ac. Land uses within the upland areas of this ROW include cropland (27 ac, 20 percent of the total ROW area); grazing land (43 ac, 31 percent); hay meadow (15 ac, 11 percent); woodland (7 ac, 5 percent); wildlife habitat such as native grasses, grass-brush, and brush habitats (23 ac, 16 percent); and roads, gravel areas, and WCGS yard areas (11 ac, 8 percent) (WCNOC 2007c).

2.2.6.2 Riparian and Wetland Plant Communities

The WCGS site encompasses approximately 9,818 ac located in Coffey County approximately 3.5 miles east of the Neosho River and 5 miles east of John Redmond Reservoir. The site includes the 5,090-ac Coffey County Lake, which was formed by the construction of an earthen dam across Wolf Creek, and the 31-ac Lime Sludge Pond.

2.2.6.2.1 Coffey County Lake and Wolf Creek

The riparian areas of Wolf Creek upstream and downstream of Coffey County Lake are typical of the oak-hickory forests found in east-central Kansas. They are medium to tall, multilayered, broadleaf deciduous forests typically occurring on the first and second terraces adjacent to streams (NRC 1975). Within the oak-hickory forest, lowland woods occupy the riparian areas of Wolf Creek. Studies were conducted during the initial licensing process for WCGS (KG&E 1982) to identify the plants composing the lowland woods along Wolf Creek. Hackberry *(Celtis occidentalis)* was dominant or codominant within the Wolf Creek woodlands. Common associate species were bur oak *(Quercus macrocarpa)*, white bitternut hickory *(Carya cordiformis)*, silver maple *(Acer saccharinum)*, black walnut *(Juglans nigra)*, American elm *(Ulmus americana)*, green ash *(Fraxinus pennsylvanica)*, and Kentucky coffee tree *(Gymnocladus dioica)*. Analysis of the distribution of tree species in the lowland woods showed that silver maple, American elm, green ash, and sycamore *(Platanus occidentalis)* were more common within the frequently inundated areas, while hackberry, eastern redbud *(Cercis canadensis)*, Kentucky coffee tree, hickories (*Carya* spp.) and oaks *(Quercus* spp.) occurred on higher, more well-drained sites (KG&E 1982).

The shrub component of the Wolf Creek riparian woodland community is comprised of species such as coralberry *(Symphoricarpos orbiculatus)*, poison ivy *(Rhus radicans)*, wild gooseberry *(Ribes missouriense)*, hackberry, and elms. The ground layer includes typical herbaceous floodplain species such as spreading chervil *(Chaerophyllum procumbens)*, wood nettle *(Laportea canadensis)*, Virginia wild rye *(Elymus virginicus)*, clearweed *(Pilea pumila)*, and fescue *(Festuca obtusa)* (NRC 1982).

The shoreline and shallow water habitats of Coffey County Lake have been colonized by species typical of wet soils or periodically flooded habitats. The shoreline vegetation includes species tolerant of various degrees of inundation and wet soil conditions, such as cottonwood *(Populus deltoides)*, black willow *(Salix nigra)*, and buttonbush *(Cephalanthus occidentalis)*. In more frequently flooded, shallow-water areas, emergent aquatic plants such as cattails (*Typha* spp.), smartweeds *(Polygonum* spp.), and water primrose *(Ludwigia peploides)* are common. Emergent and submersed plants growing in shallow but slightly deeper water include American lotus *(Nelumbo lutea)*, pondweeds (*Potemogeton* spp., primarily *p. nodosus* and *p. foliosus)*, and naiad *(Najas minor)* (WCNOC 2007c).

As the water level of Coffey County Lake fluctuates, mudflat areas develop. Plants colonizing these areas predominantly are common herbaceous species, with some woody species. Two types of plant communities typically occupy the mudflats. In poorly drained areas, plants adapted to wet, marshy areas initially dominate, such as sedges (*Carex* spp.), cattails, arrowhead *(Saggitaria latifolia*), and black willow. Other herbs common on wet mudflats include fall panic grass (*Panicum dichotomiflorum*), common cocklebur (*Xanthium strumarium*), and smartweeds. In areas where inundation is infrequent (4 to 5-yr intervals), these pioneer communities gradually transition to communities dominated by flood-tolerant woody species, such as black willow, buttonbush, and cottonwood (WCNOC 2007c).

Since WCGS operation began in 1985, activities have been performed to protect and enhance riparian areas on the station property. These have included the construction of approximately 25 ac of shallow-water, ephemeral wetlands; protection of old-growth, oak-hickory woodland; planting of bottomland forest; establishment of native grasses for buffers along the shoreline of Coffey County Lake; preservation of areas for natural succession; and exclusion of livestock (WCNOC 2007c).

2.2.6.2.2 Lime Sludge Pond

The Lime Sludge Pond is a 31-ac unlined pond located north of the switchyard and adjacent to Coffey County Lake. It was originally constructed to receive lime sludge but was never used for that purpose. The pond provides shoreline and shallow water habitats supporting communities similar to those described above for the lake (WCNOC 2006a).

2.2.6.2.3 John Redmond Reservoir and the Neosho River

The wetlands and shallow coves of John Redmond Reservoir are dominated by smartweeds, bulrush *(Scirpus* spp.), cattail, spike-rush *(Eleocharis* spp.), and sedges. Some stands of silver maple, black willow, and eastern cottonwood also are present. On the mudflats exposed during reservoir drawdown, weedy annuals such as cocklebur, foxtail grass *(Setaria* spp.), and barnyard grass *(Echinocloa* spp.) are common species (USACE 2002).

The riparian areas of the Neosho River upstream and downstream of John Redmond Reservoir were characterized in USACE (2002). The riparian woodlands along this reach of the Neosho River are bottomland hardwood forests dominated by American elm, green ash, eastern cottonwood, black willow, black walnut, sycamore, silver maple, bur oak, box elder *(Acer negundo),* and hackberry. Downstream from John Redmond Reservoir, most of the floodplain vegetation along the Neosho River and its major tributaries can be described as riparian woodland. Islands, point bars, and first terraces are dominated by species more tolerant of wet soil, such as eastern cottonwood, silver maple, and box elder. Second terraces, which are slightly higher in elevation, support eastern cottonwood, green ash, American elm, black walnut, hackberry, and bur oak (WCNOC 2007c).

The understory of the riparian woodland of the Neosho River floodplain includes coralberry, greenbriar, rough-leaf dogwood *(Cornus drummondii),* American plum *(Prunus americana),* and wild grape *(Vitis* spp.). Downriver from John Redmond Reservoir, islands, point bars, and riverbanks are invaded rapidly by sandbar willow *(Salix interior),* rough-leaf dogwood, and buttonbush, which eventually are replaced by black willow, silver maple, and eastern cottonwood (WCNOC 2007c).

2.2.6.2.4 Transmission Line ROWs

Riparian and wetland communities are a small component of the natural communities present within the transmission line ROWs.

Wolf Creek – Rose Hill Transmission Line

The Wolf Creek – Rose Hill 345-kV line traverses a total of approximately 4,950 ft (18.2 ac) of riparian woods and 480 ft (1.8 ac) of stream channel. Thus, a total of approximately 1 mile of riparian communities and waterways is traversed by the 98-mi line, representing approximately one percent of the total ROW area. Major rivers and associated watersheds traversed by the Wolf Creek – Rose Hill transmission line include the Neosho River, primarily in Coffey County, the Verdigris and Fall Rivers, primarily in Greenwood County, and the Walnut River, primarily in Butler County. Riparian vegetation communities along these rivers are substantially similar to the community described above for the Neosho River (WCNOC 2007c).

La Cygne – Benton Transmission Line (rerouted portion)

The portion of the La Cygne – Benton 345-kV transmission line rerouted around Coffey County Lake is approximately 7.7-mi long and mainly on WCGS property. The ROW is 150-ft wide and covers nearly 140 ac. There are approximately 12 ac of riparian (bottomland woodland), surface water, shoreline, and wetland habitats included in the ROW, or 8.7 percent of the total ROW area (WCNOC 2007c).

2.2.6.3 Terrestrial Fauna

The diversity, abundance, and distribution of terrestrial fauna in the vicinity of WCGS, and within the transmission line ROW, generally are governed by the available food and habitat provided by the upland, riparian, and wetland vegetation communities described above. WCGS property and the transmission line ROWs in Coffey, Greenwood, and Butler counties encompass habitat types common to eastern and south-central Kansas.

Principal classes of fauna that typically utilize these habitats and can be expected to occur within the study area include mammals, reptiles, amphibians, and birds.

Mammals that occur in terrestrial habitats of the region include the nine-banded armadillo (*Dasypus novemcinctus*), eastern cottontail (*Sylvilagus floridanus*), Virginia opossum (*Didelphis virginiana*), raccoon (*Procyon lotor*), striped skunk (*Mephitis mephitis*), coyote (*Canis latrans*), red fox (*Vulpes vulpes*), badger (*Taxidea taxis*), white-tailed deer (*Odocoileus virginianus*); insectivores such as the big brown bat (*Eptisicus fuscus*), red bat (*Lasiurus borealis*), eastern mole (*Scalopus aquaticus*), and southern short-tailed shrew (*Blarina carolinensis*); and rodents such as the woodchuck (*Marmota monax*), thirteen-lined ground squirrel (*Spermophilus tridecemlineatus*), gray squirrel (*Sciurus carolinensis*), pocket gopher (*Geomys bursarius*), and western harvest mouse (*Reithrodontomys megalotis*). Aquatic habitats in the area may be inhabited by the muskrat (*Ondatra zibethicus*), beaver (*Castor canadensis*), and mink (*Mustela vison*) (USACE 2002, WCNOC 2007c).

Reptiles that occur in terrestrial habitats of the region include the ornate box turtle (*Terepene ornata ornata*), three-toed box turtle (*Terepene carolina triunguis*), collared lizard (*Crotaphytus collaris*), Great Plains skink (*Eumeces obsoletus*), southern prairie skink (*Eumeces obtusirostris*), gopher snake (*Pituophis catenifer*), speckled kingsnake (*Lampropeltis getula holbrooki*), prairie kingsnake (*Lampropeltis calligaster*), red-sided garter snake (*Thamnophis sirtalis parietalis*), western massasauga (*Sistrurus catenatus tergeminus*), and osage copperhead (*Agkistrodon contortrix phaeogaster*). Aquatic reptiles inhabiting water bodies in the area include the snapping turtle (*Chelydra serpentina*), painted turtle (*Chrysemys picta*), and northern water snake (*Nerodia sipedon sipedon*). Amphibians that occur in terrestrial and aquatic habitats of the region include the American toad (*Bufo americanus*), Woodhouse's toad (*Bufo woodhousii*), Great Plains toad (*Bufo cognatus*), northern cricket frog (*Acris crepitans*), southern leopard frog (*Rana sphenocephala*), bullfrog (*Rana catesbeiana*), and smallmouth salamander (*Ambystoma texanum*) (Conant and Collins 1998, USACE 2002, WCNOC 2007c).

Common birds that inhabit the terrestrial habitats of the area include raptors such as the bald eagle (*Haliaeetus leucocephalus*), red-tailed hawk (*Buteo jamaicensis*), northern harrier (*Circus cyaneus*), prairie falcon (*Falco mexicanus*), American kestrel (*Falco sparverius*), turkey vulture (*Cathartes aura*), barred owl (*Strix varia*), and great horned owl (*Bubo virginianus*). Passerine, or perching, birds include the American crow (*Corvus brachyrhynchos*), eastern meadowlark (*Sturnella magna*), American goldfinch (*Carduelis tristis*), red-winged blackbird (*Agelaius phoneniceus*), northern mockingbird (*Mimus polyglottos*), eastern kingbird (*Tyrannus tyrannus*), barn swallow (*Hirundo rustica*), horned lark (*Eremophila alpestris*), American robin (*Turdus migratorius*), northern cardinal (*Cardinalis cardinalis*), brown thrasher (*Toxostoma rufum*), field sparrow (*Spizella pusilla*), and eastern bluebird (*Sialia sialis*). Upland game birds occurring in the area include the wild turkey (*Meleagris gallopavo*), northern bobwhite (*Colinus virginianus*), and mourning dove (*Zenaida macroura*) (USACE 2002, WCNOC 2007c).

Common birds that inhabit the aquatic habitats of the area include waterfowl (ducks and geese) and a variety of other water birds, such as shorebirds and wading birds. The main use by waterfowl of the lakes, ponds, and wetlands in the area is for resting and foraging during fall and spring migration; little nesting activity takes place in the vicinity (USACE 2002). Waterfowl commonly observed in the area during migration include the mallard (*Anas platyrhynchos*), wood duck (*Aix sponsa*), northern shoveler (*Anas clypeata*), blue-winged teal (*Anas discors*), green-winged teal (*Anas crecca*), cinnamon teal (*Anas cyanoptera*), lesser scaup (*Aythya affinis*), redhead (*Aythya americana*), ring-necked duck (*Aythya collaris*), common merganser

(*Mergus merganser*), Canada goose (*Branta canadensis*), snow goose (*Chen caerulescens*), and white-fronted goose (*Anser albifrons*). Shorebirds that occur in the area during migration include the greater yellowlegs (*Tringa melanoleuca*), lesser yellowlegs (*Tringa flavipes*), semipalmated sandpiper (*Calidris pusilla*), solitary sandpiper (*Tringa solitaria*), western sandpiper (*Caladris mauri*), willet (*Catoptrophorus semipalmatus*), ring-billed gull (*Larus delawarensis*), herring gull (*Larus argentatus*), Forster's tern (*Sterna forsteri*), and black tern (*Chlidonias niger*), while the killdeer (*Charadrius vociferus*) and spotted sandpiper (*Actitis macularia*) may breed in the area. Other water birds that may occur in the vicinity include the white pelican (*Pelecanus erythrorhynchos*), American coot (*Fulica americana*), pied-billed grebe (*Podilymbus podiceps*), horned grebe (*Podiceps auritus*), and double-crested cormorant (*Phalacrocorax auritus*), and wading birds such as the great blue heron (*Ardea herodias*) and green heron (*Butorides virescens*) (USACE 2002, WCNOC 2007c).

A wildlife monitoring program was begun at WCGS in 1982 to monitor and assess waterfowl, water bird, and bald eagle usage of Coffey County Lake and the Lime Sludge Pond. This program included transmission-line collision surveys to assess avian collision mortality and determine potential mitigation needs. Upon completion of monitoring in 1986, sufficient data had been collected to determine that avian collisions with transmission lines were minimal, and no endangered or threatened species were found (WCNOC 2006a). Consequently, the scope of the wildlife monitoring program was reduced (WCNOC 1988). The current program, in accordance with the Avian Protection Plan (WCNOC 2006i) consists of annually reviewing waterfowl and bald eagle survey data collected by the KDWP and then determining if changes to the wildlife monitoring program are warranted (WCNOC 2005d).

Wildlife and habitat management at WCGS involves cooperation between WCGS biologists, the FWS, and KDWP. For example, four ospreys (*Pandion haliaetus*) were released each year from 1996 to 2001 at the Wolf Creek Environmental Education Area in cooperation with KDWP in an attempt to establish a nesting population. Also, in an attempt to establish a nesting population of the American peregrine falcon (*Falco peregrinus anatum*), five juveniles were released at WCGS in 2004, and five more were released in 2005 (WCNOC 2006a).

2.2.6.4 Rare Terrestrial Species

Table 2-14 presents terrestrial animal and plant species that are Federally or State-listed as endangered or threatened (or are candidates for listing) in the counties within which WCGS (Coffey County) and its associated transmission lines (Coffey, Butler, and Greenwood Counties) are located. The species included in Table 2-14 are those that meet the following criteria:

- The species has a Federal or State legally protected status of threatened or endangered in Coffey, Greenwood, or Butler Counties, based on its listing status from the FWS and KDWP; and

- Records maintained by the FWS and KDWP indicate that the species has been recorded as occurring currently or historically in at least one of these counties.

Table 2-14. Protected Terrestrial Species Potentially Occurring in the Vicinity of WCGS and the Associated Transmission Line ROWs

Scientific Name[(a)]	Common Name[(a)]	Federal Status[(b)]	State Status[(c)]
Mammals			
Spilogale putorius	eastern spotted skunk	--	T
Birds			
Charadrius alexandrinus	snowy plover	--	T
Charadrius melodus	piping plover	(PS[1]: LT)	T
Falco peregrinus	peregrine falcon	--	E
Grus americana	whooping crane	LE	E
Haliaeetus leucocephalus	bald eagle	–[2]	E
Sterna antillarum	least tern	(PS[3]: LE)	E
Plants			
Asclepias meadii	Mead's milkweed	LT	--

[(a)] Species listed are those that (1) have Federal or State legally protected status of threatened or endangered in Coffey, Butler, or Greenwood Counties; and (2) have been recorded as occurring currently or historically in at least one of these counties.

[(b)] Federal legal status in Kansas -- definitions:

LE Listed endangered

LT Listed threatened

(PS) Partial status: listing status in only a portion of the species' range, as specified in footnotes below

[1] Piping plover status in Kansas is threatened; only populations in the Great Lakes region are endangered

[2] Bald eagle was federally delisted on August 8, 2007.

[3] Least tern status is endangered only for the population that breeds in the interior of the United States

[(c)] State legal status definitions:

E Endangered: any species of wildlife whose continued existence as a viable component of the State's wild fauna is determined to be in jeopardy.

T Threatened: any species of wildlife which appears likely, within the foreseeable future, to become an endangered species.

SNC Species in need of conservation: any nongame species deemed to require conservation measures in an attempt to keep the species from becoming a threatened or endangered species.

Sources: KDWP 2004c and 2007e; FWS 2007a, 2007b, and 2007c

Listed terrestrial species that meet these criteria include six birds, one mammal, and one plant (Table 2-14). The peregrine falcon, one of the species State-listed as endangered, has been released at WCGS (a total of ten juveniles in 2004 and 2005) as part of a program to establish a nesting population (WCNOC 2006a). The four Federally-listed species are described below. None of these species have Federally designated critical habitat in the vicinity of the study area.

2.2.6.4.1 Piping Plover

The piping plover (*Charadrius melodus)* is a small, migratory shorebird about 7 in. long that forages near water and preys on invertebrates. It breeds in three geographic regions of North America: the northern Great Plains, the Great Lakes, and the Atlantic Coast. The northern Great Plains breeding population of the piping plover is Federally-listed as threatened. The piping plover is State-listed as threatened in Kansas. The breeding range of the northern Great Plains population includes southern Alberta, northern Saskatchewan, and southern Manitoba in Canada, and eastern Montana, North and South Dakota, southeastern Colorado, Iowa, Nebraska, and north-central Minnesota. The majority of breeding pairs in the United States are in the Dakotas, Nebraska, and Montana. Fewer pairs nest in Minnesota, Iowa, and Colorado, and there is occasional nesting in Oklahoma and Kansas (FWS 2002). Piping plovers return to their breeding grounds in northern Great Plains in March or April and depart by September to winter along the Gulf Coast. Northern Great Plains breeding and nesting habitats for the piping plover include sandbars and islands in river channels; sparsely vegetated sand or gravel shorelines, peninsulas, and islands of lakes and reservoirs; and alkali wetlands and lakes (FWS 2007b). In Kansas, nesting has been recorded on sand bars along the Kansas River in the northeastern part of the State (KDWP 2004c).

Habitat destruction or degradation and poor breeding success due to predation are principal reasons for the decline in piping plover populations. Construction and operation of reservoirs on the Missouri and other river systems have reduced sandbar habitat and caused water fluctuations affecting the remaining sandbars. Plovers using the reduced sandbar areas that remain are susceptible to predation and human disturbance. Critical habitat has been designated by the FWS for piping plover breeding habitat in Minnesota, Montana, North Dakota, South Dakota, and Nebraska, but not in Kansas (FWS 2007b). KDWP has no current records of the piping plover in Coffey, Greenwood, or Butler Counties (FWS 2007c), but it designates Coffey County as being within the known historic range of the piping plover (KDWP 2004c).

2.2.6.4.2 Whooping Crane

The whooping crane (*Grus americana*) is Federally and State-listed as endangered. It is the tallest North American bird. Males approach 1.5 meters (5 ft) when standing erect. It is a wading bird with an omnivorous diet that varies by season and includes insects, frogs, rodents, small birds, minnows, and berries in summer; crabs, clams, and a few plants in winter; and frogs, fish, plant tubers, crayfish, insects, and agricultural grains during migration. The whooping crane is a long-lived species currently estimated to have a maximum longevity in the wild of at least 30 years (CWS and FWS 2007). It feeds and roosts in wetlands and upland grain fields and nests in marshy areas among cattails, bulrushes, and sedges. During migration through Kansas, it prefers resting areas in wetlands, in level to moderately rolling terrain away from human activity and where low, sparse vegetation allows it an open view (KDWP 2004c).

The whooping crane was listed as endangered in the U.S. in 1973. Population declines of the whooping crane historically were caused by habitat loss (mainly destruction of nesting habitat in prairies due to agricultural development), shooting, and displacement by human activities. Current threats include the limited genetic potential of the population (the wild population was estimated at 338 in February 2006), loss and degradation of migration stopover habitat, construction of additional power lines, and degradation of the coastal ecosystems where it winters (CWS and FWS 2007). The historical breeding range of the whooping crane included the northern Great Plains and the birds historically wintered along the Gulf of Mexico. Currently, the only self-sustaining wild population breeds in the Northwest Territories of Canada and winters at the Aransas National Wildlife Refuge on the coast of Texas (FWS 2007b). Birds from this population migrate through central Kansas in the spring (March - April) and fall (October - November) (KDWP 2004c) as part of their annual migration that covers 4,000 kilometers (2,485 miles) (CWS and FWS 2007).

Two areas in central Kansas, Cheyenne Bottoms State Waterfowl Management Area in Barton County and Quivira National Wildlife Refuge in Stafford, Reno, and Rice Counties, have been Federally designated as critical habitat for migrating whooping cranes under the Endangered Species Act (FWS 2007b). These two critical migratory habitats are on the approximate center line of a 200-mi-wide migration corridor that crosses central Kansas in a north-south orientation. The corridor was delineated by the FWS by mapping confirmed sightings of whooping cranes reported by individuals through 1999 and data from radio-tracking of whooping cranes during the period 1981 to 1984. The corridor encompasses approximately 94 percent of all sightings through 1999 (CWS and FWS 2007). The two critical habitats are more than approximately 160 miles west of WCGS and 80 miles northwest of the western terminus of the WCGS – Rose Hill transmission line ROW. WCGS is approximately 60 miles east of the migration corridor, while the terminal end of the transmission line ROW extends approximately 30 miles inside the corridor. There are no current records of the whooping crane in Coffey, Butler, or Greenwood Counties (FWS 2007c), but KDWP designates Coffey and Greenwood Counties as being within the known historic range of the whooping crane (KDWP 2004c).

2.2.6.4.3 Least Tern

Interior populations of the least tern (*Sterna antillarum*) in the United States are Federally listed as endangered. Interior populations are those more than 50 miles from the coasts. The least tern is State-listed as endangered in Kansas. The least tern is the smallest North American tern. It feeds by hovering and diving for small fish. The least tern winters in Central and South America and is found in Kansas only during migration and the summer nesting season. Its preferred nesting habitats are sparsely vegetated sand and gravel bars within wide, unobstructed, river channels. It also has been recorded nesting in sand and gravel pits, dredge islands, and along lake shorelines. The interior population of the least tern has declined primarily due to loss of habitat resulting from dam construction and river channelization on major rivers throughout the Mississippi, Missouri, and Rio Grande River systems (FWS 2007b). Because of dams, river flows often are not conducive to the creation and maintenance of sandbars with sparse vegetation. Other disturbances, such as housing construction, development, and recreational activities that disturb nest sites, also threaten least tern populations (FWS 2007b).

The Final Environmental Statement (FES) related to the operation of WCGS stated that the least tern was observed at John Redmond Reservoir in 1977, but the FES did not specify whether the occurrence referred to migratory or nesting terns (NRC 1982). One to six least terns were observed on a few occasions at Coffey County Lake during the mid-1980s, but the terns were presumed to be transients and nesting of least terns has not been recorded at Coffey County Lake (WCNOC 2006a). There are no current records of the least tern in Coffey, Greenwood, or Butler Counties (FWS 2007c). Of these three counties, KDWP designates only Coffey County as being within the known historic range of the least tern (KDWP 2004c).

2.2.6.4.4 Mead's Milkweed

Mead's milkweed (*Asclepias meadii*) is Federally-listed as threatened. The State of Kansas does not include plant species in its list of threatened and endangered species and does not provide legal protection to this species. Mead's milkweed is a perennial herb of the tallgrass prairie. It produces a single cluster of greenish-white flowers at the top of a 2-ft stalk in May and early June. Mead's milkweed has low reproductive rates but is a long-lived plant that may persist indefinitely unless destroyed by humans, animals, or pathogens. Studies based on growth of seedlings suggest that Mead's milkweed may require 15 years or more to mature from a germinating seed to a flowering adult. The habitat of Mead's milkweed principally is mesic to dry mesic upland, tallgrass prairie, generally in full sun and on slopes of less than 20 percent (FWS 2003).

Mead's milkweed was listed as threatened in 1988. Its populations have declined due to the fragmentation and destruction of tall-grass prairie as a result of intense agricultural use, urban growth, development, recreational use of sites, and hay mowing that disrupts the reproductive cycle. Mead's milkweed continues to be threatened by these factors as well as effects of habitat fragmentation that include the loss of genetic diversity, lack of pollinators, and increased insect predation (FWS 2003).

Mead's milkweed formerly was widespread over much of the eastern tallgrass prairie region of the central United States. It has been extirpated from Wisconsin and Indiana and currently is known to occur at approximately 170 sites within 34 counties in eastern Kansas, Missouri, south-central Iowa, and southern Illinois. Kansas populations are in the eastern counties from north of the Kansas River south to Neosho County in the southeastern corner of the State. Almost all of the Mead's milkweed population sites in Kansas are on privately owned land that is being used as prairie hay meadows. Mowing of these prairies typically occurs in late June to early July and results in the removal of immature fruits, thus preventing the plants from completing their life cycle (FWS 2003). The FWS Mountain-Prairie Region records this species as occurring in Coffey County (FWS 2007c). Surveys to determine the presence of Mead's milkweed on WCGS property or within the transmission line ROWs have not been performed. The presence of tallgrass prairie communities on these properties within Coffey County indicates that habitat with the potential to support Mead's milkweed may be present, although the plant is not currently known to occur in these areas.

2.2.6.4.5 Summary

Of the four Federally-listed terrestrial species in Table 2-12, only one species (the least tern) have been confirmed in the vicinity of WCGS or along the associated transmission line ROW. Least terns were recorded at Coffey County Lake in the 1980s, but nesting has not been observed there. With the exception of this species and the State-listed peregrine falcons released in the vicinity of Coffey County Lake, no other terrestrial species that is Federally or State-listed listed as threatened or endangered has been recorded as occurring in the vicinity of the WCGS site or along the associated transmission line ROWs.

2.2.7 Radiological Impacts

WCGS conducts an annual REMP in which radiological impacts to employees, the public, and the environment in and around the Wolf Creek site are monitored, documented, and compared to the appropriate standards. The objectives of the REMP are to:

- Measure and evaluate the effects of facility operation on the environs and verify the effectiveness of the controls on radioactive effluents;
- Monitor natural radiation levels in the environs of the WCGS site; and
- Demonstrate compliance with the requirements of applicable Federal regulatory agencies, including technical specifications and the ODCM.

Radiological releases are summarized in two WCGS reports: the *Annual Radiological Environmental Operating Report* (WCNOC 2003c, 2004d, 2005e, 2006g, 2007e) and *Annual Radioactive Effluent Release Report* (WCNOC 2003a, 2004a, 2005a, 2006c, 2007a). Limits for all radiological releases are specified in the WCGS ODCM and are used to meet Federal standards and requirements. The REMP includes monitoring of the waterborne environment (surface, sediment from shoreline); airborne environment (radioiodine and particulates, direct radiation); and ingestion pathways (milk, fish, food products). During 2006, there were no plant-related activation, corrosion, or fission products detected in airborne particulate and radioiodine filters, ground water, drinking water, shoreline sediment, broadleaf vegetation, crops, terrestrial vegetation, aquatic vegetation, soil, or deer samples. Activation, corrosion, or fission products attributable to plant operation were detected during 2006 in surface water, fish, and bottom sediment samples. However, the reported data on the radionuclides detected in environmental samples were below applicable NRC reporting levels and showed no significant or measurable impact from the operations at WCGS. The KDHE also performs sampling and analysis of selected environmental media in conjunction with WCGS. Historical data on releases from WCGS and the resultant dose calculations demonstrate that the doses to a maximally exposed individual in the vicinity of WCGS were a small fraction of the limits specified in 10 CFR Part 20; Appendix I to 10 CFR Part 50; and EPA radiation standards in 40 CFR Part 190. For 2006, dose values were calculated based on actual liquid and gaseous effluent release data and conservative models to simulate the transport mechanisms. The results are described in the *2006 Annual Radioactive Effluent Release Report* (WCNOC 2007a). A summary of the calculated maximum dose to an individual located at the WCGS site boundary from liquid and gaseous effluents released during 2006 is as follows:

- The calculated whole-body dose to the maximally exposed off-site member of the general public from liquid effluents was 0.149 mrem, well below the 3-mrem-dose criteria in Appendix I to 10 CFR Part 50.
- The calculated whole-body dose to the maximally exposed off-site member of the general public from gaseous effluents was 0.038 mrem, well below the 5-mrem-dose criteria in Appendix I to 10 CFR Part 50.

In addition to the routine REMP, the applicant established an on-site groundwater monitoring program in March 2006. The program is designed to monitor the on-site environment for indication of leaks from plant systems and pipes carrying liquids with radioactive material. The results were reported in the WCGS *2006 Annual Radioactive Effluent Release Report* (WCNOC 2007a). The data showed that, except for tritium, no radioactive material from the plant was detected in the groundwater samples. The level of tritium in the wells ranged from 197 pCi/l to 1,823 pCi/l, which is well below the reporting level of 20,000 pCi/l. More detailed information on water monitoring is contained in Section 2.2.3.

The applicant does not anticipate any significant changes to the radioactive effluent releases or exposures from WCGS operations during the renewal period and the impacts to the environment are, therefore, not expected to change.

2.2.8 Socioeconomic Factors

This section describes current socioeconomic factors that have the potential to be directly or indirectly affected by changes in operations at WCGS. WCGS and the communities that support it can be described as a dynamic socioeconomic system. The communities provide the people, goods, and services required by WCGS operations. WCGS operations, in turn, create the demand and pay for the people, goods, and services in the form of wages, salaries, and benefits for jobs and dollar expenditures for goods and services. The measure of the communities' ability to support the demands of WCGS depends on their ability to respond to changing environmental, social, economic, and demographic conditions.

The socioeconomics region of influence (ROI) is defined by the areas where WCGS employees and their families reside, spend their income, and use their benefits, thereby affecting the economic conditions of the region. The ROI consists of a two-county area (Coffey and Lyon counties), which is where approximately 72 percent of WCGS employees reside. The following sections describe the housing, public services, off-site land use, visual aesthetics and noise, population demography, and the economy in the ROI surrounding the WCGS site.

WCGS employs a permanent workforce of around 1,100 employees (WCNOC 2007h). Approximately 91 percent live in Anderson, Coffey, Franklin, Lyon and Osage Counties, Kansas (Table 2-15). The remaining 9 percent are divided among 13 counties in Kansas with numbers ranging from 1 to 27 employees per county. Given the residential locations of WCGS employees, the most significant impacts of plant operations are likely to occur in Coffey and Lyon counties where approximately 72 percent of the WCGS employees reside. The focus of the analysis in this SEIS is therefore on the impacts of WCGS in these two counties.

Table 2-15. WCGS Permanent Employee Residence by County in 2006

County	Number of WCGS Personnel	Percentage of Total
Anderson	66	6.5
Coffey	562	55.1
Franklin	70	6.9
Lyon	170	16.7
Osage	56	5.5
Other	96	9.4
Total	1,020	100

Source: WCNOC 2007h

WCGS schedules refueling outages at 18-month intervals. During refueling outages, site employment increases by 700 to 960 workers for approximately 40 days of temporary duty.

Most of these workers are assumed to be located in the same geographic areas as the permanent WCGS staff.

2.2.8.1 Housing

Table 2–16 lists the total number of occupied housing units, vacancy rates, and median value in the region of influence. According to the 2000 Census, there were over 18,600 housing units in the ROI, of which approximately 17,000 were occupied. The median value of owner-occupied units was $60,700 in Coffey County, which was lower than Lyon County. The vacancy rate was higher in Coffey County (10 percent) and lower in Lyon County (7.2 percent).

In 2005, the total number of housing units in Coffey County grew by more than 163 units to 4,039 (USCB 2007a).

Table 2-16. Housing in Coffey and Lyon Counties, Kansas in 2000

	Coffey	Lyon	ROI
Total	3,876	14,757	18,633
Occupied housing units	3,489	13,691	17,180
Vacant units	387	1,066	1,453
Vacancy rate (percent)	10.0	7.2	7.8
Median value (dollars)	60,700	67,900	64,300
Source: USCB 2007a and USCB 2007b			

2.2.8.2 Public Services

2.2.8.2.1 Water Supply

Approximately 72 percent of the WCGS employees reside in Coffey County (55 percent) and Lyon County (17 percent), with almost 30 percent residing in the City of Burlington (WCNOC 2006a). All of the major public water suppliers in Coffey and Lyon Counties, including municipalities and rural water districts, obtain their drinking water supply from surface water sources (Table 2-17 provides public water supply information for the Coffey County community water systems, including average daily use and maximum daily capacity. A population of approximately 8,600 is served by these water suppliers (EPA 2007). The city of Burlington, which supplies treated water to most of the other public water supply systems in the county, obtains its water supply from the Neosho River. Burlington built a new water treatment plant in 2006 that has a design capacity of 3 mgd.[e] It is intended to meet projected future demands in the county, including the accommodation of small, outlying communities currently without public

[e] Interview with City of Burlington officials on March 13, 2007.

water. The city is part of the Cottonwood and Neosho River Basins Assurance District Number 3 and holds water rights to 2.2 mgd (USACE 2002). Water right holders would receive additional water from Federal reservoirs during times of drought (KWO 2001).

Table 2-17. Coffey County Public Water Supply Systems and Capacities

Water System (1)	Water Source Type (1)	Average Daily Consumption (mgd)	Maximum Daily Capacity (mgd)
City of Burlington	Surface water	0.6 to 0.7 [a]	1.8 [a]
Coffey County Rural Water District 2	Purchased surface water	NA	NA
Coffey County Rural Water District 2E	Purchased surface water	NA	NA
Coffey County Rural Water District 3	Purchased surface water	NA	NA
City of Gridley	Purchased surface water	NA	NA
City of Lebo	Purchased surface water	NA	NA
City of LeRoy	Purchased surface water	NA	NA
City of New Strawn	Purchased surface water	NA	NA
City of Waverly	Purchased surface water	NA	NA

NA - Not applicable

(1) Source: EPA 2007

[a] Interview with City of Burlington officials on March 13, 2007.

Table 2-18 provides public water supply information for the Lyon County community water systems, including average daily use and maximum daily capacity. A population of approximately 34,000 is served by these water suppliers (EPA 2007). The city of Emporia, which supplies treated water to most of the other public water supply systems in the county, obtains its water supply from the Neosho River. The city is part of the Cottonwood and Neosho

River Basins Assurance District Number 3 and holds water rights to 20 mgd, with 1 mgd from the Cottonwood River available for peak season.[f]

Table 2-18. Lyon County Public Water Supply Systems and Capacities

Water System (1)	Water Source Type (1)	Average Daily Consumption (mgd)	Maximum Daily Capacity (mgd)
City of Admire	Purchased surface water	NA	NA
City of Allen	Purchased surface water	NA	NA
City of Emporia	Surface water	10 to 12 [b]	15 [b]
Green Acres Mobile Home Park	Purchased surface water	NA	NA
City of Hartford	Purchased surface water	NA	NA
Lyon County Rural Water District 1	Purchased surface water	NA	NA
Lyon County Rural Water District 2	Purchased surface water	NA	NA
Lyon County Rural Water District 3	Purchased surface water	NA	NA
Lyon County Rural Water District 4	Purchased surface water	NA	NA
Lyon County Rural Water District 5	Purchased surface water	NA	NA
City of Olpe	Purchased surface water	NA	NA
City of Reading	Purchased surface water	NA	NA

NA – Not applicable
(1) Source: EPA 2007
[b] Interview with City of Emporia officials on March 14, 2007.

[f] Interview with City of Emporia officials on March 14, 2007.

The Kansas Water Office coordinates the water planning process within the State and has developed the Kansas Water Plan (KWO 2004) for use in the management, conservation, and development of the water resources of the State. Coffey and Lyon Counties are for the most part located in the Neosho Basin, one of the 12 major river basins in the State. The estimated 174,000 persons residing in the basin in 2000 is projected to grow to nearly 195,000 by 2040. Surface water is the primary water supply source in the basin (nearly 80 percent, based on year 2000 water use). Over 48 percent of the water used in the basin is for municipal use, 32 percent is for industrial use, almost 12 percent for recreation, and 7 percent for irrigation.

One of the major water management issues addressed by the Kansas Water Plan is public water supply. The Plan focuses on ensuring adequate supplies of water within the basin to meet future needs for water quality and quantity. An evaluation of capacity development for public water supply systems in the Neosho Basin, to determine their technical, financial, and managerial capabilities to provide safe drinking water, identified twelve systems that had high ranked needs for improvement. Two of these systems are in Coffey County (Coffey County Rural Water Districts 2 and 2E) and one is in Lyon County (Green Acres Mobile Home Park). These three systems together serve a population of approximately 2,100. No drought vulnerable public water suppliers were identified in Coffey or Lyon Counties (KWO 2004).

2.2.8.2.2 Education

Public school systems in Coffey and Lyons Counties are organized by districts, with three separate school districts in each county. WCGS is located in the Burlington School District, Unified School District (USD) Number 244, which serves 835 students and relies on a 2006 to 2007 operating budget of over $13.7 million in expenditures (KSDE 2006a). The three public school districts serving Coffey County, including Burlington USD 244 in the center as well as Lebo-Waverly USD 243 in the north and LeRoy-Gridley USD 245 in the south, have a total 2006 to 2007 enrollment of 1,728; all three school districts have been experiencing declining enrollment (KSDE 2006a, 2006b, 2006c). The 2006 to 2007 expenditure per student ranges from $12,479 in Lebo-Waverly to $15,817 in Burlington (KSDE 2006a, 2006b, 2006c). The public school districts in Lyon County have a total 2006 to 2007 enrollment of 5,958 with the majority of students (4,850) attending schools in the Emporia USD 253 district, which has a stable student population while the other two districts are facing declining enrollment (KSDE 2006d, 2006e, 2006f).

2.2.8.2.3 Transportation

Figures 2-1 and 2-2 show the WCGS site and highways within a 50-mi radius and a 6-mi radius of WCGS. At the larger regional scale, the major highways serving WCGS are:

(1) Interstate 35, located 13 miles north of WCGS, and Interstate 70, which can be accessed 55 miles north at Topeka;

(2) U.S. Highway 75, which is located approximately 3 miles west of WCGS and runs through the city of Burlington; and

(3) U.S. Highway 169, 15 miles east of WCGS in Anderson County, and U.S. Highway 54, which crosses U.S. Highway 75 20 miles south of Burlington in Woodson County.

Local road access to WCGS is via 16th Road from the east and 17th Road from the west, both of which intersect with the facility access road, Oxen Lane, north of WCGS. These are two-lane paved roads. Approximately 6 miles northwest of WCGS, 17th Road intersects with U.S. Highway 75, which is the major north-south highway in Coffey County. Employees traveling from the north, west, and south would use 17th Road and/or U.S. Highway 75 to reach WCGS. Employees from the east would likely use 16th Road. During shift changes, there is some congestion near the intersection of 17th Road and U.S. Highway 75. However, the intersection remains clear at all other times (WCNOC 2006a).

The *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (GEIS), NUREG-1437, Volumes 1 and 2 (NRC 1996; 1999)[g] uses the Transportation Research Board's level of service (LOS) classification system, which characterizes operational conditions on a roadway, to describe existing conditions for local transportation networks. "The Kansas Department of Transportation makes LOS determinations for roadways involved in specific projects. However, there are no current LOS determinations for the roadways" in Coffey County.[h] Table 2-19 provides available daily traffic counts for roads in the vicinity of WCGS from the Kansas Department of Transportation.

Coffey County is served by two railroads, Union Pacific at LeRoy and Burlington-Northern-Santa Fe at Lebo (Coffey County 1999). There is rail service to WCGS via a 13-mi spur to the Union Pacific system near Aliceville, southeast of the site.

(g) 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.

(h) Personal communication with Hugh Bogle, Kansas Department of Transportation, District 4. June 26, 2007.

Table 2-19. Traffic Counts for Roads in the Vicinity of WCGS, 2004

Road Name/ Number	Location	Annual Average Daily Traffic Volume	Year
17th Road	1.5 miles west of U.S. 75	509	2004
17th Road	2.0 miles east of U.S. 75	1,155	2004
Oxen Lane	Near intersection with17th Road	1,082	2004
16th Road	At intersection with Trefoil Road	825	2004
U.S. 75	Near intersection with 17th Road	4,790*	2006

Sources: KDOT 2004 and 2007
* Traffic volume in 2004 at this location was 5,190.

2.2.8.3 Off-site Land Use

WCGS is located in central Coffey County. Current land use surrounding the WCGS property is predominantly rangeland and farmland (WCNOC 2006a). The area within the vicinity of WCGS (i.e., within a 6-mi radius of the site) is located entirely within Coffey County and includes the cities of Burlington approximately 3 miles to the southwest and New Strawn approximately 2.5 miles to the northwest, as well as the eastern portion of the John Redmond Reservoir (see Figure 2-2). Burlington is the principal city and county seat of Coffey County. Since most WCGS employees reside in Coffey and Lyon Counties, land use in these two counties is discussed in the following sections.

2.2.8.3.1 Coffey County

Coffey County occupies an area of 630 sq mi and is not located in a metropolitan area (USCB 2007a). Land use in the county is primarily agriculture (83 percent), mainly cropland (48 percent) and rangeland (31 percent). Non-agricultural land use, such as residential, commercial, and industrial, is concentrated in or near the cities and occupies 17 percent of the county land area. Publicly owned property in Coffey County includes the John Redmond Wildlife Area, managed by the KDWP, and the 18,500-ac Flint Hills National Wildlife Refuge located on the upstream portion of John Redmond Reservoir (WCNOC 2006a). Table 2-20 provides the acreage and percent of total for each land use category in Coffey County.

Table 2-20. Land Use in Coffey County, 2002

Land Use	Acres	Percent of Total
Agricultural	335,835	83.3
Cropland	193,375	48.0
Woodland	7,466	1.9
Rangeland /Pastureland	123,296	30.6
House lots, ponds, roads, wasteland, etc.	11,698	2.9
Non-agricultural	67,205	16.7
Total	**403,040**	**100**

Sources: USDA 2004 (agricultural land uses) and USCB 2007a (total land area)

Land use in the unincorporated areas of Coffey County (i.e., outside of city limits) is regulated by the county, primarily through zoning and subdivision regulations. Nearly all of the land in Coffey County is zoned for agricultural use, primarily A-1 Agricultural, with the areas surrounding the six cities zoned A-2 Agricultural Transitional. The A-1 Agricultural district is established to encourage the compact development of the urban areas, to preserve productive farm and ranch land, and to permit limited nonagricultural uses and low-density dwellings that would not be incompatible to the rural area and require minimum public services. The A-2 Agricultural Transition district is established to retain certain rural characteristics, but to also serve as a transition area to accommodate many of the nonagricultural uses normally located in a rural area while anticipating an increasing amount of urbanization including low-density dwellings (Coffey County Planning Board 2000). Control of land use in the cities rests with the individual municipalities, which have zoning authority for the lands within their boundaries. The cities of Burlington, Lebo, New Strawn, and Waverly have zoning ordinances.[i] The cities of Burlington and Lebo also have a Comprehensive City Plan (Kansas State Library 2007a and 2007b). Coffey County does not have a comprehensive plan to guide land use. The Southeast Kansas Regional Planning Commission is the regional planning agency responsible for overall coordination of planning in the communities of southeast Kansas, including Coffey County. However, this agency is focused on promotion of economic growth and development and does not address land use in its planning activities (SEKRPC 2007).

[i] Interview with Coffey County officials on March 13, 2007.

2.2.8.3.2 Lyon County

Lyon County has a land area of 851 sq mi and is located in the Emporia, Kansas micropolitan area (USCB 2007b). The county, located northwest of Coffey County, includes the City of Emporia, which is the county seat and the closest population center to WCGS. The major land use in Lyon County is agriculture (91 percent), primarily cropland (48 percent) and rangeland (37 percent). The remaining 9 percent of the county is occupied by non-agricultural land uses. Residential uses are concentrated around the City of Emporia, as well as scattered throughout rural Lyon County along rural water system supply lines and arterial roads and highways (Lyon County Planning Board 2001). Table 2-21 identifies the acres in each land use category in Lyon County and the percent of the total land area that each category occupies.

Table 2-21. Land Use in Lyon County, 2002

Land Use	Acres	Percent of Total
Agricultural	493,853	90.7
Cropland	261,814	48.1
Woodland	10,642	1.9
Rangeland/Pastureland	201,208	36.9
House lots, ponds, roads, wasteland, etc.	20,189	3.7
Non-agricultural	50,704	9.3
Total	**544,557**	**100**

Sources: USDA 2004 (agricultural land uses) and USCB 2007b (total land area)

The Lyon County Planning Board, in cooperation with the Board of County Commissioners, adopted the latest update of the Lyon County Comprehensive Plan in 2001 (Lyon County Planning Board 2001). The Comprehensive Plan includes broad goals that set the direction for the future of the county, including agricultural, development, and housing goals, as well as more detailed objectives to guide future development. As in Coffey County, Lyon County and the cities within the county guide land use through local zoning bylaws. The Lyon County Comprehensive Plan provides a framework in which residential, non-farm development is directed toward the Emporia-Lyon County Metropolitan Planning Area and along designated urban access corridors in order to protect and conserve good agricultural land. Commercial and industrial development is encouraged in areas where public services are available or easily extended.

2.2.8.4 Visual Aesthetics and Noise

The WCGS plant structures can be seen from the surrounding area, which has flat to gently rolling topography. The main vertical components of the WCGS building complex are the domed reactor containment building (approximately 234 ft tall) and the turbine building (approximately 150 ft tall). The upper portion of the reactor containment and turbine buildings can be seen from U.S. Highway 75 located 2.75 miles west of the facility. Motorists traveling on a number of local roads, some of which pass within 1.5 miles, can see various facility structures (WCNOC 2007i). Overhead transmission lines pass over local roads as well as numerous county, State, and U.S. highways on their way to connect to the regional electric power grid. As described in Section 2.1.7 of this SEIS, these lines are contained within approximately 106 miles of 150-ft-wide ROWs that include a total area of over 1920 ac in Coffey, Greenwood, and Butler Counties.

Noise levels produced by WCGS operations have not been measured (WCNOC 2007j). However, the facility is bordered by undeveloped rangeland and Coffey County Lake, reducing the noise levels that may reach local residents. Also, most equipment is located inside facility buildings, which acts to reduce noise levels observed off-site. Higher noise levels are associated with testing of on-site alarms and off-site warning sirens. The nearest residence is located 1.7 miles west of the reactor containment building, across Coffey County Lake, on Native Road SE. According to Coffey County officials, there have been no noise issues concerning the plant, even from close neighbors.[j] The only issue is the sirens, which are tested weekly.

2.2.8.5 Demography

According to the 2000 Census, approximately 13,095 people lived within a 32-kilometer (20-mi) radius of WCGS, which equates to a population density of 10 persons per sq mi (WCNOC 2006a). This density translates to the least sparse Category 1 (less than 40 persons per sq mi and no community with 25,000 or more persons within 20 miles) using the GEIS measure of sparseness. Approximately 176,301 people live within an 80-kilometer (50-mi) radius of WCGS (WCNOC 2006a). This equates to a population density of 23 persons per sq mi. Applying the GEIS proximity measures, WCGS is classified as proximity Category 1 (no city with 100,000 or more persons and less than 50 persons per sq mi within 50 miles). Therefore, according to the sparseness and proximity matrix presented in the GEIS, the WCGS ranks of sparseness Category 1 and proximity Category 1 result in the conclusion that WCGS is located in a low population area.

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[j] Interview with Coffey County officials on March 13, 2007.

Table 2–22 shows population projections and growth rates from 1970 to 2050 in Coffey and Lyon counties. The growth rate in Coffey County showed a 6 percent increase for the period of 1990 to 2000. Beyond 2000, the population is expected to remain relatively unchanged and slightly decrease at a very low rate beyond the year 2010. In Lyon County, the population grew between 1990 and 2000 and is also expected to decrease slightly through 2050.

Table 2-22. Population and Percent Growth in Coffey and Lyon Counties, Kansas from 1970 to 2000 and projected for 2010 to 2050

	Coffey County		Lyon County	
Year	Population	Percent Growth [(a)]	Population	Percent Growth [(a)]
1970	7,397	—	32,071	—
1980	9,370	26.7	35,108	9.5
1990	8,404	-10.3	34,732	-1.1
2000	8,865	5.5	35,935	3.5
2010	8,939	0.8	35,263	-1.9
2020	8,795	-1.6	34,742	-1.5
2030	8,690	-1.2	35,096	1.0
2040	8,629	-0.7	35,076	-0.1
2050	8,567	-0.7	35,056	-0.1

— = No data available.

(a) Percent growth rate is calculated over the previous decade.

Sources: 1970 - 2000, USCB 2007a and USCB 2007b; projected population data for 2010 and 2020, Kansas Division of the Budget, http://da.state.ks.us/budget/ecodemo.htm (accessed July 12, 2006); projected population data for 2030 to 2050 (calculated).

The 2000 demographic profile of the region of influence population is included in Table 2–23. Persons self-designated as minority individuals comprise 18.9 percent of the combined total population of these two counties. This minority population is composed largely of Hispanic or Latino residents who reside in Lyon County.

Table 2-23. Demographic Profile of the Population in the WCGS Region of Influence

	Coffey County	Lyon County	Region of Influence
Race (2000) (percent of total non-Hispanic population)			
White	96.3	77.3	81.1
Black or African American	0.2	2.2	1.8
American Indian and Alaska Native	0.5	0.4	0.4
Asian	0.3	2.0	1.7
Native Hawaiian and Other Pacific Islander	0.0	0.0	0.0
Some other race	0.0	0.1	0.1
Two or more races	1.1	1.3	1.3
Ethnicity			
Hispanic or Latino	137	6,010	6,147
Percent of total population	1.5	16.7	13.7
Minority Population (including Hispanic or Latino ethnicity)			
Total minority population	330	8,149	8,479
Percent minority	3.7	22.7	18.9

Source: USCB 2007a and 2007b

2.2.8.5.1 Transient Population

Within 80 kilometers (50 miles) of WCGS, colleges and recreational opportunities attract daily and seasonal visitors who create demand for temporary housing and services. In 2000 in Coffey County, 1.9 percent of all housing units are considered temporary housing for seasonal, recreational, or occasional use. By comparison, temporary housing accounts for only 0.5 percent and 0.9 percent of total housing units in Lyon County and Kansas, respectively (USCB 2007b).

2.2.8.5.2 Migrant Farm Worker

Migrant farm workers are individuals whose employment requires travel to harvest agricultural crops. These workers may or may not have a permanent residence. Some migrant workers may follow the harvesting of crops, particularly fruit, throughout the midwestern U.S. rural areas. Others may be permanent residents near WCGS who travel from farm to farm harvesting crops.

Migrant workers may 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 (USCB) minority and low-income population counts.

Coffey and Lyon counties host relatively small numbers of migrant workers. According to 2002 Census of Agriculture estimates, 147 temporary farm laborers (those working fewer than 150 days per year) were employed on 75 farms in Coffey County, and 428 were employed on 188 farms in Lyon County (USDA 2002).

2.2.8.6 Economy

This section contains a discussion of the economy, including employment and income, unemployment, and taxes.

2.2.8.6.1 Employment and Income

Between 2000 and 2005, the civilian labor force in the Coffey County area increased 13.5 percent to the 2005 level of 5,261. The civilian labor force in the Lyon County area grew 6.6 percent to the 2005 level of 20,519 (USCB 2007b).

In 2005, employment in the services industry represented the largest sector of employment in both counties combined followed closely by manufacturing and retail trade industries (Kansas Department of Labor 2006). The largest employer in Coffey County in 2006 was Wolf Creek Nuclear Operating Corporation with 900 employees (see Table 2-24). The majority of employment in Coffey County is located in the city of Burlington.

Table 2-24. Major Employers in Coffey County in 2006

Firm	Number of Employees
Wolf Creek Nuclear Operating Corporation	900
Coffey Health System	250
Unified School District #244	166
Coffey County	160
Countertop Trends	70
Mid-American Machine	50
Hoover's Thriftway	40
Arnold's Greenhouse	35
Charloma, Inc.	35

Source: Southeast Kansas Inc., http://www.sekinc.org/counties/coffey_employers.htm, accessed May 7, 2007.

Income information for Coffey and Lyon counties is presented in Table 2–25. There are slight differences in the income levels between the two counties. The median household and per capita income in Coffey and Lyon counties were both well below the Kansas average. In 1999, only 6.6 percent of the population in Coffey County was living below the official poverty level, while in Lyon County, 14.5 percent of the population was living below the poverty level (USCB 2007b).

Table 2-25. Income Information for the WCGS Region of Influence

	Coffey County	Lyon County	Kansas
Median household income 1999 (dollars)	37,839	32,819	40,624
Per capita income 1999 (dollars)	18,337	15,724	20,506
Percent of persons below the poverty line (2000)	6.6	14.5	9.9

Sources: USCB 2007a and USCB 2007b

2.2.8.6.2 Unemployment

In 2005, the annual unemployment average in the Coffey and Lyon counties were 5.6 and 4.5 percent, respectively, which were slightly higher and lower than the annual unemployment average of 5.5 percent for Kansas (USCB 2007a and USCB 2007b).

2.2.8.6.3 Taxes

WCNOC pays annual real estate taxes to Coffey County. From 2000 through 2006, WCNOC paid between $23.9 and $26.3 million annually in property taxes to Coffey County (see Table 2–26). This represented between 79 and 85 percent of the county's total annual tax revenue. Each year, Coffey County retains a portion of this tax money for county operations and disburses the remainder to school districts, fire districts, and the county's municipalities to fund their respective operating budgets. The local public school system, USD #244, receives 38 to 46 percent of the property tax payment (WCNOC 2006a).

At present, the State of Kansas has taken no action on deregulation, which could, if enacted, affect tax payments to Coffey County. However, any changes to WCGS property tax rates due to deregulation would be independent of license renewal.

The continued availability of WCGS and the associated tax base is an important feature in the ability of the Coffey County and county municipalities to continue to invest in infrastructure and to draw industry and new residents.

Table 2-26. Coffey County Tax Revenues, WCGS Property Tax, and WCGS Property Tax as a Percentage of Tax Revenues, 2000 to 2006

Entity	Year	Tax Revenues (in millions of dollars)	Property Tax Paid by WCGS (in millions of dollars)	WCGS Property Tax as Percentage of Tax Revenues
Coffey County	2000	28.7	24.3	85
	2001	29.6	23.9	81
	2002	29.4	24.5	83
	2003	30.6	24.6	81
	2004	31.3	25.0	80
	2005	31.6	25.1	79
	2006	33.1	26.3	80

Sources: 2000 to 2004 data from WCNOC 2006a; 2005 and 2006 data from Raaf 2007

2.2.9 Historic and Archaeological Resources

This section presents a brief summary of the region's cultural background and a description of known historic and archaeological resources at the WCGS site and its immediate vicinity. The information presented was collected from area repositories, the Kansas State Historical Society (KSHS), and the applicant's Environmental Report (WCNOC 2006a).

2.2.9.1 Cultural Background

The first Native Americans to settle in the Central Plains arrived approximately 11,000 years before present. Archaeological evidence suggests that these early groups hunted large mammals using projectiles tipped with distinctively flaked stone points. Over the following several thousand years prehistoric peoples in this region adapted to environmental changes, subsisting on wild plant foods and smaller game. During the most recent portion of prehistory, beginning a few thousand years before the present, indigenous populations began to settle in semi-permanent villages based in part on agriculture and fishing and to use pottery for both food preparation and storage.

During proto-historic times Osage Indians from Missouri had begun exploiting the resources of the lower stretches of the Neosho River in Kansas. Groups of Sac and Fox, Pottawatomie, and Kickapoo later moved into eastern Kansas. Historic accounts indicate that Sac and Fox bands ranged through Coffey County, just north of the WCGS area (KG&E and KCP&L 1974).

The Spanish were the first Europeans to explore Kansas when, in the middle part of the 16th century, explorer Francisco Vasquez de Coronado arrived seeking gold. In the late 18th century, France claimed most of Kansas and 12 other future states as part of the Louisiana Territory. Kansas was acquired from France in 1803, as part of the Louisiana Purchase.

Historical records indicate that Meriwether Lewis and William Clark's Corps of Discovery made camp on the Kansas side of the Missouri River during their expedition to explore the new purchase in 1804 (WCNOC 2006a).

The middle part of the 19th century marked a surge in European settlement, following the passage of the Kansas-Nebraska Act in 1854 and the Homestead Law in 1862 (WCNOC 2006a). In the last quarter of the 19th century "Turkey Red" wheat was introduced by Mennonite immigrants from Russia. The introduction of this new crop provided the basis for Kansas as a wheat-producing state (WCNOC 2006a).

2.2.9.2 Historic and Archaeological Resources at the WCGS Site

2.2.9.2.1 Previously Identified Resources

The KSHS houses the State's archaeological site files and information on historic resources such as buildings and houses, including available information concerning the National or State Register eligibility status of these resources. The NRC cultural resource team visited the KSHS and reviewed site files on archaeological sites located within or nearby the WCGS property.

Two surveys, conducted in 1973 and 1974, of Wolf Creek and the WCGS plant area resulted in the identification of 25 prehistoric sites within or adjacent to present day Coffey County Lake (KG&E and KCP&L 1974). The most significant of these sites, listed as the Anderson Site (14CF508), is described as being located "on a low terrace on the east bank of Wolf Creek." This site has since been inundated by the construction of Coffey County Lake. It is located approximately 150 meters west of the north end of the northern baffle dike. Initial recordation of the site noted a surface scatter of "stone chips, potsherds, chunks of heat altered limestone, and daub." Later excavations revealed more artifacts and five postmold features. Analysis of temporally diagnostic artifacts recovered from the 14CF508 indicates that the site was occupied during the Plains Woodland period of prehistory (about 500 to 1000 years BP).

Of the 25 prehistoric sites recorded during the 1973 to 1974 surveys, 23 were inundated by the construction of Coffey County Lake. The two sites not inundated by the lake (14CF503 and 14CF504) are located to the south of the earthen dam at the southern end of the lake, and were likely impacted during initial dam construction activity.

A review of the KSHS files to identify above-ground cultural resources in Coffey County revealed a total of five resources listed on the National Register of Historic Places (NPS 2007). Within the town of Burlington there are three historic structures listed on the National Register. None of these sites are located within the boundaries of the WCGS site.

2.2.9.2.2 Results of Walkover Survey

The NRC staff performed an informal walkover survey of the WCGS property during the site audit (March 12-16, 2007), including the main generating station area, the environmental education area, and a portion of the transmission line ROW. During this walkover it was observed that the main generating station area has been extensively disturbed and graded, while much of the environmental education area and transmission line ROW appear to have been only minimally disturbed. All of the buildings and structures that comprise the station have been constructed since the mid 1970s.

2.2.9.2.3 Potential Archaeological Resources

Due to disturbances associated with site preparation and construction, the main generating station area has little or no potential for archaeological resources. There is potential for archaeological resources to be present in the environmental education area, along the transmission line ROW, and along the shores of Coffey County Lake. These areas appear to have been only minimally disturbed and are comprised of landforms that may have been attractive during prehistory for varied resource exploitation.

2.2.10 Related Federal Project Activities and Consultations

The NRC staff reviewed the possibility that activities of other Federal agencies might impact the renewal of the Operating License (OL) for WCGS. 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.

The NRC staff has reviewed local Federally owned facilities and Federally permitted industrial facilities in the local area near Burlington, Kansas, and has determined that there are no Federal project activities that would make it desirable for another Federal agency to become a cooperating agency for preparing this SEIS. The only known Federal project in the area is the operation of John Redmond Reservoir by the USACE.

The USACE is currently involved in consideration of an action that could affect future operations at WCGS. In June 2002, USACE published a draft Supplement to the Final Environmental Impact Statement (EIS) for the reallocation of water supply storage within the reservoir (USACE 2002). The purpose of this action would be to raise the level of the conservation pool within the reservoir in order to ensure a continuing ability to meet contractual requirements to supply water to the State of Kansas under a water supply agreement reached in 1975 (USACE 2002). This agreement was reached to allow the State of Kansas to provide this water, under contract, to the Cottonwood and Neosho River Basins Water Assurance District Number 3, and to WCGS.

According to the USACE EIS, the water supply agreement was developed in 1975 to ensure a water supply of 34,900 ac-ft annually for the two users for the duration of the 50-year design life of the reservoir, which extended to 2014. However, by the late 1990s, USACE had determined that the rate of siltation in the conservation pool was higher than anticipated, and would result in limiting the ability of USACE to meet the contractual obligation to supply this amount of water. Based on this analysis, USACE evaluated alternatives to meet the contractual obligation, and their preferred alternative was to raise the level of the conservation pool from 1,039 to 1,041 ft above MSL (USACE 2002). Currently, this EIS remains in draft, and it is unknown whether USACE intends to implement the preferred alternative.

NRC is required under Section 102(c) of the National Environmental Policy Act of 1969, as amended 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 EPA and the FWS. Consultation correspondence is included in Appendix E. The EPA submitted written comments during the scoping process; their comments are addressed in this SEIS.

2.3 References

10 CFR Part 20. Code of Federal Regulations, Title 10, *Energy*, Part 20, "Standards for Protection Against Radiation."

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

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

40 CFR Part 261. Code of Federal Regulations, Title 40, *Protection of Environment*, Part 261, "Identification and Listing of Hazardous Waste."

40 CFR Part 273. Code of Federal Regulations, Title 40, *Protection of Environment*, Part 273, "Standards for Universal Waste Management."

Argonne National Laboratory (ANL). 2005. "Tritium (Hydrogen-3)." Human Health Fact Sheet, August 2005. Accessed at: www.ead.anl.gov/pub/doc/tritium.pdf. February 6, 2008.

Canadian Wildlife Service and U.S. Fish & Wildlife Service (CWS and FWS). 2007. *International Recovery Plan: Whooping Crane* (*Grus americana*), Third Revision. Accessed at: http://www.fws.gov/endangered on June 2007.

City of Burlington. 2007. *Annual Water Quality Report – 2007.* Burlington, Kansas.

Coffey County Planning Board. 2000. "Zoning Regulations of Coffey County, Kansas". Official Copy as Incorporated by Resolution Number 386-A. Edition of June 21, 2000. Effective Date July 7, 2000.

Coffey County. 1999. "Coffey County Economic Development, Transportation/Location." Accessed at: http://www.coffeycountyks.org/ecodevo/trans.html on June 1, 2007.

Colvin, M. A. 1993. *Ecology and Management of White Bass: a Literature Review.* Missouri Department of Conservation, Dingell-Johnson project F-I-R-42, Study 1-31, Job 1, Final Report.

Conant, R. and J. T. Collins. 1998. *A Field Guide to Reptiles & Amphibians, Eastern and Central North America*. Third edition, expanded. Houghton Mifflin, Boston.

Cross, F. B. and J. T. Collins. 1995. *Fishes in Kansas*. Second Edition. University of Kansas Natural History Museum. p. 315

Daniels, Harry. 2007. "Hybrid Striped Bass". Accessed at: http://www.msstate.edu/dept/srac/bass.htm on June 12, 2007.

Department of Energy (DOE). 2002. *A Graded Approach for Evaluating Radiation Doses to Aquatic and Terrestrial Biota.* DOE-STD-1153-2002. Washington, D.C. July.

EA Engineering, Science, and Technology, Inc. (EA). 1988. *Wolf Creek Generating Station Operational Phase Environmental Monitoring Program, Final Report.* Prepared for Wolf Creek Nuclear Operating Corporation. Great Plains Regional Office.

Ecological Analysts, Inc. 1981. *Wolf Creek Generating Station Operational Phase Environmental Monitoring Program, Final Report.* Wolf Creek Nuclear Operating Corporation, Wichita, Kansas. June.

Environmental Protection Agency (EPA). 2005. *Local Drinking Water Information, Kansas Drinking Water, List of Water Systems in Safe Drinking Water Information System database for Coffey and Lyon Counties.* Accessed at: http://www.epa.gov/enviro/html/sdwis/sdwis_query.html on April 21, 2005.

Environmental Protection Agency (EPA). 2007. Safe Drinking Water Information System (SDWIS) Query Results for Coffey County and Lyon County, Kansas. Accessed at: http://www.epa.gov/enviro/html/sdwis/sdwis_ov.html on May 16, 2007.

Environmental Protection Agency (EPA). 2007. "Radiation Protection, Tritium." Accessed at: http://www.epa.gov/rpdweb00/radionuclides/tritium.html. February 6, 2008.

Etnier, D. A. and W. C. Starnes. 1993. *The Fishes of Tennessee*. University of Tennessee Press, Knoxville, Tennessee.

Fish and Wildlife Service (FWS). 1991. *Neosho Madtom Recovery Plan*. FWS Region 6, Denver, CO. p. 42.

Fish and Wildlife Service (FWS). 2002. *Environmental Assessment: Proposal of Critical Habitat for the Northern Great Plains Breeding Population of Piping Plovers* (*Charadrius melodus*). South Dakota Ecological Services Field Office, Pierre. June.

Fish and Wildlife Service (FWS). 2003. *Mead's Milkweed* (*Asclepias meadii*) *Recovery Plan*. Great Lakes-Big Rivers Region, Fort Snelling, Minnesota. p. 120.

Fish and Wildlife Service (FWS). 2004. "Endangered and Threatened Wildlife and Plants; Final Designation of Critical Habitat for the Topeka Shiner; Final Rule." *Federal Register*, Volume 69, pp. 44,736-44,770, July 27.

Fish and Wildlife Service (FWS). 2005. "Species Assessment and Listing Priority Assignment Form, Neosho Musket (*Lampsilis rafinesqueana*) Candidate Form." October. Accessed at: http://ecos.fws.gov/speciesProfile/SpeciesReport on June 8, 2007.

Fish and Wildlife Service (FWS). 2007a. Threatened and Endangered Species System (TESS). Accessed at: http://ecos.fws.gov/tess_public/StateListingAndOccurrence.do?state=KS on January – June 2007.

Fish and Wildlife Service (FWS). 2007b. Species Information, Threatened and Endangered Species System (TESS), Species Profiles. Accessed at: http://ecos.fws.gov/tess_public/StartTESS.do on June 2007.

Fish and Wildlife Service (FWS). 2007c. Mountain-Prairie Region, Endangered Species Program. Accessed at: http://www.fws.gov/mountain%2Dprairie/endspp/ on February – June 2007.

Haines, D. 1998. *1997 Fisheries Monitoring Report*. Wolf Creek Generating Station. Wolf Creek Lake.

Haines, D.E. 2000. "Biological Control of gizzard shad impingement at a nuclear power plant." *Environmental Science and Policy* 3: S275-S281.

Haines, D. 2006. Zebra mussel (*Dreissena polymorpha*) Monitoring near Wolf Creek Generating Station 2005 Report and 2006 Plans. WCNOC. March 22, 2006.

Hammond, R. 2006. Microfouling, Asiatic Clam and Zebra Mussel Control Program for Wolf Creek Generating Station. Wolf Creek Nuclear Operating Corporation, Burlington, Kansas. WCEM-05-012.

Hazelton Environmental Sciences. 1979. *Final Report of Preconstruction Environmental Monitoring Program WCGS, March 1978 - February 1979.* Kansas Gas and Electric Company. Wichita, Kansas. May.

Hazelton Environmental Sciences. 1980. *Final Report of Preconstruction Environmental Monitoring Program WCGS, March 1979 - February 1980.* Kansas Gas and Electric Company. Wichita, Kansas. June.

Jirak, Leonard. 2005. Progress and Management Report; John Redmond Reservoir. KDWP.

Juracek, Kyle E. and Perry, Charles A. 2005. *Gravel Sources for the Neosho River in Kansas, 2004.* USGS Scientific Investigations Report 2005-5282. Accessed at: http://pubs.usgs.gov/sir/2005/5282/ on May 21, 2007.

Kansas Department of Health and Environment (KDHE). 1974. "Information on Facility Exemption from Section 316(a) of PL 92-500." Letter from M. Gray, Kansas Department of Health and Environment, Topeka, Kansas, to G. Koester, Kansas Gas and Electric Company, Wichita, Kansas, December 13, 1974.

Kansas Department of Health and Environment (KDHE). 1975a. "Information on Facility Exemption from Discharge of Heat." Letter from D. Carlson, Kansas Department of Health and Environment, Topeka, Kansas, to G. Koester, Kansas Gas and Electric Company, Wichita, Kansas, April 10, 1975.

Kansas Department of Health and Environment (KDHE). 1975b. "Information on Possible Recreational Uses of the Wolf Creek Facility." Letter from M. Gray, Kansas Department of Health and Environment, Topeka, Kansas, to M. Miller, Kansas Gas and Electric Company, Wichita, Kansas, February 21, 1975.

Kansas Department of Health and Environment (KDHE). 2004. "Kansas Water Pollution Control Permit and Authorization to Discharge Under the National Pollutant Discharge

Elimination System (NPDES)." Kansas Permit Number. I-NE07-PO02, Federal Permit Number. KS0079057. December 30, 2004.

Kansas Department of Health and Environment (KDHE). 2005. *Report of Radiological Environmental Monitoring of the Environs Surrounding Wolf Creek Generating Station, July 2004 to June 2005.* Topeka, Kansas.

Kansas Department of Health and Environment (KDHE). 2006a. *Report of Radiological Environmental Monitoring of the Environs Surrounding Wolf Creek Generating Station, July 2005 to June 2006.* Topeka, Kansas.

Kansas Department of Health and Environment (KDHE). 2006b. *Environmental radiation Surveillance Program for the Environs Surrounding Wolf Creek Generating Station for the period of July 2006 through June 2007.* Topeka, Kansas.

Kansas Department of Health and Environment (KDHE). 2007a. *Drinking Water Analytical Data submitted for Safe Drinking Water Act compliance.* Topeka, Kansas.

Kansas Department of Health and Environment (KDHE). 2007b. *Neosho Basin Total Maximum Daily Load (TMDL) Reports. Accessed at:* http://www.kdheks.gov/tmdl/netmdl.htm on March 26, 2007.

Kansas Department of Labor. 2006. Labor Market Information Services. Updated September 14, 2006.

Kansas Department of Wildlife and Parks (KDWP). 2004a. "Species Information: Topeka Shiner (Notropis topeka)". Accessed at: http://www.kdwp.state.ks.us/news/other_services/threatened_and_endangered_species/threatened_and_endangered_species/species_information on June 2007.

Kansas Department of Wildlife and Parks (KDWP). 2004b. "Species Information: Neosho madtom (Noturus placidus)". Accessed at http://www.kdwp.state.ks.us/news/other_services/threatened_and_endangered_species/threatened_and_endangered_species/species_information on June 2007.

Kansas Department of Wildlife and Parks (KDWP). 2004c. "Threatened and Endangered Species, Species Information." Accessed at: http://www.kdwp.state.ks.us/news/otherservices/threatenedandendangered_species/threatened and endangered species/speciesinformation on June 2007.

Kansas Department of Wildlife and Parks (KDWP). 2006. *Kansas Department of Wildlife & Parks Stream Monitoring and Assessment Program Sub-Watershed Report*. Pratt, Kansas. February.

Kansas Department of Wildlife and Parks (KDWP). 2007a. "Coffey County Lake". Accessed at: http://kdwp.state.ks.us/news/fishing/where_to_fish_in_kansas/fishing_locations_publicwaters/region_5/coffey_county_lake on May 22, 2007.

Kansas Department of Wildlife and Parks (KDWP). 2007b. "Council Grove Wildlife Area". Accessed at: http://www.kdwp.state.ks.us/news/layout/set/printkdwp_info/locations/wildlife areas/region_4/council grove on May 22, 2007.

Kansas Department of Wildlife and Parks (KDWP). 2007c. "Marion Reservoir". Accessed at: http://kdwp.state.ks.us/news/kdwp_info/locations/reservoirs/region_4/marion on May 22, 2007.

Kansas Department of Wildlife and Parks (KDWP). 2007d. "John Redmond Reservoir". Accessed at: http://kdwp.state.ks.us/news/fishing/where_to_fish_in_kansas/fishing_locations_publicwaters/region_5/john_redmond_reservoir on May 22, 2007.

Kansas Department of Wildlife and Parks (KDWP). 2007e. Threatened and Endangered Species, County Lists. Accessed at: http://www.kdwp.state.ks.us/news/otherservices/threatenedandendangered_species/threatened and endangered species/county_lists on January - June 2007.

Kansas Department of Transportation (KDOT). 2004. " FY2004 Annual Average Daily Volumes on County Major Collector Rural Roads, District 4" map. Prepared by the KDOT, Bureau of Transportation Planning in cooperation with the U.S. Department of Transportation, Federal Highway Administration. Published June 2004. Accessed at: http://www.ksdot.org/burtransplan/maps/CountMaps/Districts/d4rs04.pdf on May 31, 2007.

Kansas Department of Transportation (KDOT). 2007. "2007 Traffic Flow Map, Kansas State Highway System". KDOT, Bureau of Transportation Planning in cooperation with U.S. Department of Transportation, Federal Highway Administration. March 2007. Accessed at: http://www.ksdot.org/burtransplan/maps/CountMaps/Districts/count06.pdf on May 31, 2007.

KansasFishes.com. 2007a. "Channel Catfish". Accessed at: http://www.kansasfishes.com/Pages/channelcatfish.htm on June 2007.

KansasFishes.com. 2007b. "White Bass". Accessed at: http://www.kansasfishes.com/Pages/whitebass.htm on June 2007.

KansasFishes.com. 2007c. "Smallmouth Bass". Accessed at: http://www.kansasfishes.com/Pages/smallmouthbass.htm on June 2007.

KansasFishes.com. 2007d. "Largemouth Bass". Accessed at: http://www.kansasfishes.com/Pages/largemouthbass.htm on June 2007.

KansasFishes.com. 2007e. "White Crappie". Accessed at: http://www.kansasfishes.com/Pages/whitecrappie.htm on June 2007.

KansasFishes.com. 2007f. "Walleye". Accessed at: http://www.kansasfishes.com/Pages/walleye.htm on June 2007.

KansasFishes.com. 2007g. "Gizzard Shad". Accessed at: http://www.kansasfishes.com/Pages/gizzardshad.htm on June 2007.

Kansas Gas and Electric Company (KG&E). 1975. "Information on Facility Exemption from Discharge of Heat." Letter from G. Koester, Kansas Gas and Electric Company, Wichita, Kansas, to M. Gray, Kansas Department of Health and Environment, Topeka, Kansas. April 4, 1975.

Kansas Gas and Electric Company (KG&E). 1982. *Wolf Creek Generating Station Unit No. 1, Environmental Report Operating License Stage.*

Kansas Gas and Electric Company (KG&E). 1986. *Wolf Creek Generating Station 1984-1985 Preoperational Wildlife Monitoring Report; May 1984-April 1985.* Wichita, Kansas. April.

Kansas Gas and Electric Company and Kansas Power and Light Company (KG&E and KCP&L). 1974. *Environmental Report Volume I, Wolf Creek Generating Station.* July 22.

Kansas Geological Survey (KGS). 2007. *KGS Water Wells Query Answer, Coffey County.* Accessed at: http://abyss.kgs.ku.edu/pls/abyss on June 8, 2007.

Kansas State Department of Education (KSDE). 2006a. "Burlington USD 244 Budget Profile 2006-2007." Accessed at: http://www3.ksde.org/budget/d0244pi7.pdf on May 30, 2007.

Kansas State Department of Education (KSDE). 2006b. "Lebo-Waverly USD 243 Budget Profile 2006-2007." Accessed at: http://www3.ksde.org/budget/d0243pi7.pdf on May 31, 2007.

Kansas State Department of Education (KSDE). 2006c. "LeRoy-Gridley USD 245 Budget Profile 2006-2007. " Accessed at: http://www3.ksde.org/budget/d0245pi7.pdf on May 31, 2007.

Kansas State Department of Education (KSDE). 2006d. "Emporia USD 253 Budget Profile 2006-2007." Accessed at: http://www3.ksde.org/budget/d0253pi7.pdf on May 31, 2007.

Kansas State Department of Education (KSDE). 2006e. "North Lyon County USD 251 Budget Profile 2006-2007." Accessed at: http://www3.ksde.org/budget/d0251pi7.pdf on May 31, 2007.

Kansas State Department of Education (KSDE). 2006f. "Southern Lyon County USD 252 Budget Profile 2006-2007." Accessed at: http://www3.ksde.org/budget/d0252pi7.pdf on May 31, 2007.

Kansas State Library. 2007a. Blue Skyways, Towns and Cities, Burlington. Accessed at: http://skyways.lib.ks.us/towns/Burlington/transportation.html on January 3, 2007.

Kansas State Library. 2007b. Blue Skyways, Towns and Cities, Burlington. Accessed at: http://skyways.lib.ks.us/towns/Lebo/locgov.htm on June 13, 2007.

Kansas Water Office (KWO). 2001. Water Assurance Program. Fact Sheet No. 8. January 2001. Accessed at: http://kwo.org/Reports%20%%20Publications/Fact%20Sheets/No_8_Water_Assurance_Program.pdf on May 17, 2007.

Kansas Water Office (KWO). 2002. *Information on water supply capacity, Public Wholesale Water Supply District #12.* http://www.kwo.org/reorts$20&$20publications/2002_wtr_marketing_status_rpt.pdf. (Accessed June 6, 2007).

Kansas Water Office (KWO). 2004. *Kansas Water Plan, Neosho Basin Section*. November. Accessed at: http://www.kwo.org/Kansas%20Water%20Plan/NEO_basin_111804.pdf on May 23, 2007.

Kimmel, B. L. and A. W. Groeger. 1986. "*Limnological and Ecological Changes Associated with Reservoir Aging.*" pp. 103-109. Reservoir Fisheries management: Strategies for the 80's. Reservoir Committee, Southern Division American Fisheries Society.

Lyon County Planning Board. 2001. "Comprehensive Plan for Lyon County." February. Accessed at: http://lyoncounty.org/LYON%20COUNTY%20COMPREHENSIVE%20PLAN.pdf on January 5, 2007.

Mammoliti, C.S. 2004. *Recovery Plan for the Topeka Shiner* (*Notropis topeka*) *in Kansas.* Kansas Department of Wildlife and Parks, Pratt, Kansas. p. 50.

Mosher, T. D. 2000. *Assessment of a 254-mm Minimum Length Limit for Crappie in Three Northeastern Kansas Reservoirs Final Report*. Kansas Department of Wildlife and Parks. Federal Aid Project Number FW-9-12 and F-30-R-1.

Muoneke, M. I., C. C. Henry, and O. E. Maughan. 1992. *Population structure and food habits of white crappie Pomoxis annualris Rafinesque in a turbid Oklahoma reservoir.* Journal of Fish Biology. Volume 1 p. 647. October.

Nalco Environmental Sciences. 1976. *Final Report of Preconstruction Environmental Monitoring Program WCGS, March 1975 - February 1976.* Kansas Gas and Electric Company. Wichita, Kansas. May.

Nalco Environmental Sciences. 1977. *Final Report of Preconstruction Environmental Monitoring Program WCGS, March 1976 - February 1977.* Kansas Gas and Electric Company. Wichita, Kansas. May.

Nalco Environmental Sciences. 1978. *Final Report of Preconstruction Environmental Monitoring Program WCGS, March 1977 - February 1978.* Kansas Gas and Electric Company. Wichita, Kansas. May.

National Oceanic and Atmospheric Administration (NOAA). 2004. *Local Climatological Data – Annual Summary With Comparative Data – Topeka, Kansas (TOP) ISSN 0198-2419.* Asheville, North Carolina.

National Oceanic and Atmospheric Administration (NOAA). 2007a. *Kansas Climate Records.* Accessed at http://www.crh.noaa.gov/ict/?n=ksrecords on July 18, 2007.

National Oceanic and Atmospheric Administration (NOAA). 2007b. *Yearly Normals and Means.* Accessed at http://www.crh.noaa.gov/ict/?n=yearly on July 18, 2007.

National Park Service (NPS). 2007. National Register Information System. Index by State/County. Accessed at: http://www.nr.nps.gov/iwisapi/explorer.dll?IWS_SCHEMA=NRIS1&IWS_LOGIN=1&IWS_REPORT=100000066 on June12, 2007.

Nuclear Regulatory Commission (NRC). 1975. *Final Environmental Statement related to Construction of Wolf Creek Generating Station, Unit 1*, NUREG-175/096, Docket Number STN 50- 482. Office of Nuclear Reactor Regulation, Washington, DC.

Nuclear Regulatory Commission (NRC). 1982. *Final Environmental Statement Related to the Operation of Wolf Creek Generating Station Unit No. 1.* NUREG-0878. Office of Nuclear Reactor Regulation, Washington, DC.

Nuclear Regulatory Commission (NRC). 2007. *Tornado Climatology of the Contiguous United States.* NUREG/CR-4461, Revision 2. Office of Nuclear Regulatory Research, Washington, DC.

Obermeyer, B.K. 2000. *Recovery Plan for Four Freshwater Mussels in Southeast Kansas: Neosho Mucket (Lampsilis rafinesqueana), Ouachita Kidneyshell (Ptychobranchus occidentalis), Rabbitsfoot (Quadrula cylindrica cylindrica), and Western Fanshell (Cyprogenia aberti).* Kansas Department of Wildlife and Parks, Pratt, Kansas. p. 83.

O'Brien W. J., B. Loveless, and D. Wright. 1984. *Feeding Ecology of Young White Crappie in a Kansas Reservoir.* North American Journal of Fisheries management; 4: pp. 341-349.

Osterkamp, W.R., and Hedman, E.R. 1981. "Channel geometry of regulated streams in Kansas as related to mean discharge, 1970-1980: Kansas Water Office Technical Report Number 15."

Platkin, J. L., M. T. Barbour, K. D. Porter, S. K. Gross, and R. M. Hughes. 1989. *Rapid Bioassessment Protocols for Use in Streams and Rivers: Benthic Macroinvertebrates and Fish.* U.S. Environmental Protection Agency, Office of Water, EPA/444/4-89001, May 1989.

Putnam, J. E. and Schneider, D. R. 2005. *Water resources data – Kansas, water year 2004.* USGS Water-data Report KS-04-01.

Raaf, Jo Ann. 2007. Tax Figures for Wolf Creek Nuclear Plant and Coffey County Tax Revenue, facsimile from Jo Ann Raaf, Coffey County Treasurer, to Jeff Rikhoff, NRC. May 17, 2007.

Rhodes, F. T. 1991. Letter to Kansas Dept. of Wildlife and Parks with 1990 Conditional Wildlife Permit Activities Report and 1991 Renewal Application. F. T. Rhodes, WCNOC, Burlington, Kansas. January 15.

Southeast Kansas Regional Planning Commission (SEKRPC). 2007. "About SEKRPC." Accessed at: http://www.sekrpc.org/aboutme.htm on June 1, 2007.

State of Kansas Department of Agriculture, Division of Water Resources. 1977a. "Approval of Application and Permit to proceed, Appropriation of Water for Beneficial Use File Number 20,275." August, 1977.

State of Kansas Department of Agriculture, Division of Water Resources. 1977b. " Approval of Application and Permit to proceed, Appropriation of Water for Beneficial Use File Number 14,626." August, 1977.

State of Kansas Department of Agriculture, Division of Water Resources. 1977c. "Approval of Application and Permit to proceed, Appropriation of Water for Beneficial Use File Number 19,882." August, 1977.

State of Kansas Water Resources Board. 1976. "Water Purchase Contract Number 76-2."

Studley, Seth E. 1996. *Changes in High-Flow Frequency and Channel Geometry of the Neosho River Downstream from John Redmond Dam, Southeastern Kansas.* USGS Water-Resources Investigations Report 96-4243. Accessed at: http://ks.water.usgs.gov/Kansas/pubs/reports/wrir.96-4243.html on May 28, 2007.

Tomelleri, J. R. and M. E. Eberle. 1990. *Fishes of the Central United States.* University Press of Kansas.

U.S. Army Corp of Engineers (USACE). 2002. *Draft Supplement to the Final Environmental Impact Statement Prepared for the: Reallocation of Water Supply Storage Project: John Redmond Lake, Kansas.* Volume 1. June.

U.S. Army Corp of Engineers (USACE). 2005. *Initial Appraisal of the Neosho River Logjam, John Redmond Reservoir, Kansas.* February. Tulsa, Oklahoma.

U.S. Army Corp of Engineers (USACE). 2006. *Project Management Plan. John Redmond Dam and Reservoir, Kansas Watershed Feasibility Study.* Tulsa District. Tulsa, Oklahoma. September.

U.S. Army Corp of Engineers (USACE). 2007a. "Tulsa District, Recreation – Council Grove Lake". Accessed at: http://www.swt.usace.army.mil/recreat/ViewHistoryMessage.cfm?tblMessages__LakeName=Council%20Grove%20Lake on May 22, 2007.

U.S. Army Corp of Engineers (USACE). 2007b. "Tulsa District, Recreation - John Redmond Reservoir". Accessed at: http://www.swt.usace.army.mil/recreat/ViewHistoryMessage.cfm?tblMessages__LakeName=John%20Redmond%20Reservoir on May 22, 2007.

U.S. Army Corp of Engineers (USACE). 2007c. "Tulsa District, Recreation - Marion Reservoir". Accessed at: http://www.swt.usace.army.mil/recreat/ViewHistoryMessage.cfm?tblMessages__LakeName=Marion%20Reservoir on May 22, 2007.

U.S. Army Corp of Engineers (USACE). 2007d. *John Redmond Dam and Reservoir, Kansas Watershed; Interim Feasibility Study*. Tulsa District U.S. Army Corps of Engineers Public Workshop" brochure. Available at http://www.kwo.org/KWO%20Programs%20and%20Projects/Rpt_john_redmond_trifold_final_042307_kw.pdf on May 22, 2007.

U.S. Census Bureau (USCB). 2000. Census of Population and Housing 2000, Summary File 1. Accessed at: http://factfinder.census.gov on May 15, 2007.

U.S. Census Bureau (USCB). 2007a. "State & County QuickFacts, Coffey County, Kansas." Accessed at: http://quickfacts.census.gov/qfd/states/20/20031.html on June 13, 2007.

U.S. Census Bureau (USCB). 2007b. "State & County QuickFacts, Lyon County, Kansas." Accessed at: http://quickfacts.census.gov/qfd/states/20/20111.html on June 13, 2007.

U.S. Department of Agriculture (USDA). 2002. Census of Agriculture. Accessed at: http://www.nass.usda.gov/census/census02/volume1/pa/index2.htm on April 27, 2007

U.S. Department of Agriculture (USDA). 2004. 2002 Census of Agriculture, Kansas, State and County Data, Volume 1, Geographic Area Series, Part 16. AC-02-A-16. Issued June 2004. Accessed at: http://www.nass.usda.gov/census/census02/volume1/ks/KSVolume104.pdf on June 13, 2007.

U.S. Environmental Protection Agency. 1989. *Rapid Bioassessment Protocols for Use in Streams and Rivers: Benthic Macroinvertebrates and Fish*. Washington, DC.

U.S. Geological Survey (USGS). 1979. *Burlington Quadrangle, 7.5 Minute Series Topographic Map*, Photorevised 1979.

U.S. Geological Survey (USGS). 2007. "Kansas Minimum Desirable Streamflows (MDS), in cubic feet per second (ft3/s)" table. Accessed at: http://ks.water.usgs.gov/Kansas/waterwatch/drought/mds.alpha.html. Accessed June 8, 2007.

U.S. Geological Survey (USGS). 2008. "USGS Surface-Water Annual Statistics for Kansas". Accessed at: http://nwis.waterdata.usgs.gov/ks/nwis/annual/?referred_module=sw. Accessed February 20, 2008.

Westar Energy, Inc. (Westar). 2007. "Company Profile." http://www.westarenergy.com on June 13, 2007.

Wildhaber, M. L., V. M. Tabor, J. E. Whitaker, A. L. Allert, D. W. Mulhern, P. L. Lamberson, and K. L. Powell. 2000. "Ictalurid populations in relation to the presence of a main-stem reservoir in a Midwestern warmwater stream with emphasis on the threatened Neosho madtom." *Transactions of the American Fisheries Society* 129: pp. 1264-1280.

Willis, D.W. 1986. *Review of Water Level Management on Kansas Reservoirs*. pp. 110-114 in Reservoir Fisheries management: Strategies for the 80's. Reservoir Committee, Southern Division American Fisheries Society.

Wolf Creek Generating Station (WCGS). 1974. *Environmental Report, Revised, Section 2.5 Hydrology*. Response to Additional Request for Information A29.

Wolf Creek Generating Station (WCGS). 1980. *Wolf Creek Generating Station Unit No. 1, Environmental Report, Operating License Stage - Volume 1*. Burlington, Kansas.

Wolf Creek Nuclear Operating Corporation (WCNOC). 1988. "Wolf Creek Generating Station 1987-1988 Operational Wildlife Monitoring Report". Environmental Management Section, Burlington, Kansas. November.

Wolf Creek Nuclear Operating Corporation (WCNOC). 2000. "Wolf Creek Generation Station November National Pollutant Discharge Elimination System (NPDES) Monitoring Report, Permit I-NE07-PO02." Letter from J. W. Johnson, Wolf Creek Nuclear Operating Corporation, Burlington, Kansas, to M. Bosch-Hastings, Kansas Department of Health and Environment, Topeka, Kansas. December 15, 2000.

Wolf Creek Nuclear Operating Corporation (WCNOC). 2001. "Wolf Creek Generation Station April 2001 National Pollutant Discharge Elimination System (NPDES) Monitoring Report, Permit I-NE07-PO02." Letter from J. W. Johnson, Wolf Creek Nuclear Operating Corporation, Burlington, Kansas, to S. Shores-Miller, Kansas Department of Health and Environment, Topeka, Kansas. May 11, 2001.

Wolf Creek Nuclear Operating Corporation (WCNOC). 2002. "Wolf Creek Generation Station (WCGS) June 2002 National Pollutant Discharge Elimination System (NPDES) Monitoring Report, Permit I-NE07-PO02." Letter from J. W. Johnson, Wolf Creek Nuclear Operating Corporation, Burlington, Kansas, to S. Shores-Miller, Kansas Department of Health and Environment, Topeka, Kansas. July 12, 2002.

Wolf Creek Nuclear Operating Corporation (WCNOC). 2003a. *Wolf Creek Generating Station Annual Radioactive Effluent Release Report – 26*. Burlington, Kansas.

Wolf Creek Nuclear Operating Corporation (WCNOC). 2003b. "Wolf Creek Generation Station (WCGS) May 2003 National Pollutant Discharge Elimination System (NPDES) Discharge Monitoring Report, Permit I-NE07-PO02 and WET Testing Results of Outfalls 003 and 006." Letter from K. J. Moles, Wolf Creek Nuclear Operating Corporation, Burlington, Kansas, to J. Martin, Kansas Department of Health and Environment, Topeka, Kansas. June 26, 2003.

Wolf Creek Nuclear Operating Corporation (WCNOC). 1997. *Fishery Monitoring Report for Wolf Creek Lake*. Burlington, Kansas.

Wolf Creek Nuclear Operating Corporation (WCNOC). 2003c. *2002 Annual Radiological Environmental Operating Report*. Burlington, Kansas.

Wolf Creek Nuclear Operating Corporation (WCNOC). 2004a. *Wolf Creek Generating Station Annual Radioactive Effluent Release Report – 27*. Burlington, Kansas.

Wolf Creek Nuclear Operating Corporation (WCNOC). 2004b. *Wolf Creek Generating Station Firing Range Management Plan for Soil Lead Contamination*. February 2004. Document Control Number WCEM-08-004.

Wolf Creek Nuclear Operating Corporation (WCNOC). 2004c. "Wolf Creek Generation Station (WCGS) May 2004 National Pollutant Discharge Elimination System (NPDES) Discharge Monitoring Report, Permit I-NE07-PO02." Letter from K. J. Moles, Wolf Creek Nuclear Operating Corporation, Burlington, Kansas, to J. Martin, Kansas Department of Health and Environment, Topeka, Kansas. June 17, 2004.

Wolf Creek Nuclear Operating Corporation (WCNOC). 2004d. *2003 Annual Radiological Environmental Operating Report*. Burlington, Kansas.

Wolf Creek Nuclear Operating Corporation (WCNOC). 2005a. *Wolf Creek Generating Station Annual Radioactive Effluent Release Report – 28*. Burlington, Kansas.

Wolf Creek Nuclear Operating Corporation (WCNOC). 2005b. "Wolf Creek Generation Station (WCGS) June 2005 National Pollutant Discharge Elimination System (NPDES) Discharge Monitoring Report, Permit I-NE07-PO02." Letter from K. J. Moles, Wolf Creek Nuclear Operating Corporation, Burlington, Kansas, to J. Martin, Kansas Department of Health and Environment, Topeka, Kansas. July 25, 2005.

Wolf Creek Nuclear Operating Corporation (WCNOC). 2005c. "Wolf Creek Generation Station (WCGS) July 2005 National Pollutant Discharge Elimination System (NPDES) Discharge Monitoring Report, Permit I-NE07-PO02." Letter from K. J. Moles, Wolf Creek Nuclear

Operating Corporation, Burlington, Kansas, to J. Martin, Kansas Department of Health and Environment, Topeka, Kansas. August 22, 2005.

Wolf Creek Nuclear Operating Corporation (WCNOC). 2005d. *Wolf Creek Generating Station, Annual Environmental Operating Report 2004.* Burlington, Kansas.

Wolf Creek Nuclear Operating Corporation (WCNOC). 2005e. *2004 Annual Radiological Environmental Operating Report*. Burlington, Kansas.

Wolf Creek Nuclear Operating Corporation (WCNOC). 2006a. *Applicant's Environmental Report; Operating License Renewal Stage*. Appendix E of License Renewal Application, Wolf Creek Generating Station Unit 1, Docket Number 50-482, Facility Operating License Number NPF-42, (Revision 0).

Wolf Creek Nuclear Operating Corporation (WCNOC). 2006b. Enclosure 3 to WM 06-0046 An Assessment of the Potential Impacts on Fish and Shellfish Resources from Impingement Related to the Operating License Renewal for Wolf Creek Generating Station, Unit No. 1. Contained in: Letter from Matthew W. Sunseri, Wolf Creek Nuclear Operating Corporation to U.S. Nuclear Regulatory Commission regarding Docket Number 50-482: Supplementary Environmental Information to Support the Application for Renewed Operating License for Wolf Creek Generating Station. M 06-0046. November 17, 2006.

Wolf Creek Nuclear Operating Corporation (WCNOC). 2006c. *Wolf Creek Generating Station Annual Radioactive Effluent Release Report – 29.* Burlington, Kansas.

Wolf Creek Nuclear Operating Corporation (WCNOC). 2006d. *Land Management at Wolf Creek Generating Station, 2005 Progress Report and 2006 Land Management Plan.* March 2006.

Wolf Creek Nuclear Operating Corporation (WCNOC). 2006e. *Wolf Creek Generating Station, 2006 Land Use Census Report.* September 2006.

Wolf Creek Nuclear Operating Corporation (WCNOC). 2006f. *Supplementary Environmental Information to Support the Application for Renewed Operating License for Wolf Creek Generating Station. Docket Number 50-482.* Burlington, Kansas.

Wolf Creek Nuclear Operating Corporation (WCNOC). 2006g. *2005 Annual Radiological Environmental Operating Report*. Burlington, Kansas.

Wolf Creek Nuclear Operating Corporation (WCNOC). 2006h. "Wolf Creek Generation Station (WCGS) June 2006 National Pollutant Discharge Elimination System (NPDES) Discharge

Monitoring Report, Permit I-NE07-PO02." Letter from K. J. Moles, Wolf Creek Nuclear Operating Corporation, Burlington, Kansas, to M. Matheis, Kansas Department of Health and Environment, Topeka, Kansas. July 24, 2006.

Wolf Creek Nuclear Operating Corporation (WCNOC). 2006i. *Avian Protection Plan at Wolf Creek Generating Station.* August. p. 30.

Wolf Creek Nuclear Operating Corporation (WCNOC). 2007. "Docket 50-482: Response to NRC Request for Additional Information Related to Wolf Creek Generating Station License Renewal Application." Item Number 31. Cooling Water Intake Structures, Comprehensive Demonstration Study, May 9, 2007.

Wolf Creek Nuclear Operating Corporation (WCNOC). 2007a. *Wolf Creek Generating Station Annual Radioactive Effluent Release Report – 30.* Burlington, Kansas.

Wolf Creek Nuclear Operating Corporation (WCNOC). 2007b. "Docket Number 50-482: Response to NRC Request for Additional Information Related to Wolf Creek Generating Station License Renewal Application." Item Number 38. Letter from Terry J. Garrett, CNOC, to NRC Document Control Desk, Washington, DC, May 9, 2007.

Wolf Creek Nuclear Operating Corporation (WCNOC). 2007c. Docket Number 50-482: Wolf Creek Nuclear Operating Corporation's Response to Request for Additional Information Regarding the Review of the License Renewal Application for Wolf Creek Generating Station. ET 07-0001. January 11, 2007.

Wolf Creek Nuclear Operating Corporation (WCNOC). 2007d. "Docket Number 50-482: Response to NRC Request for Additional Information Related to Wolf Creek Generating Station License Renewal Application." Item Number A75. Letter from Terry J. Garrett, CNOC, to NRC Document Control Desk, Washington, DC, May 9, 2007.

Wolf Creek Nuclear Operating Corporation (WCNOC). 2007e. "Docket Number 50-482: Response to NRC Request for Additional Information Related to Wolf Creek Generating Station License Renewal Application." Item Number M19. Letter from Terry J. Garrett, CNOC, to NRC Document Control Desk, Washington, DC, May 9, 2007.

Wolf Creek Nuclear Operating Corporation (WCNOC). 2007f. *2006 Annual Radiological Environmental Operating Report.* Burlington, Kansas.

Wolf Creek Nuclear Operating Corporation (WCNOC). 2007g. "Docket Number 50-482: Response to NRC Request for Additional Information Related to Wolf Creek Generating Station

License Renewal Application." Item Number A17. Letter from Terry J. Garrett, CNOC, to NRC Document Control Desk, Washington, DC, May 9, 2007.

Wolf Creek Nuclear Operating Corporation (WCNOC). 2007h. Number of Employees by County Residence. Wolf Creek Generating Station. Burlington, Kansas. March.

Wolf Creek Nuclear Operating Corporation (WCNOC). 2007i. Docket Number 50-482: Wolf Creek Nuclear Operating Corporation's Response to Request for Additional Information Regarding the Review of the License Renewal Application for Wolf Creek Generating Station. ET 07-0001. January 11, 2007.

Wolf Creek Nuclear Operating Corporation (WCNOC). 2007j. "Docket Number 50-482: Response to NRC Request for Additional Information Related to Wolf Creek Generating Station License Renewal Application." Item Number 41. Information on plant noise, May 9, 2007

World Book Encyclopedia, *Kansas Climate*, Chicago, IL, 2006.

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; 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.

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[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

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

Category 1 and Category 2 issues related to refurbishment that are not applicable to Wolf Creek Generating Station (WCGS) because they are related to plant design features or site characteristics not found at WCGS are listed in Appendix F.

The potential environmental effects of refurbishment actions would be identified, and the analysis would be summarized within this section, if such actions were planned. Wolf Creek Nuclear Operating Corporation (WCNOC) indicated that it has performed an evaluation of structures and components pursuant to Title 10 of the Code of Federal Regulations (CFR), Part 54, Section 54.21 to identify activities that are necessary to continue operation of WCGS 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 Environmental Report (WCNOC 2006).

Table 3-2. Category 2 Issues for Refurbishment Evaluation

ISSUE—10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Sections	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 were 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. The Commission issued a Final *Policy Statement on the Treatment of Environmental Justice Matters in NRC Regulatory and Licensing Actions* in 2004 (NRC 2004).

However, WCNOC 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 (NRC 1982). In addition, WCNOC'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 WCGS beyond the end of the existing operating licenses. 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."

Nuclear Regulatory Commission (NRC). 1982. *Final Environmental Statement Related to Operation of Wolf Creek Generating Station, Unit 1.* NUREG-0878, Washington, DC.

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

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, DC.

Nuclear Regulatory Commission (NRC). 2004. "Policy Statement on the Treatment of Environmental Justice Matters in NRC Regulatory and Licensing Actions." *Federal Register* Volume 69, pp. 52040-52048. Washington, DC August 24, 2004.

Wolf Creek Nuclear Operating Corporation (WCNOC). 2006. *Applicant's Environmental Report – Operating License Renewal Stage, Wolf Creek Generating Station. Docket Number. 50-482.* Burlington, Kansas.

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 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 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 Wolf Creek Generating Station (WCGS). Section 4.1 addresses issues applicable to the WCGS cooling system. Section 4.2 addresses issues related to transmission lines and on-site 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 renewal term. Section 4.5 addresses issues related to groundwater use and quality, while Section 4.6 discusses the impacts of renewal-term operations on threatened and endangered species. Section 4.7 addresses potential new information that was identified during the scoping period and Section 4.8 discusses cumulative impacts. The results of the evaluation of environmental issues related to operation during the renewal term are summarized in

[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.

Section 4.9. Finally, Section 4.10 lists the references for Chapter 4. Category 1 and Category 2 issues that are not applicable to WCGS because they are related to plant design features or site characteristics not found at WCGS 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 WCGS cooling system operation, during the renewal term, are listed in Table 4-1. Wolf Creek Nuclear Operating Corporation (WCNOC) stated in its Environmental Report (ER; WCNOC 2006a) that it is not aware of any new and significant information associated with the renewal of the WCGS operating license (OL). The U.S. Nuclear Regulatory Commission (NRC) staff also has not identified any new and significant information during its independent review of the WCNOC ER, the Staff's site audit, the scoping process, or evaluation of other available information. For all of the Category 1 issues, the Staff concluded in the GEIS that the impacts would be 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 WCGS Cooling System During the 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
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

Table 4-1. (cont'd)

AQUATIC ECOLOGY (FOR ALL PLANTS)	
Accumulation of contaminants in sediments or biota	4.2.1.2.4; 4.3.3; 4.4.2.2; 4.4.3
Entrainment of phytoplankton and zooplankton	4.2.2.1.1; 4.3.3; 4.4.3
Cold shock	4.2.2.1.5; 4.3.3; 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
TERRESTRIAL RESOURCES	
Cooling pond impacts on terrestrial resources	4.4.4
Human Health	
Microbiological 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 Category 1 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 WCGS ER, the site audit, the scoping process, or evaluation of other available information. Therefore, the Staff concludes that there would be no impacts of altered current patterns at intake and discharge structures during the 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 WCGS ER, the site audit, the scoping process, or evaluation of other available information. Therefore, the Staff concludes that there would be no impacts of altered thermal stratification of lakes during the 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 WCGS ER, the site audit, the scoping process, or evaluation of other available information. Therefore, the Staff concludes that there would be no impacts of scouring caused by discharged cooling water during the 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 WCGS ER, the site audit, the scoping process, review of monitoring programs, or evaluation of other available information. Therefore, the Staff concludes that there would be no impacts of eutrophication during the 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 WCGS ER, the site audit, the scoping process, and evaluation of other available information including the National Pollutant Discharge Elimination System (NPDES) permit for WCGS, or discussion with the U.S. Environmental Protection Agency (EPA) and Kansas Department of Health and the Environment (KDHE) NPDES compliance offices. Therefore, the Staff has determined that there would be no significant impacts of discharge of chlorine or other biocides during the 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 the 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 WCGS ER, the site audit, the scoping process, and evaluation of other available information including the NPDES permit for WCGS, or discussion with the EPA and KDHE NPDES compliance offices. Therefore, the Staff has determined that there would be no significant impacts of discharge of sanitary wastes and minor chemical spills during the 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 WCGS ER, the site audit, the scoping process, or evaluation of other available information including the NPDES permit for WCGS. Therefore, the Staff concludes that there would be no impacts of discharges of other metals in wastewater during the 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.

As discussed in Section 2.2.3.1.4, monitoring data from both WCNOC and KDHE have documented the bioaccumulation of tritium in fish within Coffey County Lake (WCNOC 2006b, KDHE 2006a). Both the WCNOC annual report (WCNOC 2006b) and KDHE annual report (KDHE 2006a) provide an evaluation of the risk posed to humans from exposure to tritium concentrations in the surface water and fish in Coffey County Lake. Both reports note that Coffey County Lake is not used as a drinking water source, and the lake is not approved for any recreational activity other than fishing. The KDHE report provides a dose assessment for a standard man consuming 21 kilograms per year (kg/yr) of fish from Coffey County Lake, and calculates that the man would receive a committed effective dose equivalent of 0.017 millirems (mrem; KDHE 2006a). WCNOC performs a similar calculation, resulting in a committed effective dose equivalent of 0.013 mrem. These calculated doses are much less than the 100 mrem regulatory limit for a member of the public (KDHE 2006a).

The Staff has not identified any new and significant information during its independent review of the WCGS ER, the site audit, the scoping process, or evaluation of available information. Therefore, the Staff concludes that there would be no impacts of accumulation of contaminants in sediments or biota during the renewal term beyond those discussed in the GEIS.

- <u>Entrainment of phytoplankton and zooplankton</u>. 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 WCGS ER, the site audit, the scoping process, review of monitoring programs, or evaluation of other available information. Therefore, the Staff concludes that there would be no impacts of entrainment of phytoplankton and zooplankton during the renewal term beyond those discussed in the GEIS.

- <u>Cold shock</u>. 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 WCGS ER, the site audit, the scoping process, or evaluation of other available information. Therefore, the Staff concludes that there would be no impacts of cold shock during the 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 affect the larger geographical distribution of aquatic organisms.

The Staff has not identified any new and significant information during its independent review of the WCGS ER, the site audit, the scoping process, review of monitoring programs, or evaluation of other available information. Therefore, the Staff concludes that there would be no impacts on distribution of aquatic organisms during the 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 WCGS ER, the site audit, the scoping process, or evaluation of other available information. Therefore, the Staff concludes that there would be no impacts of premature emergence of aquatic insects during the 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 WCGS ER, the site audit, the scoping process, review of monitoring programs, or evaluation of other available information. Therefore, the Staff concludes that there would be no impacts of gas supersaturation during the 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 WCGS ER, the site audit, the scoping process, review of monitoring programs, or evaluation of other available information. Therefore, the Staff concludes that there would be no impacts of low dissolved oxygen during the 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 WCGS ER, the Staff's site visit, the scoping process, or evaluation of other available information. Therefore, the Staff concludes that there would be no impacts of losses from predation, parasitism, and disease among organisms exposed to sub-lethal stresses during the 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 WCGS ER, the site audit, the scoping process, or evaluation of other available information. Therefore, the Staff concludes that there would be no impacts of stimulation of nuisance organisms during the renewal term beyond those discussed in the GEIS.

- Cooling pond impacts on terrestrial resources. 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 WCGS ER, the site audit, the scoping process, or evaluation of other available information. Therefore, the Staff concludes that there would be no impacts of cooling ponds on terrestrial resources during the 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 WCGS ER, the site audit, the scoping process, or evaluation of other available information. Therefore, the Staff concludes that there would be no impacts of microbiological organisms on occupational health during the 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 WCGS ER, the site audit, the scoping process, or evaluation of other available information. Therefore, the Staff concludes that there would be 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 renewal term that are applicable to WCGS are discussed in the sections that follow, and are listed in Table 4-2.

Table 4-2. Category 2 Issues Applicable to the Operation of the WCGS Cooling System During the 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 towers and cooling ponds using makeup water from a small river with low flow)	4.3.2.1; 4.4.2.1	A	4.1.1
AQUATIC ECOLOGY (FOR PLANTS WITH COOLING POND HEAT-DISSIPATION SYSTEMS)			
Entrainment of fish and shellfish in early life stages	4.2.2.1.2; 4.4.3	B	4.1.2
Impingement of fish and shellfish	4.2.2.1.3; 4.4.3	B	4.1.3
Heat shock	4.2.2.1.4; 4.4.3	B	4.1.5
Human Health			
Microbiological organisms (public health) (plants using a lake, canal, or cooling pond or that discharge to a small river)	4.3.6	G	4.1.6

4.1.1 Water Use Conflicts

For plants with cooling pond systems that are supplied with make-up water from a small river with low flow, the potential impact on instream and riparian communities is considered a Category 2 issue, thus requiring a site-specific assessment for license renewal review. Near WCGS, the Neosho River at Burlington has an average annual flow of approximately 1,603 cubic ft per second (cfs; Putnam and Schneider 2005). This volume meets the NRC definition of a small river of 100,000 cfs (3.15×10^{12} cubic feet per year listed in 10 CFR Part 51.53(c)(3)(ii)(A)), resulting in water use conflicts being a potentially applicable issue for relicensing of WCGS.

In order to evaluate potential impacts related to water withdrawal from Wolf Creek and the Neosho River, and the potential for impacts to instream and riparian communities associated with the Neosho River, the Staff independently reviewed the WCGS ER, visited the site, consulted with Federal and State resource agencies, and reviewed the applicant's existing NPDES permit and other existing data and literature.

The GEIS considered surface water use conflicts to be a Category 2 issue for two separate reasons:

1) Consumptive water use can adversely affect riparian vegetation and instream aquatic communities in the stream. Reducing the amount of water available to either the riparian zones or instream communities could result in impacts to threatened and endangered species, wildlife, and recreational uses of the water body. In addition, riparian vegetation performs several important ecological functions, included stabilizing channels and floodplains, influencing water temperature and quality, and providing habitat for aquatic and terrestrial wildlife (NRC 1996). The GEIS specifically mentioned WCGS as an example of a facility that had already experienced water-use conflicts associated with the withdrawal of make-up water during drought periods (NRC 1996).

2) Continuing operation of these facilities depends on the availability of water within the river from which they are withdrawing water. For facilities that are located on small bodies of water, the volume of water available is expected to be susceptible to droughts and to competing water uses within the basin. In cases of extreme drought, these facilities may be required to curtail operations if the volume of water available is not sufficient (NRC 1996).

An additional potential effect of the withdrawal of water from a small river is that the withdrawal may have an impact on groundwater levels and, therefore, result in groundwater use conflicts (NRC 1996). This is considered to be a separate Category 2 issue, and is evaluated in Section 4.5.1 of this Supplemental Environmental Impact Statement (SEIS). In addition, the facility purchases water from local sources to use as potable water. Potential impacts associated with the use of this purchased water during the license renewal period are discussed in Section 4.4.2.

The water stored within Coffey County Lake is used as cooling water, and also acts as the supply for the Service Water and Essential Service Water Systems for the facility. The three separate physical sources of make-up water to Coffey County Lake include:

- All natural flows within the Wolf Creek drainage basin upstream of the Coffey County Lake dam. Administratively, these flows are obtained by WCGS through water appropriation file number 20,275 (State of Kansas 1977a in WCNOC 2006c). The reported average monthly stream flow in Wolf Creek prior to construction of the WCGS facility was approximately 8,100 gallons per minute (gpm), or 18 cfs (NRC 1982 in WCNOC 2006c).

- A portion of the natural flows within the Neosho River basin. These natural flows are defined as the water within the John Redmond Reservoir above the elevation of 1,039 feet (ft) above mean sea level (MSL). These flows are obtained by WCGS through two separate water appropriations: water appropriation file number 14,626 (55 cfs, up to a maximum of 25,000 acre (ac)-ft per yr, and water appropriation file number 19,882 (170 cfs, up to a maximum of 57,300 ac-ft per yr) (State of Kansas 1977b, State of Kansas 1977c in WCNOC 2006c).

- The conservation pool within the John Redmond Reservoir, which is defined as the water contained in the reservoir below the elevation of 1,039 ft above MSL. This water is obtained through purchase contract number 76-02 with the Kansas Water Resources Board (State of Kansas 1976 in WCNOC 2006c).

To evaluate whether the re-licensing of WCGS would result in an impact with respect to water use conflicts, the potential impact of water withdrawals from each of these three sources was evaluated separately. For each source, the potential impact was evaluated with respect to the two reasons that water use conflicts were made a Category 2 issue – the potential for impacts to instream and riparian communities and the potential for shut down of the facility due to water shortage.

4.1.1.1 Impacts to Instream and Riparian Communities

4.1.1.1.1 Instream and Riparian Impacts in Wolf Creek

Wolf Creek is an intermittent stream subject to drying during periods of drought. It was impounded by the construction of the Coffey County Lake dam approximately 5.5 miles upstream of the confluence where this tributary empties into the Neosho River. Because of the capture of water in the Coffey County Lake and the resulting evaporation and seepage losses from the lake, it is likely the flow in Wolf Creek below the dam has been reduced by WCGS operations. However, Wolf Creek is un-gauged, and current flow measurements for the creek are unavailable.

During the most severe drought of record for the Wolf Creek basin, which lasted from 1951 to 1957, the estimated discharge from Wolf Creek was zero for much of the period (NRC 1975). During future drought conditions, water would not be released from Coffey County Lake, and this intermittent stream may dry up as it has during droughts prior to the construction and operation of WCGS (NRC 1982). Prior to construction of the dam, the estimated average annual flow in Wolf Creek was 18 cfs at the Neosho River (NRC 1982). Near the Wolf Creek confluence, the estimated average annual flow in the Neosho River at Burlington during water years 1963 to 2004 was 1603 cfs (Putnam and Schneider 2005). Based on this river flow and the estimated annual average Wolf Creek flow prior to construction, the creek would have contributed approximately one percent of the average flow in this reach of the river. Thus, the marginal reductions in Wolf Creek flow due to WCGS are expected to have a negligible effect on flow in the Neosho River. Additionally, because Wolf Creek was historically an intermittent stream, WCGS operations are not expected to affect instream and riparian resources in Wolf Creek downstream of the dam.

4.1.1.1.2 Instream and Riparian Impacts in the Neosho River

The surface water resources within and along the Neosho River that may be affected by water use conflicts include instream and riparian communities. These instream and riparian resources are described in detail in Section 2 of this SEIS. The instream organisms include rare species, and the Neosho River below John Redmond Dam has been designated by the Kansas Department of Wildlife and Parks (KDWP) as critical habitat for the Neosho madtom (*noturus placidus*) and five mussels, the Neosho mucket (*Lampsilis rafinesqueana*), Ouachita kidneyshell (*Ptychobranchus occidentalis*), rabbitsfoot (*Quadrula cylindrica*), western fanshell (*Cyprogenia aberti*), and flutedshell (*Lasmigona costata*). All of these species are State-listed as threatened or endangered, and the Neosho madtom and Neosho mucket have Federal status as threatened and candidate species, respectively. The Neosho River also is a drinking water source for several towns downstream of John Redmond Reservoir, including Burlington and Iola.

To support these resources, the State of Kansas has established Minimum Desirable Streamflow (MDS) levels in the Neosho River "for instream uses relative to fish, wildlife, water quality, general aesthetics and downstream domestic and senior water rights" (KWO 2001). The MDS established for the Neosho River at Iola, Kansas under the Kansas Water Appropriation Act (KWAA) is 40 cfs from July to March. The MDS increases to 60 cfs in April and 200 cfs in May and June if the reservoir is in flood pool in order to maintain flows that support fish spawning in the river; otherwise, the MDS in April through June is 40 cfs (KWAA 2004).

The estimated average annual flow in the Neosho River at Iola, approximately 55 miles downstream of John Redmond Reservoir, was 1,865 cfs for water years 1899 to 2005, and at Burlington, approximately 5 river miles downstream of John Redmond Reservoir and upstream of the Wolf Creek confluence, was 1,603 cfs for water years 1962 to 2005 (Putnam and Schneider 2005). Based on these long-term averages, the annual average flow near Burlington is approximately 86 percent of the flow downstream at Iola. Consequently, when the MDS is 40 cfs at Iola, the streamflow near Burlington may be estimated to be approximately 34 cfs. Based on habitat characteristics (current velocity and depth) reported in the literature for two sensitive indicator species, the Neosho madtom and the Neosho mucket mussel, the applicant calculated the approximate flows in the Neosho River that would correspond to these conditions. The estimated preferred flows were 15 to 55 cfs for the Neosho madtom and 35 cfs for the Neosho mucket. Comparison of these preferred flows for habitat maintenance to flow under the worst-case MDS of 40 cfs measured at Iola indicated that this range of desirable flows generally would be maintained (WCNOC 2007a). Therefore, the MDS is expected to protect populations of the

Neosho madtom and Neosho mucket in the Neosho River from John Redmond Dam downstream to Iola. Flows sufficient to protect these two rare species also are expected to protect other species of fish and invertebrates in the river.

The withdrawal of water from the natural flows within the Neosho River is regulated by the conditions of the two appropriation mechanisms used by WCGS to acquire the water. These conditions require that withdrawals of natural flows can only be made when the flow volume remaining within the Neosho River downstream of the Makeup Water Screen House (MUSH) intake structure is 250 cfs or greater (WCNOC 2006c). The appropriations mechanism allows WCNOC to request a variance of the 250 cfs limitation from the Chief Engineer of the Division of Water Resources (DWR). Such a variance has never been requested. Although the appropriation mechanisms are not subject to the MDS restriction of 40 to 200 cfs for the Neosho River, the Chief Engineer is required to consider the public interest before a variance would be approved.

The purchase of water from the conservation pool does not directly impact the rate of water flow in the Neosho River, since the water is drawn directly from the dam, and not the river. The purchase of the conservation pool water would only occur when the water elevation within John Redmond Reservoir is below 1,039 ft above MSL, and under these conditions, the flow rate within the Neosho River would already be below the 250 cfs required to acquire water through the appropriations (WCNOC 2006c). Therefore, the Neosho River would already be in a low flow or drought condition (WCNOC 2006c). Low flow conditions in the Neosho River correlate with low precipitation and the resulting low release volumes from the John Redmond Reservoir and are not the direct result of WCGS withdrawals.

Prior to the beginning of facility operations, the NRC conducted an analysis of the impact of water withdrawal from the Neosho River during severe and prolonged drought conditions (NRC 1975). This analysis evaluated the expected water withdrawal rates from WCGS during what was considered to be a 1 in 50 year drought. The precipitation and water volume data to support the study were taken from actual measurements on the Neosho River during the period from January 1951 to December 1959, which corresponded with a 1 in 50 year drought. The results of this analysis were that withdrawal of stored contract water by WCGS at an average annual rate of 41 cfs would cause reduced flows within the river, would extend the duration and severity of low flow conditions, and could cause stress to aquatic communities and fish populations (NRC 1982).

Similar to the Neosho River appropriations, the withdrawal of water from the conservation pool through the purchase contracts is regulated by the conditions of the purchase contract and also is restricted by the physical limitations of the MUSH withdrawal system (WCNOC 2006c). These restrictions result in a maximum withdrawal rate of 70 cfs for stored water from the conservation pool (WCNOC 2006c).

Although MDS levels have been established to protect aquatic resources in the Neosho River, the appropriations and water purchase contract mechanisms under which WCGS obtains make-up water are not subject to these restrictions. The MDS restrictions apply only to junior water rights obtained after April 12, 1984, and Kansas Statutes Annotated (KSA) 82a-703b(b) states that "all vested rights, water appropriation rights and applications for permits to appropriate water having a priority date on or before April 12, 1984, shall not be subject to any minimum desirable streamflow requirements." As the WCGS appropriations were established prior to April 12, 1984, they are not subject to the restrictions. The water purchase contract is also not subject to MDS restrictions.

Reducing flow below desirable levels can have a variety of adverse effects on instream aquatic and riparian communities. Lower water levels in streams can cause water to drain from riparian marshes and vegetated areas and damage or destroy riparian plant communities that provide habitat, refugia, and nursery areas for fish and invertebrates. Habitat can also be lost from the stream due to decreased volume and area of aquatic habitat. With lowered water levels, fish can lose refuges; nesting, spawning, and nursery areas; and cover. With less habitat, fish and invertebrates would become more crowded and be subject to increased frequency of inter- and intra-specific interactions, such as predation. The decreased habitat can increase the susceptibility of fish not only to predatory fish, but also to piscivorous birds and mammals such as raccoons (*Procyon lotor*). Not only the quantity but also the quality of habitat can be affected. Lowered flow rates can alter sediment processes and characteristics, such as siltation, suspension, transportation, and sorting that in turn can affect success of invertebrate communities and fish reproductive processes. Lower stream flow and shallower water can increase stream water temperatures, which can degrade fish and invertebrate habitat. Decreased flow and turbulence and increased water temperature can reduce dissolved oxygen levels in some reaches and decrease the quality of fish habitat. These examples illustrate the complex ways in which reducing flow below desirable levels can adversely affect instream and riparian habitat quality and quantity and the populations of fish and invertebrates that inhabit them.

4.1.1.2 Availability of Water During License Renewal Term

4.1.1.2.1 Availability of Water from Wolf Creek

The limiting factor in the ability of the facility to withdraw water using their Wolf Creek appropriations is the volume of water existing in the Wolf Creek drainage above Coffey County Lake. WCGS has the right and the physical capability to withdraw 100 percent of the water within Wolf Creek, so there are no physical or administrative limitations. However, because Wolf Creek is an intermittent drainage basin, the contribution of the Wolf Creek flow to the total volume of water necessary to operate WCGS is small. The estimated annual flow volume within

Wolf Creek is reported to be 18 cfs (NRC 1982), and during drought periods, this volume is likely to be reduced to 0 cfs. The volume of water available to WCGS through the water appropriations from the natural flows within the Neosho River is 225 cfs, so the average flow in Wolf Creek is less than 10 percent of the volume of water available to the facility from the Neosho River appropriations. Therefore, the availability of water within the Wolf Creek basin is not likely to have a substantial impact on the overall availability of water for facility operations.

4.1.1.2.2 Availability of Water from Neosho River

The ability of WCGS to access water from the Neosho River may be limited by several factors, including the presence of water, competing uses, administrative limitations, and physical limitations. During a severe drought, it is likely that the volume of water available through the Neosho River and Wolf Creek appropriations would be very low or zero. Therefore, the ultimate limitation on the availability of water to maintain facility operations lies in the availability of water within the conservation pool of John Redmond Reservoir, accessed through the WCGS purchase contract.

Historically, the purchase of water from the conservation pool has been the primary source of water to WCGS. A review of the Annual Environmental Operating Reports for 1985 to 2005 indicates that the volume of water obtained through the purchase contract is highly variable, ranging from 0.464 to 6.810 billion gallons per yr (WCNOC 2007b). The purchase contract limits the total amount of water that can be withdrawn on an annual basis to 9.672 billion gallons, while the WCGS standard operating procedure (SOP) AP 26A-006 Section 6.11.3 places an annual limit of 4.83 billion gallons of water (WCNOC 2007c). From 2002 to 2006, the actual volume of water withdrawal from both appropriations and the purchase contract has ranged from 3.7 to 4.92 billion gallons per yr (WCNOC 2003a, WCNOC 2004a, WCNOC 2005a, WCNOC 2006b). This ranges from 38 to 51 percent of the volume allowed under the purchase contract. Therefore, WCGS has never approached their full allotment.

In the most severe drought conditions, stipulations within the water purchase contract could be used to further limit the amount available to be withdrawn by WCGS (WCNOC 2006a). The contract contains the following clauses that reserve the right of the State of Kansas to limit water purchases to protect downstream users and instream and riparian communities:

- If the total amount of water contracted for withdrawal from the John Redmond Reservoir in the next 12-month period is greater than the supply available from that reservoir which is deemed to be 9.672 billion gallons per yr due to a prolonged drought, the Board will apportion the available waters among the purchasers having contracts therefore as may best provide for the health, safety, and general welfare of the people of this state as determined by the Board. (State of Kansas 1976 in WCNOC 2006c).

- If, because of an emergency, the Board deems it necessary for the health, safety, or general welfare of the people of Kansas to reduce or terminate the withdrawal of water from John Redmond Reservoir, the Board will apportion any available water among persons having contracts as may best provide for the health, safety, or general welfare of the people of Kansas . . . . (State of Kansas 1976 in WCNOC 2006c).

- Whenever the elevation of water in the reservoir is below 1,039 ft above mean sea level, the amount of water taken at the point of withdrawal from the reservoir will not exceed a running average rate of 26,499 million gallons per day (mgd; State of Kansas 1976 in WCNOC 2006c).

These provisions indicate that WCGS's contract for water purchase from the conservation pool is not a right, and can be curtailed by the state, if necessary, to prevent impacts to other users and resources. This could occur if water levels in John Redmond Reservoir were to drop below the bottom level of the conservation pool at 1,020 ft above MSL. If water withdrawals were severely limited or eliminated, it would cause a subsequent reduction of the water level in Coffey County Lake through evaporation and seepage. If the water level in Coffey County Lake falls below 1,080 ft above MSL, the facility would implement plant procedure OFN SG-003: "Natural Events" (WCNOC 2003a in WCNOC 2006a). If the lake level were to fall below 1,075 ft above MSL, facility operations would be shut down (WCNOC 2006a). Coffey County lake levels are measured by WCGS operational staff for comparison to water withdrawals and regional precipitation. NRC staff also evaluated Coffey County Lake elevations to determine if WCGS withdrawals occur on low flow days as described in Appendix A, Response to Comments. During low flow periods, the facility minimizes withdrawals and replenishes lake levels during periods of high flow.

While these actions to curtail water supply to the facility have never occurred, incidents where other water rights are curtailed to maintain the MDS flow rate in the Neosho River are becoming increasingly common (KWO 2004). The Kansas Water Plan, Neosho Basin Section, specifically addresses "Protecting and Enhancing Instream Flow" as a Basin Priority Issue for the Neosho River (KWO 2004). According to this section, droughts in 2000, 2002, and 2003 had raised concern about streamflow in several basins in Kansas, and administration of junior water rights to meet the MDS on the Neosho River had become more frequent and longer in duration. Most recently, water rights that had been obtained after April 12, 1984, were curtailed for the period from November 8, 2006 to February 21, 2007 (WCNOC 2007b). The Neosho River is now closed to new appropriations during the irrigation season (May to September), and there continues to be new water right permit applications, mostly for recreational uses (KWO 2004).

Another possible limitation on the access to water through the purchase contract during the WCGS re-license term (2025 to 2045) is that the available volume of water in John Redmond Reservoir is decreasing due to sedimentation (USACE 2002). The designed lifespan of John

Redmond Reservoir is 50 years, beginning at the opening of the reservoir in 1964, and the water supply contract is based on the amount of storage space that was projected to be available at the end of the design life in 2014 (USACE 2002). However, the reservoir is silting up faster than was projected. The Design Sedimentation Rate in the conservation pool of the reservoir was 404 ac-ft per yr, while the reported actual rate from 1964 to 2007 is 874 ac-ft per yr (KWO 2007). The higher rate of sedimentation is causing a reduction in the volume of water available within the conservation pool, and it is now projected that this reduction could affect the ability of the U.S. Army Corps of Engineers (USACE) to meet their contractual obligation to provide 9.672 billion gallons per yr to the Kansas Water Office (KWO; and thus to WCGS) through 2014 (USACE 2002). The analysis concluded that, without action, there would be a 25 percent reduction in water available for cooling purposes at WCGS, and this could reduce WCNOC's ability to operate the facility during years when the full contracted water capacity was required (USACE 2002).

This faster–than-expected decrease in the volume of the conservation pool has led the USACE to develop a draft Environmental Impact Statement (EIS) and plan for water reallocation to ensure that the water supply obligation can be met through 2014 (USACE 2002). The USACE's preferred alternative in the draft EIS is to reallocate the water storage capacity in the reservoir by raising the level of the conservation pool by 2 ft, from 1,039 ft to 1,041 ft above MSL (USACE 2002). This action was proposed to ensure the availability of water to meet the contractual obligations through 2014. However, this action would reduce the amount of storage space within the reservoir available for flood control, and could result in increasing the frequency or severity of floods. Also, the reallocation of the water storage in the reservoir considered in the draft EIS would only ensure availability of water through the end of the design life of the reservoir, which is 2014 (USACE 2002).

The gradual reduction of the available water volume due to sedimentation in the conservation pool in John Redmond Reservoir suggests that water use conflicts would continue to become more likely through the re-licensing period beginning in 2025. Although WCGS has never used its full allocation, the proposed reallocation of the storage space by USACE is designed only to ensure adequate water supply through 2014 (USACE 2002). Therefore, it is likely that other actions would be required to ensure an adequate water supply through the re-licensing period from 2025 to 2045. The scope of these actions has not yet been decided. The USACE, Kansas Water Office (KWO), and WCNOC have all indicated that they are aware of the long-term issue, and that discussions have occurred to begin planning for the future water supply.[b] However,

[b] Personal Communications and Meeting Minutes as follows:
Personal communication between Robert Dover, Hydrologist for Earth Tech and Steve Nolan, USACE discussing the draft EIS. June 12, 2007. (Accession No. ML072420200).
Personal communication between Robert Dover and Cheryl Buttenhoff, KWO, discussing withdrawal from the Neosho River. June 27, 2007. (Accession No. ML072420200).

there are currently no definitive plans or proposals in place to supply water during the re-licensing period.

4.1.1.2.3 Summary of Impacts Related to Water Use Conflicts

The aquatic resources within the Wolf Creek drainage basin have been increased by facility operations due to the construction of Coffey County Lake. Prior to facility construction, there was no perennial surface water within this basin (WCNOC 2006a). However, the analysis of the water use by the facility for cooling and service water purposes indicates that, although physical and administrative controls on water withdrawal rates exist, water withdrawals can still occur, and have occurred, during times when the natural flow rate in the Neosho River is already below the 40 cfs MDS established to be protective of instream and riparian communities.

There may also be water use conflicts associated with long-term availability of the current water supply (John Redmond Reservoir) during the re-licensing period. The proposed action described in the WCGS Environmental Report (ER; WCNOC 2006a) assumes that John Redmond Reservoir would continue to be the primary source of makeup water, but does not address the likelihood that the availability of this source is being reduced through sedimentation. The documentation of the sedimentation issue in the USACE draft EIS (USACE 2002) and the Kansas Water Office Fact Sheet for John Redmond Reservoir (KWO 2007) strongly suggest that future actions will be required to ensure the continuity of the water supply. If no actions are taken, the volume of water available within the conservation pool would continue to decrease, and the supply of water to WCGS would begin to compete with the volumes of water available to maintain adequate streamflow and provide flow to the Cottonwood and Neosho River Basins Water Assurance District Number 3. If this situation coincides with a drought condition, continued water withdrawal by WCGS could severely deplete habitat and affect biota within and along the Neosho River. Such conditions could result in derating the plant temporarily during drought periods. Actions that may be taken to increase the water availability during the relicense period may include additional reallocations of the conservation and flood pools within the reservoir, dredging of sediment from the reservoir, or accessing alternative water supplies (groundwater or surface water based) from the local area. Once a proposal is developed and evaluated, it is likely that the impacts and specific mitigation measures would be evaluated in future National Environmental Policy Act (NEPA) environmental documentation developed by USACE, or the State of Kansas.

Because these future actions have not yet been proposed, it is currently not possible to determine the impacts that would be associated with them. Therefore, due to the uncertainty associated with water availability to the WCGS, the Staff has determined that impacts associated with future water use conflicts may range from SMALL to MODERATE.

Meeting minutes from a conference call on June 21, 2007 discussing water use of the John Redmond Reservoir. Participants included NRC, Earth Tech, and WCNOC. (Accession No. ML071840181).

The NRC staff has identified potential mitigation measures, which may help reduce adverse impacts related to water use conflicts during the license-renewal term for continued operation of WCGS. Such mitigation measures include managing water withdrawals in a manner that continues to maintain the MDS levels within the Neosho River. Other mitigation measures may be appropriate, depending on the future actions taken to address the reduction in water availability within John Redmond Reservoir..

4.1.2 Entrainment of Fish and Shellfish in Early Life Stages

For nuclear power plants such as WCGS with cooling pond heat dissipation systems, entrainment of fish and shellfish in early life stages into cooling water systems associated with the plant is considered a Category 2 issue requiring a site-specific assessment for the license renewal review. The Staff reviewed the WCGS ER; visited the site; consulted with Federal and State resource agencies; and reviewed the applicant's existing NPDES permit and correspondence between WCNOC and KDHE, environmental studies, and information related to operational entrainment studies conducted at WCGS.

Section 316(b) of the Clean Water Act (CWA 1977), the common name for the Federal Water Pollution Control Act, requires that the location, design, construction, and capacity of cooling intake structures reflect the best technology available for minimizing adverse environmental impacts (33 USC 1326). Entrainment of fish and shellfish into the cooling system is a potential adverse environmental impact that could be minimized by use of the best technology available.

WCGS has not been required by KDHE or EPA to perform entrainment monitoring. The State of Kansas issued the first NPDES permit for WCGS in 1977 and the permit subsequently has been renewed seven times. The State has never required WCNOC to conduct a 316(b) study for WCGS, and it has not made an explicit 316(b) determination for the station. The lack of an explicit determination is not unusual in Kansas and WCNOC has concluded that issuance of the WCGS NPDES permit by the State constitutes an implicit determination that the WCGS cooling water intake structure reflects the best technology available for minimizing adverse environmental impacts such as the entrainment of fish and shellfish in early life stages (WCNOC 2006d). However, because there is not a formal 316(b) determination, the NRC staff has conducted a full analysis of impacts due to entrainment and impingement in this SEIS.

Entrainment of fish and other organisms can occur at two locations associated with WCGS: the circulating water intake structure (CWIS) on Coffey County Lake and the MUSH on the Neosho River. The organisms subject to entrainment are those small enough to pass through the 3/8-inch (in.) openings of the traveling screens within the intakes. Of these, the organisms principally of concern are the eggs and larvae of fish and invertebrates.

4.1.2.1 Coffey County Lake Cooling Water Entrainment

Entrainment monitoring at the Coffey County Lake cooling water intake was not required for initial licensing of WCGS. The NRC relied on the State of Kansas for determination of the need for monitoring in regard to aquatic issues (NRC 1984). The State of Kansas has not required such monitoring. Thus, no entrainment monitoring program has been initiated (WCNOC 2006d).

Limited data on larval fish in Coffey County Lake have been collected by WCNOC (WCNOC 2006d). Samples were collected to provide a rough estimate of the amount of larval entrainment and the effects of entrainment on the biota of Coffey County Lake and were evaluated by the NRC (1975, 1982). The evaluations assumed that entrainment would result in 100 percent mortality. Thermal shock in the condensers was expected to be the main cause of entrainment mortality, though stresses associated with mechanical damage, chemical additions, and pressure changes were also considered likely to contribute to mortality (WCNOC 2006d). There were no shellfish species (e.g. mollusks and crustaceans) in Coffey County Lake considered likely to be entrained at the cooling water intake. Most shellfish likely to be found in Coffey County Lake (for example, crayfish) tend to be benthic and are not particularly susceptible to entrainment. Therefore, the focus of the evaluation was fish, primarily in the larval stage (WCNOC 2006d).

To determine numbers of larval fish present in the water at the intake, vertical tows with a plankton net were completed from the lake bottom to the surface. These samples were collected monthly from March through August 2005 to determine approximate peak occurrence of larvae. Two to three replicate samples were collected at 8-hour (hr) intervals over a 24-hr period to detect differences between night and day. The plankton net had an opening 30 centimeters (cm) in diameter and a mesh size of 0.5 millimeter (mm). The results indicated a possible peak in larval numbers during late May to June (WCNOC 2006d), similar to results from studies in the Neosho River (EAI 1982, Wedd 1985). Larval fish densities (larvae per cubic meter) estimated from these samples were 1.31 for gizzard shad (*Dorosoma cepedianum*), 0.47 for white crappie (*Pomoxis annularis*), and 0.36 for freshwater drum (*Aplodinotus grunniens*). In comparison, annual larval densities (larvae per cubic meter) in the Neosho River during 1981 were 52,950 for gizzard shad, 600 for white crappie, and 1,320 for freshwater drum (WCNOC 2006d).

Although sample sizes were small, the results indicated that larval fish densities were much lower upstream of the cooling water intake in Coffey County Lake than in the Neosho River (WCNOC 2006d). This suggests that the area near the cooling water intake is unlikely to be an important spawning or nursery area in Coffey County Lake and that WCGS probably does not remove appreciable numbers of larval fish from the fishery. It is likely that other factors, such as predation, were limiting gizzard shad densities in Coffey County Lake (WCNOC 2006d).

4.1.2.2 Neosho River Makeup Water Entrainment

Makeup water to maintain Coffey County Lake is pumped from the Neosho River. Water is withdrawn from the Neosho River at the makeup water intake facility, the MUSH, located immediately downstream of John Redmond Dam. Because the withdrawals are not for the purposes of cooling, according to the State of Kansas, Section 316(b) of the CWA does not apply to the Neosho River MUSH (Staab 2007) and the Neosho River intake is not subject to EPA or Kansas Phase II 316(b) cooling water intake regulations (WCNOC 2006d). Discussion of entrainment impacts with the State of Kansas also occurred during the initial certification and discharge permitting process (KG&E 1975).

In order to evaluate potential entrainment effects, extensive larval fish monitoring was conducted in the Neosho River from 1975 to 1982, before and during initial operation of the MUSH (NRC 1975 and 1982, WCNOC 2006a). No records of invertebrate monitoring are available. Monitoring of larval fish in the Neosho River prior to and during initial MUSH operation was extensive (Nalco 1976, 1977, and 1978; Hazelton 1979 and 1980; EAI 1981 and 1982; and Wedd 1985). The gizzard shad was the dominant species in most samples, though the freshwater drum and various members of the sucker family (Catostomidae) and the minnow family (Cyprinidae) also were common. In general, larval fish appeared in the Neosho River each year beginning in April and continuing until July, with peak levels typically occurring during June. Therefore, WCNOC came to the conclusion that makeup water withdrawals during other times of the year would be unlikely to entrain appreciable numbers of fish larvae (WCNOC 2006d).

The majority of the larvae identified in these studies are likely to have originated as drift from John Redmond Reservoir and not from reproduction within the Neosho River. Even if these species reproduced in the riverine habitat below the dam, there is a very limited area for nesting habitat in the river upstream of the MUSH and below the dam from which larvae or eggs could drift into the MUSH. In addition, the eggs of most native riverine fish are demersal and remain on or within the substrate, while the larvae may tend to drift downstream and have minimal ability to move upstream against the current. Thus, the potential for eggs or larvae of reproducing populations of native fish species within the Neosho River to be present in the water column immediately below John Redmond Dam and subject to entrainment is negligible. Similarly, the potential for Neosho River invertebrates to be entrained is negligible as most invertebrates present in the Neosho River are demersal and thus only susceptible to entrainment during downstream drift and emergence.

Fishery monitoring in the river subsequent to the beginning of WCGS operations revealed no reductions in populations or other changes that could be attributed to makeup pumping (EAI 1982). The normally higher precipitation and river flows in spring usually have reduced the need for makeup diversion and the potential for entrainment during the months of peak larval occurrences (WCNOC 2006d), and this would be expected to continue during the renewal period, at least in years with near normal precipitation.

Unlike cooling water intakes, the WCGS makeup intake does not subject entrained organisms to thermal stresses. As a result, many of the fish would be expected to pass through the makeup pumps and piping and survive in Coffey County Lake. This is considered the mechanism by which gizzard shad, white bass (*Morone chrysops*), white crappie, and all rough fish species living in Coffey County Lake became established. These species were not initially stocked in Coffey County Lake by WCGS (WCNOC 2006d). Although fish transferred to Coffey County Lake by this mechanism are lost from the aquatic community of the Neosho River, they contribute to the fish populations of Coffey County Lake and may replace some of the limited number of larvae lost to entrainment within the Coffey County Lake intake.

4.1.2.3 Summary of Entrainment Impacts

The Staff has reviewed the available information on the potential impacts of the cooling water intake resulting from the entrainment of fish and shellfish in early life stages and concludes that the impacts would be SMALL and that, therefore, no additional mitigation is warranted. The Staff considered mitigation measures to minimize impacts associated with entrainment. These measures include fine mesh screens, circulating water flow reduction, and cooling towers. The Staff concluded that implementation of such measures would not be beneficial enough to be warranted.

4.1.3 Impingement of Fish and Other Aquatic Organisms

For plants with cooling pond cooling systems, such as WCGS, impingement of fish and shellfish on traveling debris screens associated with nuclear power plant cooling water intakes is considered a Category 2 issue, thus requiring a site-specific assessment for license renewal review. To evaluate this, the Staff reviewed the WCGS ER; visited the site; consulted with Federal and State resource agencies; and reviewed the applicant's existing NPDES permit and correspondence between WCGS and KDHE, environmental studies, and information related to operational impingement studies conducted at WCGS. Impingement of fish and other organisms can occur at two locations associated with WCGS: the CWIS on Coffey County Lake and the MUSH on the Neosho River.

4.1.3.1 Impingement at Coffey County Lake Cooling Water Intake

4.1.3.1.1 Impingement Monitoring

Impingement surveys were conducted monthly at WCGS over the December 2004 through March 2006 period. A fine-mesh (0.25-in. bar mesh) collection basket was placed in a catch basin to collect all fish washed from the CWIS traveling screens over a given 24-hr period. Fish were removed from the basket every 8 hours and identified, measured, and examined in order to ascertain their condition. Each fish was classified as "live," "recently dead," or "dead" based on its physical condition. Fish categorized as "recently dead" were assumed to have been alive when impinged and to have died in the collection basket as a result of exposure and oxygen deprivation (WCNOC 2006e). All fish categorized as "dead" based on examination were considered to have been dead before they were impinged on the traveling screens. These fish were assumed by the applicant to represent natural mortality in Coffey County Lake. However, the NRC staff does not agree with this assumption because the fish may have died as a result of being impinged or due to natural mortality.

Because the traveling screen wash passes though a trash grating (with 1 in. by 3.75-in. [2.54 cm by 9.53 cm] openings) at the point at which it leaves the Circulating Water Screenhouse (CWSH) and flows into Coffey County Lake, the following assumptions were made by WCNOC in estimating monthly and annual rates of impingement mortality by extrapolating from the basket surveys (WCNOC 2006a):

- All fish greater than 100 mm total length (TL), no matter their condition in the collection basket, would die under normal circumstances because they would not likely pass through the openings in the trash grating.
- All fish in the collection basket less than or equal to 100 mm TL categorized as "live" or "recently-dead" would, under normal circumstances, return to Coffey County Lake and survive. However, survival studies have not been performed by WCGS to verify this assumption and the NRC staff does not agree with this assumption.

The NRC staff also evaluated the impingement data collected from December 2004 through March 2006 and estimated the monthly and annual rates of impingement mortality based on more conservative assumptions:

- Recently dead fish less than or equal to 100 mm TL were assumed to have died as a result of impingement.
- Dead fish may have died of natural causes, but they also may have died from impingement; therefore, in calculating monthly impingement mortality, it was assumed that all dead fish died from impingement.
- As a result, all fish and shellfish were assumed to have died from impingement except live fish and shellfish less than or equal to 100 mm TL.

Table 4-3 presents the assumptions utilized by WCNOC and NRC staff in order to extrapolate monthly and annual impingement totals based on fish length and condition.

Table 4-3. Assumptions Used in Estimating Impingement Totals

Fish Length	Condition	WCNOC Assumption	NRC Assumption
> 100 mm TL	Dead	Natural mortality	Natural or Impingement mortality
	Recently dead	Impingement mortality	Impingement mortality
	Live	Impingement mortality	Impingement mortality
</= 100 mm TL	Dead	Natural mortality	Natural or Impingement mortality
	Recently dead	Would have survived	Impingement mortality
	Live	Would have survived	Impingement mortality

Adapted from: WCNOC 2006e

Fish size and condition were used to determine if fish would have returned to the reservoir and survived had the collection basket not been in place. After these adjustments, data from 24-hr basket surveys served as the basis for estimates of monthly and annual impingement mortality rates, and their effect on the Coffey County Lake environment. To extrapolate monthly and annual impingement rates, the number of fish collected over a given 24-hr period was multiplied by the number of days in the month in which the data were collected. The monthly totals were then summed to calculate annual totals. Because no data were available from April 2005, when the plant was down for re-fueling, the impingement rates for March and May 2005 were evaluated for use as surrogates. The May data were ultimately used because they reflected a much higher rate of impingement and, thus, were more conservative. Similarly, March 2006 data were used as surrogates for February 2006 when data were unable to be collected. For annual impingement rates, only 2005 data were used to capture all four seasons and corresponding lake conditions (WCNOC 2006a).

4.1.3.1.2 Assessment of Impingement Impacts

Totals of 420 fish and 104 invertebrates (crayfish and Asiatic clam [*Corbicula fluminea*]) were collected in impingement samples at WCNOC during the December 2004 to March 2006 time period (Table 4-4). Five fish species represented 93 percent of all impinged fish: freshwater drum (33 percent of fish collected), white crappie (23 percent), gizzard shad (21 percent), bluegill (*Lepomis macrochirus*; 11 percent), and channel catfish (*Ictalurus punctatus*; 6 percent). Smaller numbers of white bass, buffalo (*Ictiobus* spp.), walleye (*Sander vitreus*), smallmouth bass (*Micropterus dolomieu*), and flathead catfish (*Pylodictis olivaris*) were also collected, but none of these species comprised more than 4 percent of the total. Invertebrates collected over the 16-month period were 87 Asiatic clams and 17 crayfish (WCNOC 2006e).

Table 4-4. Total Number of Fish Collected in Impingement Samples from the CWIS on Coffey County Lake (December 2004 – March 2006)

	Species [(1)]														
Date	**GS**	**RCS**	**SBF**	**CC**	**FC**	**WB**	**BG**	**SMB**	**WC**	**WAE**	**FWD**	**AC**	**CR sp.**	**Total**	**Temp °F**
Dec-04	30	0	3	7	0	8	12	0	27	0	98	2	1	188	38.5
Jan-05	20	1	0	2	0	0	0	0	0	0	0	0	2	25	37.5
Feb-05	0	0	0	1	0	0	0	0	0	0	1	0	1	3	45.2
Mar-05	0	0	0	0	0	0	0	0	0	0	0	0	0	0	47.5
Apr-05	0	0	0	0	0	0	0	0	1	0	0	0	0	1	64.9
May-05	0	0	0	0	0	0	1	0	1	0	0	33	1	36	70.2
Jun-05	22	0	0	0	0	0	5	0	0	0	0	20	1	48	81.8
Jul-05	3	0	0	0	0	0	1	0	1	0	2	6	2	15	85.8
Aug-05	2	0	0	0	0	3	0	1	10	0	7	1	2	26	80.7
Sep-05	0	0	0	0	0	0	1	0	1	0	3	15	1	21	79.9
Oct-05	0	0	0	0	0	1	0	0	0	1	1	4	0	7	67.6
Nov-05	1	0	0	1	0	2	26	0	33	1	0	2	0	66	57.8
Dec-05	10	0	3	5	1	2	2	0	19	0	19	0	4	65	40.5
Jan-06	0	0	0	3	0	0	0	0	1	0	1	3	2	10	45.1
Feb-06	0	0	0	0	0	0	0	0	0	0	0	0	0	0	42.0
Mar-06	0	0	0	5	0	1	0	0	2	0	4	1	0	13	46.4
2005 (Totals)	58	1	3	9	1	8	36	1	66	2	33	81	14	313	
ALL	88	1	6	24	1	17	48	1	95	2	136	87	17	524	

(1) Fish species abbreviations:

Gizzard shad	GS	Smallmouth bass	SMB
River carpsucker	RCS	White crappie	WC
Smallmouth buffalo	SBF	Walleye	WAE
Channel catfish	CC	Freshwater drum	FWD
Flathead catfish	FC	Asiatic clam	AC
White bass	WB	Crayfish spp.	CR sp.
Bluegill	BG		

Adapted from: WCNOC 2006a

Approximately 52 percent of all fish and invertebrates impinged were found dead in the collection basket. Gizzard shad showed the highest mortality rate at 63 percent (WCNOC 2006a). Gizzard shad are known to be fragile and subject to winter kills (Haines 2000) as well as summer kills (Mettee et al. 1996). Freshwater drum also showed a fairly high rate of mortality, 58 percent. Mortality rates for bluegill, channel catfish, and white crappie were 48 percent, 46 percent, and 31 percent, respectively.

To estimate mortality due to impingement, WCNOC and NRC adjusted the data in accordance with the assumptions in Table 4-3 by removing the fish unlikely to die or to have died from impingement. This resulted in monthly impingement mortality rates ranging from 0 to 1,612 under WCNOC assumptions (Table 4-5) and from 28 to 5,706 under NRC assumptions (Table 4-6). Under WCNOC assumptions, an annual total of 957 fish (no shellfish) was estimated to have died as a result of being impinged (Table 4-5). However, under NRC assumptions, annual totals of 6,690 fish and 2,545 shellfish were estimated to have died (Table 4-6). This corresponds to annual impingement mortality rates of 31 percent for finfish and 0 percent for shellfish using WCNOC assumptions (WCNOC 2006e) and rates of 100 percent for finfish and 43 percent for shellfish using NRC assumptions. The WCNOC and NRC assumptions taken together put lower and upper bounds on impingement mortality and, therefore, provide a measure of uncertainty of the impingement estimates.

The highest impingement rates were observed in late spring to early summer (June) and fall to early winter (November and December). Water temperatures in the 30s and low 40s (°F) were generally associated with higher rates of impingement and impingement mortality for all fish species, but trends were less than clear-cut. The lowest temperature observed over the 16-month period (37.5°F in January 2005) was associated with a fairly low impingement rate (WCNOC 2006e).

WCNOC (2006e) stated that there appeared to be no correlation (based on visual evidence only) between cooling water withdrawal rates and impingement mortality, although no data were provided to confirm this. The authors stated that the highest impingement rates were often associated with the operation of two circulating water pumps and the lowest impingement rates were often associated with the operation of three circulating water pumps. The authors also stated that environmental factors influence impingement as much or more than operational factors. These environmental factors include meteorology (frontal movement, specifically air temperature, wind speed, wind direction), water quality (water temperature, dissolved oxygen levels at depth), and biology (distribution and abundance of species that are vulnerable to impingement, such as gizzard shad; overall health of the fish community; size and age composition, as smaller fish are relatively more vulnerable than larger fish, which are stronger.

Table 4-5. Estimated Monthly Impingement Mortality for the CWIS on Coffey County Lake – Based on WCNOC Assumptions (1)
(December 2004 – March 2006)

	Species (2, 3)													
Date	**GS**	**RCS**	**SBF**	**CC**	**FC**	**WB**	**BG**	**SMB**	**WC**	**WAE**	**FWD**	**AC**	**CR sp.**	**Total**
Dec-04	155	0	93	0	0	186	0	0	62	0	1116	0	0	1612
Jan-05	341	31	0	0	0	0	0	0	0	0	0	0	0	372
Feb-05	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mar-05	0	0	0	0	0	0	0	0	0	0	31	0	0	31
Apr-05(4)	0	0	0	0	0	0	0	0	31	0	0	0	0	31
May-05	0	0	0	0	0	0	0	0	31	0	0	0	0	31
Jun-05	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Jul-05	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Aug-05	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sep-05	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Oct-05	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nov-05	0	0	0	0	0	60	0	0	30	30	0	0	0	120
Dec-05	0	0	31	0	0	62	31	0	93	0	155	0	0	372
Jan-06	0	0	0	0	0	0	0	0	31	0	0	0	0	31
Feb-06(5)	0	0	0	31	0	0	0	0	31	0	31	0	0	93
Mar-06	0	0	0	31	0	0	0	0	31	0	31	0	0	93
2005 (Totals)	341	31	31	0	0	122	31	3	185	30	186	0	0	957
ALL	496	31	124	62	0	308	31	0	340	30	1364	0	0	2786

(1) Mortality was adjusted for fish considered alive and likely returned to the lake unharmed in accordance with the WCNOC assumptions in Table 4-3.
(2) Fish species abbreviations:

Gizzard shad	GS	White bass	WB	Freshwater drum	FWD
River carpsucker	RCS	Bluegill	BG	Asiatic clam	AC
Smallmouth buffalo	SBF	Smallmouth bass	SMB	Crayfish spp.	CR sp.
Channel catfish	CC	White crappie	WC		
Flathead catfish	FC	Walleye	WAE		

(3) All live and recently dead fish and shellfish in impingement samples that were ≤ 100 mm total length were considered likely to have returned to the lake alive. Recently dead fish > 100 mm total length were assumed to have died from impingement and all dead fish were assumed to have died from natural causes.
(4) Data unable to be collected due to a facility shutdown. Surrogate data from May 2005 were used.
(5) Data unable to be collected. Surrogate data from March 2006 were used.
Adapted from: WCNOC 2006a
CWIS = cooling water intake structure

Table 4-6. Estimated Monthly Impingement Mortality for the CWIS on Coffey County Lake – Based on NRC Assumptions [(1)]
(December 2004 – March 2006)

	Species [(2, 3)]													
Date	GS	RCS	SBF	CC	FC	WB	BG	SMB	WC	WAE	FWD	AC	CR sp.	Total
Dec-04	930	0	93	186	0	248	372	0	837	0	3,038	2	0	5,706
Jan-05	620	31	0	62	0	0	0	0	0	0	0	0	31	744
Feb-05	0	0	0	0	0	0	0	0	0	0	28	0	0	28
Mar-05	0	0	0	0	0	0	0	0	0	0	31	0	0	31
Apr-05[(4)]	0	0	0	0	0	0	31	0	31	0	0	713	0	775
May-05	0	0	0	0	0	0	31	0	31	0	0	713	0	775
Jun-05	660	0	0	0	0	0	150	0	0	0	0	600	30	1,440
Jul-05	93	0	0	0	0	0	31	0	31	0	62	93	31	341
Aug-05	62	0	0	0	0	93	0	31	310	0	217	0	31	744
Sep-05	0	0	0	0	0	0	30	0	30	0	90	150	0	300
Oct-05	0	0	0	0	0	31	0	0	0	31	31	124	0	217
Nov-05	30	0	0	30	0	60	780	0	990	30	0	60	0	1,980
Dec-05	310	0	93	155	31	62	62	0	589	0	589	0	62	1,953
Jan-06	0	0	0	93	0	0	0	0	31	0	31	31	31	217
Feb-06[(5)]	0	0	0	93	0	31	0	0	62	0	124	31	0	341
Mar-06	0	0	0	93	0	31	0	0	62	0	124	31	0	341
2005 (Totals)	1,775	31	93	247	31	246	1,115	31	2,012	61	1,048	2,453	185	9,328
ALL	2,705	31	186	712	31	556	1,487	31	3,004	61	4,365	2,548	216	15,933

(1) Mortality was adjusted for fish considered alive and likely returned to the lake unharmed in accordance with the NRC assumptions in Table 4-3.
(2) Fish species abbreviations:

Gizzard shad	GS	White bass	WB	Freshwater drum	FWD
River carpsucker	RCS	Bluegill	BG	Asiatic clam	AC
Smallmouth buffalo	SBF	Smallmouth bass	SMB	Crayfish spp.	CR sp.
Channel catfish	CC	White crappie	WC		
Flathead catfish	FC	Walleye	WAE		

(3) All live fish and shellfish in impingement samples that were ≤ 100 mm total length were considered likely to have returned to the lake alive. All other fish and shellfish in the samples (dead, recently dead, or alive and > 100 mm total length) were assumed to have died as a result of impingement.
(4) Data unable to be collected due to a facility shutdown. Surrogate data from May 2005 were used.
(5) Data unable to be collected. Surrogate data from March 2006 were used.
Adapted from: WCNOC 2006a
CWIS = cooling water intake structure

swimmers). While these factors are known to have a major impact on impingement, no data were available to corroborate this for Coffey County Lake and WCGS.

The fishery in Coffey County Lake reflects Coffey County Lake management efforts to biologically control impingement rates by promoting predator species. This effort was undertaken to prevent the economic and operational difficulties that could be caused by excessive impingement, particularly of gizzard shad. Predator species that are considered important at WCGS to control impingement include species that are also important for recreational fishing purposes. These species, which include channel catfish, white bass, wiper hybrids (*Morone saxatilis* x *M. chrysops*), smallmouth bass, largemouth bass (*Micropterus salomides*), white crappie, and walleye, are discussed below.

Channel catfish

During the 16-month monitoring period, channel catfish collected in the impingement samples totaled 24 (Table 4-4). Based on the WCNOC and NRC assumptions presented above, it was estimated that a total of 62 to 712 channel catfish would have been impinged on the CWIS screens during the period (Tables 4-5 and 4-6). WCNOC concluded that these fish would have all been returned to the lake alive and, thus, there was no impingement mortality related to the operation of the screens (WCNOC 2006e).

White bass

During the 16-month monitoring period, white bass collected in the impingement samples totaled 17 (Table 4-4). Based on the WCNOC and NRC assumptions presented above, it was estimated that 308 to 556 white bass would have been impinged on the CWIS screens (Tables 4-5 and 4-6).

Based on annual fish monitoring data for Coffey County Lake (expressed as the catch-per-unit-effort [CPUE]), the white bass population in Coffey County Lake has remained relatively consistent (Table 2-9). Survival rates for Coffey County Lake white bass were unavailable, but survival in regional reservoirs ranged from 21 to 52 percent and averaged 35 percent (Colvin 1993). Growth rates in Coffey County Lake indicate that it would take approximately 3 years for white bass to reach 12 in. (305 mm) TL, which is the current minimum length for recreational harvest (WCNOC 2006e). Using an average annual survival of 35 percent, the 122 white bass removed from the Coffey County Lake population by impingement would correspond to 5.2 fish by the time they are available for recreational harvest (WCNOC 2006a). This would equate to 0.3 to 1.4 percent of the annual recreational harvest from 1999 through 2005 (WCNOC 2006e).

Wiper hybrids, Smallmouth bass, and Largemouth bass

There were no wiper hybrids or largemouth bass collected in the impingement samples, and only one smallmouth bass was observed (Table 4-4). The one smallmouth that was collected was dead (WCNOC 2006e).

Population trends for these species have been variable throughout the life of Coffey County Lake. Both the largemouth bass and the wiper had a higher CPUE during the initial years of reservoir operation, whereas the smallmouth bass CPUE has varied consistently throughout the 22-year sampling program (Table 2-9). However, due to the lack of impingement for these species, it is unlikely that WCGS has any impact on these species.

White crappie

During the 16-month monitoring period, white crappie collected in the impingement samples totaled 95 (Table 4-4). Based on the WCNOC and NRC assumptions presented above, it was estimated that 340 to 3,004 white crappie would have been impinged on the CWIS screens during the period (Tables 4-5 and 4-6).

White crappie is an important species for WCGS because gizzard shad is one of its major forage items. Most of the crappies impinged during this study were slightly longer than the 100 mm TL used for data adjustment and were young-of-year (YOY) fish (WCNOC 2006e).

Annual survival rates for Coffey County Lake have not been calculated; however, annual survival rates ranging from 23 to 46 percent have been reported in the region (Mosher 2000, Muoneke et al. 1992). WCNOC states that white crappie survival is likely to be toward the higher range due to relatively larger, longer-lived crappie present in Coffey County Lake (WCNOC 2006e).

Average growth rates for Coffey County Lake crappies indicate that they typically reach the recreational length limit of 14 in. (356 mm) TL at 4 years of age. Applying the higher 46 percent survival rate to the adjusted impinged fish yields reductions to 185 after year one, to 85 after year two, to 39 after year three, and to 18 after year four. Accordingly, impingement would cause 18 crappies to be unavailable for recreational harvest (WCNOC 2006e).

Walleye

During the 16-month monitoring period, walleye collected in the impingement samples totaled 2 (Table 4-4). Based on the WCNOC and NRC assumptions presented above, it was estimated that a total of 30 to 61 walleye would have been impinged on the CWIS screens during the period (Tables 4-5 and 4-6).

Catch curve regressions for walleye in Coffey County Lake for 2003 and 2004 indicate an average total survival rate of 29 percent (WCNOC 2006e). At the current slot limit (18 to 26 in. protected) and at growth rates present in 2003 and 2004, the 30 walleye at 388 mm TL (length of impinged specimen) would remain available for recreational harvest for approximately 2 years. Applying the 29 percent survival estimate, reductions to the extrapolated 30 impinged walleye would be 21.3 fish the first year, and an additional 6.2 fish the second year. This means that of the 30 impinged walleye, if similar impingement, survival, and growth continued annually, estimated annual loss to the recreational fishery would be 11.2 walleye (8.7 fish remaining after the first year, plus 2.5 remaining after the second year) (WCNOC 2006e).

Gizzard shad

One of WCNOC's primary goals in managing the fishery in Coffey County Lake is to eliminate excessive gizzard shad wintertime impingement events (WCNOC 2006e). Shad are also an important species that provide forage to upper trophic level species. Reductions caused by natural predation or other influences, such as winter die-offs or WCGS impingement, cannot be greater than the population can recover from. Extremely low shad densities could cause subsequent reduction in important predator species (Haines 2000).

During the 16-month monitoring period, gizzard shad collected in the impingement samples totaled 88 (Table 4-4). Based on the WCNOC and NRC assumptions presented above, it was estimated that 496 to 2,705 gizzard shad would have been impinged on the CWIS screens during the period (Tables 4-5 and 4-6). Using 2005 data as representative of annual mortality, the adjusted impingement mortality for the gizzard shad ranged from 341 (WCNOC 2006e) to 1,775 (NRC assumptions).

An estimate of the total gizzard shad estimate from Coffey County Lake was derived based on mid-summer seine hauls from 1983 through 1997 (Haines 2000). Average density estimates in Coffey County Lake of similar sized shad over the 1983 through 1997 period were 3 million (Haines 2000). Mortality attributable to impingement represents 0.01 percent of this average YOY population estimate (WCNOC 2006e).

Other species

Several other species have been observed in the impingement sampling at WCGS. These include:

- River carpsucker (*Carpiodes carpio*)
- Smallmouth buffalo (*Ictiobus bubalus*)
- Flathead catfish

- Bluegill
- Freshwater drum
- Crayfish species
- Asiatic clam

Other than the freshwater drum, these species were all observed in low numbers in the impingement samples (Table 4-4). None of these species are considered to be recreationally important or critical to the management of impingement by WCGS (WCNOC 2006e).

4.1.3.2 Impingement at Neosho River Makeup Water Intake

4.1.3.2.1 Impingement Monitoring

An additional intake at WCGS is on the Neosho River. Water is withdrawn periodically from the Neosho in order to ensure adequate pool levels in Coffey County Lake. Water from the Neosho is withdrawn by the MUSH prior to being piped to Coffey County Lake. The MUSH is situated on the east side of the Neosho River downstream of John Redmond Dam. Because the withdrawals at the MUSH are a water transfer and are not for the purpose of power plant cooling, the State of Kansas has determined that this intake structure is exempt from the CWA 316(b) requirements (Staab 2007).

As a condition of the Wolf Creek Construction Permit Number CPPR-147, the NRC required Kansas Gas and Electric Company (KG&E) to monitor the impingement of fish during the lake-filling phase of construction. The NRC requirement was outlined in Section 6.1.3.2 of the Wolf Creek Generating Station, Unit No. 1 Final Environmental Statement, NUREG-75/096. The 1-year impingement study on the MUSH was performed between November 1980 and October 1981 (KG&E 1981).

Two 12-hr screen counts were conducted twice weekly between April and July and twice a month from August to March. The first screen count started at 0800 hrs and ended at 2000 hrs, while the second count started at 2000 hrs and ended at 0800 hrs. Traveling screens were washed starting about 30 minutes before the beginning and end of a sample period, with all debris and fish washed from the screen into an aluminum basket or nylon bag net. The mesh size of both the basket and the bag was 0.375 in. (KG&E 1981).

4.1.3.2.2 Assessment of Impingement Impacts

At the MUSH, impingement was dominated by the major clupeid species present, gizzard shad (Table 4-7). Gizzard shad, along with white bass and freshwater drum, comprised more than 99.9 percent of total impingement. Peak impingement for all three of these taxa occurred during

Table 4-7. Total Number of Fish Collected in Impingement Samples for the MUSH on the Neosho River (November 1980 – October 1981)

	Species																							
Date	(1) GS	CC	GF	RS	GHS	NO sp.	GOS	PI sp.	RCS	SBF	CCF	BCF	FCF	WB	BG	OSF	LSF	GSF	LE sp.	WC	WAE	FWD	Monthly Total	Temp °F
Nov-80	117,302	0	0	0	0	0	0	0	24	12	314	0	0	60	0	0	0	0	0	24	0	2,440	120,176	40.46
Dec-80	597,151	0	0	0	0	9	0	0	0	9	124	0	0	625	9	0	0	0	12	59	0	2,751	600,749	39.74
Jan-81	24,514,431	0	0	0	0	0	0	0	48	0	168	0	0	1,951	0	0	0	17	0	164	0	6,990	24,523,769	39.02
Feb-81	79,732,164	0	0	0	0	0	0	0	0	2,050	2,050	0	0	241,357	0	0	0	0	0	5,869	0	155,745	80,139,235	33.08
Mar-81	2,954	0	0	0	18	55	36	18	0	18	2,092	0	0	238	0	36	0	0	0	365	0	66,602	72,432	54.5
Apr-81	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0	N/A
May-81	19	0	2	0	0	0	2	2	0	6	196	2	6	0	3	61	0	6	0	2	0	265	572	67.64
Jun-81	174	4	4	7	4	7	0	7	0	0	68	0	0	53	11	46	25	11	0	92	0	453	966	75.02
Jul-81	273	10	3	0	3	10	0	0	27	3	37	0	13	262	13	63	60	43	0	130	3	485	1,438	80.6
Aug-81	145	0	0	0	0	21	0	0	0	0	124	0	21	21	0	0	0	0	0	166	0	104	602	74.48
Sep-81	134	0	0	0	0	0	0	0	0	0	104	0	0	134	0	0	0	0	0	401	0	728	1,501	75.92
Oct-81	520	46	0	0	0	0	0	0	0	0	153	0	60	46	0	0	0	0	0	45	0	2,793	3,663	60.26

(1) Fish species abbreviations:

Gizzard shad	GS	Blue catfish	BCF
Common carp	CC	Flathead catfish	FCF
Goldfish	GF	White bass	WB
Red shiner	RS	Bluegill	BG
Ghost shiner	GHS	Orangespotted sunfish	OSF
Notropis sp.	NO spp.	Longear sunfish	LSF
Golden shiner	GOS	Green sunfish	GSF
Pimephales sp.	PI spp.	Lepomis sp.	LE spp.
River carpsucker	RCS	White crappie	WC
Smallmouth buffalo	SBF	Walleye	WAE
Channel catfish	CCF	Freshwater drum	FWD

No sampling completed N/A

Adapted from: Koester 1982

January and February and was predominately YOY fish (Koester 1982). Gizzard shad were by far the most dominant component of impinged fish, composing over 99 percent of the calculated total (KG&E 1981). Koester (1982) hypothesized that during peak impingement, shad were being discharged from John Redmond Reservoir in a stressed condition and were unable to avoid the low intake velocities present at the MUSH. No threatened, endangered, or rare species were impinged at the MUSH during this study (KG&E 1981).

During the monitoring period, low rainfall resulted in low discharge rates from John Redmond Reservoir, which consistently isolated the MUSH intake channel from the Neosho River throughout late 1980 and early 1981. Additionally, filling of Coffey County Lake occurred during this time period; therefore, pumps were constantly running during this study (KG&E 1981). The MUSH has been used for transfer of water to Coffey County Lake every year since the plant went on line. Records were not available to the NRC staff to determine how often the MUSH is used, but the 2006 Annual Environmental Operating Report stated that makeup activities occurred from September 1 through December 20, 2006 and that a total of 3.665 billion gallons (38 percent of the contracted allotment) was transferred (Moles 2007). From 1985 until 2005, an average of 3.16 billion gallons of water per yr was transferred to Coffey County Lake (WCNOC 2007b).

The MUSH is only operated to maintain water levels in Coffey County Lake. Therefore, under normal rainfall levels or greater, the MUSH would be utilized only sparingly and impingement of organisms from the Neosho river will be minimized. The impingement of larger fish should be minimal because the operational intake velocities of approximately 0.5 ft per second (fps) are low in comparison to the stream flows in habitats where most species of fish native to this watershed occur (WCNOC 2006e). In the MUSH vicinity, Neosho River flows can typically range from 0.8 to 4.9 fps (Wedd 1985). Based on this, the applicant concluded that impingement of adult fish would rarely occur and then only when the fish are in a physiologically weakened condition or dead and, thus, unable to avoid even the low current velocities near the MUSH intake (WCNOC 2006e). WCNOC has procedural guidelines to avoid pumping during the cold winter months (WCNOC 2006e). This may also help to minimize impingement rates.

During times of water use conflicts when the MUSH is withdrawing water from the Neosho river and water levels are low, impingement impacts to fish populations may increase. The reduced volume and area of habitat in the Neosho River below the John Redmond Dam may cause the density of fish susceptible to impingement to be higher and could result in increased impingement rates if fish seeking new habitat and refuges congregate in the MUSH area. Together these changes could increase impingement impacts.

Survival studies of impinged organisms on the MUSH screens have not been conducted. However, it is likely that, for the organisms impinged at the MUSH, survival is likely to be low due to the lack of a fish-return system (fish are currently washed off the screens, directed to a sluiceway, and then dropped at least 10 ft to the river).

4.1.3.3 Summary of Impingement Impacts

The data used by NRC staff to evaluate the potential impacts of renewal of the operating license at WCGS represents only a small percentage of the operating period. Most of the MUSH impingement data were collected over 20 years ago and may not represent current biological conditions. As a result, any determination of impact has a much higher level of uncertainty than would likely exist at a plant with a consistent long-term impingement monitoring program. Because EPA and KDHE consider Coffey County Lake to be a cooling impoundment, the regulatory agencies have not required WCGS to consistently monitor impingement.

The State of Kansas issued the first NPDES permit for WCGS in 1977 and has issued seven renewals since that time. The state has never required WCNOC to conduct a 316(b) study for WCGS but has made no explicit 316(b) determination for the station. The lack of an explicit determination is not unusual in Kansas, though, and WCNOC concludes that State issuance of the WCGS NPDES permit constitutes an implicit determination that the WCGS cooling water intake structure reflects the best technology available for minimizing adverse environmental impact such as entrainment of fish and shellfish (WCNOC 2006a).

Similar to the CWIS, the MUSH also has a very small and old data set from which to evaluate the potential effects of the proposed action. KDHE and EPA both consider the pumping of water to Coffey County Lake from the Neosho River to be a water withdrawal and a transfer of water from one basin to another. Water transfers are not covered by NPDES permitting; thus, there are no 316(b) requirements to fulfill for the MUSH.

However, NRC staff evaluated impingement studies conducted at WCGS over the December 2004 to March 2006 period. These studies suggest that impingement rates were very low in absolute numbers of fish and impingement mortality was relatively low. Available data also suggest that impingement has had little or no effect on fish populations in Coffey County Lake.

NRC staff also evaluated impingement due to makeup water diversion during the worst-case conditions, which was initial Coffey County Lake filling. Since that time, makeup pumping during WCGS operation has been less frequent and has diverted less volume (WCNOC 2006e). WCNOC has administrative guidelines in place to avoid makeup pumping when low flow conditions may be expected. However, during times of water use conflicts when the MUSH is withdrawing water from the Neosho River and water levels are low below John Redmond Dam, impingement impacts to fish populations may increase. The reduced volume and area of habitat in the Neosho River may cause the density of fish susceptible to impingement to be higher and could result in increased impingement rates as the fish congregate in deeper pools such as those found in the MUSH area. Together these changes could increase impingement impact.

Therefore, based on a review of the available information relative to potential impacts of the cooling water intake system and the makeup water intake system on the impingement of fish and other aquatic organisms, the Staff concludes that impacts on aquatic organisms in both Coffey County Lake and the Neosho River during the renewal term would be SMALL, if no water use conflicts exist. However, if SMALL to MODERATE impacts occur due to water use conflicts (see Section 4.1.1), fish would have less available habitat to use as a refuge and would likely be exposed to greater pumping frequency and volume removals from the Neosho River. Therefore, impingement impacts in the Neosho River could also be SMALL to MODERATE.

The NRC staff has identified potential mitigation measures that might reduce adverse impacts due to impingement during the license-renewal term for continued operation of WCGS. The mitigation measures include a fish-return system, behavioral barriers, and barrier nets. However, the Staff concluded that implementing such measures would not be cost beneficial enough to be warranted.

4.1.4 Heat Shock

For plants with cooling ponds or reservoirs, the effects of heat shock are listed as a Category 2 issue and require plant-specific evaluation before license renewal. The NRC identified impacts on fish and shellfish resources resulting from heat shock as a Category 2 issue because of continuing concerns about thermal discharge effects and the possible need to modify thermal discharges in the future in response to changing environmental conditions (NRC 1996). To perform this evaluation, the Staff reviewed the WCGS ER; visited the site; consulted with Federal and State resource agencies; and reviewed the applicant's existing NPDES permit and correspondence between WCGS and KDHE, environmental studies, and information related to operational thermal studies conducted at WCGS.

Information considered in the evaluation includes: (1) the type of cooling system and (2) evidence of a CWA Section 316(a) variance or equivalent State documentation. WCGS has a once-through heat dissipation system that is classified by NRC as a cooling pond system because it withdraws from and discharges to a cooling pond (Coffey County Lake). For the purposes of facility classification, a cooling pond was defined as "a man-made impoundment that does not impede the flow of a navigable system and that is used primarily to remove waste heat from condenser water prior to recirculating the water back to the main condenser" (NRC 1996). Section 316(a) of the CWA establishes a process by which a discharger can demonstrate that the established thermal discharge limitations are more stringent than necessary to protect balanced, indigenous populations of fish and wildlife and obtain facility-specific thermal discharge limits (33 USC 1326).

WCGS received Permit No. I-NE07-P002 to discharge under the NPDES, which was approved by the Administrator of the EPA pursuant to Section 402(b) of the Federal Water Pollution Control Act Amendments of 1972 [PL 92-500, 33 USC 1342 (b)]. Based on the criteria set forth in Section 306 of PL 92-500, EPA regulations at 40 CFR 423, and information submitted by KG&E, the KDHE determined that the WCGS was exempt from Federal thermal standards and that thermal discharge studies pursuant to Section 316(a) of PL 92-500 were not required (Koester 1974, Gray 1974, Koester 1975). However, the WCGS was determined by the State of Kansas, Department of Health and Environment, to be subject to the Water Quality Criteria for Interstate and Intrastate Waters of Kansas (Carlson 1975). The current WCGS NPDES Permit (No. I-NE07-PO02) does not contain thermal effluent limitations.

4.1.4.1 Cooling Water Discharge to Coffey County Lake

The WCGS cooling system and discharge are described in Section 2.1.3. Condenser cooling water is withdrawn from Coffey County Lake through the circulating water intake structure. After passing through the condenser, the heated water is returned to Coffey County Lake through the circulating water discharge structure located at the northwest corner of the facility. This structure has a discharge well that overflows into a 40-ft wide apron and then onto the surface of Coffey County Lake. The heated effluent is discharged from the circulating water discharge structure into an approximately 290-ac cove in Coffey County Lake. A baffle dike (Baffle Dike B) directs the effluent along a northwesterly path as it leaves the discharge cove to allow greater heat dissipation before warm water mixes with water in the main body of the lake (Figures 2-3 and 2-4; WCNOC 2006f).

Field temperature measurements in the immediate discharge area during late September and October 1985 were 4 to 7 degrees (°) F lower than the condenser outlet temperature, indicating rapid cooling as the discharge jet enters the lake. Vertical temperature distributions measured in the discharge cove in October 1985 exhibited substantial vertical and horizontal heterogeneity. The apparent rapid mixing of the discharge and the surface plume reduces the volume of water with maximum discharge temperatures. This mixing and the resulting temperature heterogeneity reduce the amount of warm water available to fish and provide a thermal refuge for fish that may be attracted to the discharge cove for reasons other than the warmer water, such as to forage or seek flowing water (EA 1985). Horizontal temperature profiles showed that the thermal plume remained perched on the surface throughout most of the discharge area. With WCGS at or near full power, the plume depth typically extended to a depth of 10 to 12 ft. Water temperatures below that depth often were similar to the cooler WCGS intake area. In effect, this artificial stratification provides a thermal refuge and a zone of passage for fish within the thermally influenced discharge area of Coffey County Lake (WCNOC 2006f).

Additional data collected in 1985 and 1986 indicated that the behavior of the thermal discharge within the discharge cove was strongly affected by factors such as the temperature difference between the discharged water and ambient lake water, the number of pumps operating, wind, and morphology of the cove. Wind plays a large role in discharge cove temperature distribution. A strong south wind greatly lengthens the path of discharged water, which expands the heated area. Conversely, strong north, east, or northeast winds force the discharge current tightly against Baffle Dike B and quickly out of the cove (WCNOC 2006f). The most important morphological features of the discharge cove were found to be the two arms on the north side of the cove and the deepwater area at its center, all of which are thermally isolated from water movements during normal operations. In the absence of a strong south wind, the two arms extending to the north of the cove are thermally isolated and near ambient temperature. The deep portion of the cove remains near ambient temperatures, with only the overlying water layers being affected by the warm water discharge during extended periods of normal plant operations (WCNOC 2006f).

Based on data prior to and including 1992, temperature stratification patterns in Coffey County Lake appear to be independent of the WCGS discharge in parts of the lake away from the thermal plume. Stratification that would have been detrimental to the lake's fishery or productivity was not observed (WCNOC 1993). Any thermal plume impacts in Coffey County Lake are limited and localized due to the relatively small 290-ac area that the discharge cove occupies within the 5,090-ac Coffey County Lake (less than 6 percent of Coffey County Lake). Data on the vertical and horizontal distribution of temperatures within the cove also suggest the area of maximum thermal effects from the plant is even smaller than the area of the cove and varies with meteorological conditions (WCNOC 2006f).

Potential thermal impacts on the Coffey County Lake fishery were intensively studied by WCNOC during the initial operational period. Fish thermal distribution and preference were determined by electrofishing in the discharge area and correlating fish numbers with water temperatures (WCNOC 1987a). As the ambient lake temperatures cooled to below 50°F, certain fish species were found to move into the thermal plume, which was about 80°F. This occurred typically during October through March. When ambient temperatures rose above 50°F, fish were found to leave the plume area according to their species-specific, preferred temperature ranges (WCNOC 2006f).

Fish mortality resulting from heat shock has not been observed in Coffey County Lake. There are no fish wintering areas or migration routes affected by the thermal plume, and fish avoid the plume when temperatures exceed their thermal tolerance limits. Substrate types in the discharge cove, such as silt, clay, and gravel, are common in areas not affected by the thermal plume and would not be unavailable to fish as a result of the plume. During colder periods, many fish were found to be attracted to the warmer temperatures of the plume. Thus, the thermal plume affects less than 6 percent of the area of Coffey County Lake and has not been observed to result in acute impacts to fish, such as death or disability (WCNOC 2006f).

4.1.4.2 Coffey County Lake Discharge to Wolf Creek and the Neosho River

The KDHE determined in 1976 that "the Water Quality Criteria of the State of Kansas will be enforced in the Neosho River, below the confluence of the Wolf Creek, except for an appropriate mixing zone. The State Water Quality Criteria will not apply to Wolf Creek, which is unclassified under the State Water Quality Criteria. In general, the effluent limitations to be stipulated in the NPDES permit will apply at the point the cooling lake discharges into Wolf Creek" (Carlson 1976). WCGS discharges from Coffey County Lake into the Neosho River are regulated by NPDES permit limitations. Because discharges from Coffey County Lake are sporadic, water is sampled on the first day of each discharge and weekly thereafter. In 1985, the first year of WCGS operation, effluent parameters measured included temperature, pH, flow rate, and concentrations of total dissolved solids (TDS), sulfate, and chloride (WCNOC 2006f).

Wolf Creek inputs to the Neosho River were regulated to maintain a zone of passage for aquatic organisms at the confluence. Consequently, the flows allowable from Wolf Creek have ranged from zero to unrestricted, depending on the differences in temperature and water quality between Wolf Creek and the Neosho River, with a maximum temperature of 90°F allowable in the Neosho River downstream of the mixing zone. In 1985, no NPDES violations at the Coffey County Lake discharge were recorded. In September 1994, a new NPDES permit set discharge limits from Coffey County Lake for sulfates, chlorides, and pH, but it included no flow restrictions based on water quality in the Neosho River. No NPDES permit violations have been observed at the Coffey County Lake discharge to Wolf Creek and at no time did water quality criteria restrict cooling lake discharge to the Neosho River (WCNOC 2006f).

A monitoring program was begun in the Neosho River in 1973 to satisfy licensing requirements and assess facility impacts. The monitoring was to continue through at least two years of plant operation, which was satisfied in 1987. No adverse impacts greater than those predicted and evaluated in licensing documents were identified. Subsequent to 1987, the scope and frequency of Neosho River monitoring has been gradually reduced. After analyses of 1995 data, it was determined that further water quality monitoring was not necessary and it was discontinued. Overall, the monitoring studies in the Neosho River indicated that there had been no apparent deleterious effects on phytoplankton, macroinvertebrates, or fish populations in the river as a result of temperature or other water quality impacts from WCGS (WCNOC 2006f).

4.1.4.3 Summary of Heat Shock Impacts

The Staff has reviewed the available information on heat shock, including the conditions of the NPDES permit, the operating history of WCGS, the Staff's site visit, and other public sources. The staff evaluated the potential impacts to aquatic resources due to heat shock during continued operation during the renewal period. The Staff concluded that the potential impacts to aquatic resources due to heat shock during the renewal term would be SMALL.
During the course of the SEIS preparation, the Staff considered mitigation measures, such as cooling towers, for the continued operation of WCGS during the license renewal term. Based on the NRC staff assessment, no new mitigation measures are beneficially warranted for impacts related to heat shock.

4.1.5 Microbiological Organisms (Public Health)

For power plants that use a cooling pond, lake, or canal or that discharge to a small river, the effects of microbiological organisms on human health are listed as a Category 2 issue and require plant-specific evaluation for license renewal review. This issue is applicable to WCGS because the facility uses a cooling pond as defined in the GEIS (NRC 1996). Also, the cooling pond (Coffey County Lake) discharges to Wolf Creek, which is an ungauged intermittent stream that empties into the Neosho River about 5.5 miles downstream. The Neosho River at Burlington, just upstream of its confluence with Wolf Creek, has an average annual flow of approximately 5.06×10^{10} cubic ft/yr (Putnam and Schneider 2005), which meets the NRC definition of a small river (less than 3.15×10^{12} cubic ft/yr) in 10 CFR 51.53 (c)(3)(ii)(G). This issue is also relevant to WCGS because Coffey County Lake is used by the public for fishing. It is not used for swimming.

The Category 2 designation is based on the potential for public health impacts associated with thermal enhancement of *Naegleria fowleri*, a pathogenic amoeba, and other enteric pathogens that could not be determined generically. The NRC noted that impacts of nuclear plant thermal discharges are considered to be of small significance if they do not enhance the presence of microorganisms that are detrimental to water quality and pubic health (NRC 1996).

Microbiological organisms that grow at temperatures above 45°C to 50°C (113°F to 122°F) are termed thermophilic, or heat-loving, organisms (Brock 1974). WCGS monitors water temperature in Coffey County Lake at the cooling water intake structure and in the discharge cove created by the baffle dike. During the summer months, water temperatures in the discharge cove, including areas adjacent to the discharge structure, can range from 90°F to 110°F. Water temperature at the intake structure is in the range of 77°F to 81°F, which is likely similar to the temperatures found throughout the lake (WCNOC 2006a). During warmer months, water temperatures in the cooling pond could support survival of thermophilic microorganisms; however, temperatures are generally below the range most conducive to their growth and reproduction.

In 1987, WCNOC collected water and sediment samples from the cooling pond and commissioned an outside consultant to analyze the samples for the presence of *Naegleria fowleri*. The analysis did not identify any of the pathogenic species of *Naegleria*; however, it did find an abundance of the nonpathogenic species in the discharge cove. No *Naegleria* were detected in water or sediment from the intake structure. High levels of other thermophilic amoebae can sometimes interfere with detecting the pathogen (WCNOC 1987b). Fishermen are not allowed in the discharge cove near the discharge structure and, therefore, are not exposed to the warmest water (WCNOC 2006a).

WCNOC requested that KDHE provide information on any studies that may have been conducted on thermophilic microorganisms in the WCGS region and any concerns the agency might have relative to these organisms in Coffey County Lake. KDHE responded that there have not been any reports of illness from thermophilic pathogens associated with Coffey County Lake and, since swimming is not allowed, that there is no likely threat from pathogens to the public's use of the lake.

Based on its independent review of the above information, the Staff concludes that the potential impacts to public health from microbiological organisms, resulting from operation of the WCGS cooling water discharge system to the aquatic environment on or in the vicinity of the site, are SMALL and additional mitigation is not warranted.

4.2 Transmission Lines

The three transmission lines built to connect WCGS with the transmission system that existed before the construction of WCGS are described in Section 2.1 and shown on Figure 2-5. The Wolf Creek – Rose Hill line and connecting sections of the Wolf Creek – Benton and Wolf Creek – La Cygne lines total approximately 106 miles of 345-kilovolt (kV) transmission line within 150-ft-wide right-of-ways (ROWs). The transmission line ROWs include a total area of approximately 1,922 ac. These transmission lines are owned and maintained by Westar Energy, Inc (Westar).

Westar follows a standard vegetation management program on these and their other transmission line ROWs. The program is designed to allow operation of the lines at their full rated capacity without outages caused by an energized line contacting vegetation. Ongoing surveillance and maintenance of these transmission lines and ROWs ensure continued conformance to transmission line design standards. The transmission line ROW maintenance practices include both mechanical cutting and chemical/herbicide methods. Transmission line ROWs are first cleared of vegetation through mechanical mowing and pruning. One to two years after mechanical clearing, ROWs are treated with herbicides (Westar Undated). Herbicide management is essential because repeated mechanical cutting causes vegetation to grow back thicker and fuller requiring more frequent mechanical management that exposes workers and the environment to risks from petroleum products that fuel the cutting and mowing equipment (Edison Electric Institute 2007). Herbicides used by electric companies to manage the growth of undesirable vegetation in the transmission line ROWs are generally lower in toxicity to humans and animals than petroleum products released by mechanical cutting equipment (Edison Electric Institute 2007).

Category 1 issues in 10 CFR Part 51, Subpart A, Appendix B, Table B-1 that are applicable to transmission lines from WCGS are listed in Table 4-8. The NRC staff has not identified any new and significant information during its independent review of the WCGS ER, the site audit, the scoping process, or evaluation of other available information that would indicate any new and significant information associated with the renewal of the WCGS OL. Therefore, the Staff concludes that there would be no impacts related to these issues beyond those discussed in the GEIS. For all of those issues, the Staff concluded in the GEIS that the impacts would be SMALL, and additional facility-specific mitigation measures are not likely to be sufficiently beneficial to be warranted.

Table 4-8. Category 1 Issues Applicable to the WCGS Transmission Lines During the Renewal Term

ISSUE—10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Sections
TERRESTRIAL RESOURCES	
Power line ROW 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 ROW	4.5.7
AIR QUALITY	
Air quality effects of transmission lines	4.5.2
LAND USE	
On-site land use	4.5.3
Power line ROW	4.5.3

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

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

  > The impacts of ROW maintenance on wildlife 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 WCGS ER (WCNOC 2006a), the site audit, the scoping process, consultation with the U.S. Fish and Wildlife Service (FWS), or evaluation of other information. Therefore, the Staff concludes that there would be no impacts of power line ROW maintenance on wildlife during the 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 WCGS ER (WCNOC 2006a), the site audit, the scoping process, consultation with the FWS, or evaluation of other information. Therefore, the Staff concludes that there would be no impacts of bird collisions with power lines during the 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 WCGS ER (WCNOC 2006a), the site audit, the scoping process, or evaluation of other information. Therefore, the Staff concludes that there would be no impacts of electromagnetic fields on flora and fauna during the 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.

The Staff has not identified any new and significant information during its independent review of the WCGS ER (WCNOC 2006a), the site audit, the scoping process, consultation with the FWS and KDWP, or evaluation of other information. Therefore, the Staff concludes that there would be no impacts of power line ROW maintenance on floodplains and wetlands during the 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 WCGS ER (WCNOC 2006a), the site audit, the scoping process, or evaluation of other information. Therefore, the Staff concludes that there would be no air quality impacts of transmission lines during the renewal term beyond those discussed in the GEIS.

- On-site land use. Based on the information in the GEIS, the Commission found that:

> Projected on-site 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 WCGS ER (WCNOC 2006a), the site audit, the scoping process, or evaluation of other information. Therefore, the Staff concludes that there would be no on-site land use impacts during the 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 ROWs 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 WCGS ER (WCNOC 2006a), the site audit, the scoping process, or evaluation of other information. Therefore, the Staff concludes that there would be no impacts of power line ROWs on land use during the renewal term beyond those discussed in the GEIS.

Two Category 2 issues exist for the transmission lines. The issue of chronic effects was not categorized the GEIS, but is being treated as a Category 2 issue in this SEIS. The Category 2 issues are listed in Table 4-9 and are discussed in Sections 4.2.1 and 4.2.2.

Table 4-9. Category 2 and Uncategorized Issues Applicable to the WCGS Transmission Lines During the 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

Based on the GEIS, the Commission found that electric shock resulting from direct access to energized conductors or from induced charges in metallic structures has not been found to be a problem at most operating plants and generally is not expected to be a problem during the license renewal term. However, site-specific review is required to determine the significance of the electric shock potential along the portions of the transmission lines that are within the scope of this SEIS.

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), the applicant 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.

An analysis of the WCGS transmission lines' conformance with the NESC standard was conducted using computer modeled data of induced current under the transmission lines. Objects located near the transmission lines can become electrically charged due to their immersion in the lines' electromagnetic field. This electrical charge results in a current that flows through the object to the ground. This current is called "induced" because there is no direct connection between the line and the object. The induced current can also flow to the ground through the body of a person who touches the electrically charged object. An object that is insulated from the ground can actually store an electrical charge, becoming what is called "capacitively charged." A person standing on the ground and touching a vehicle or a fence receives an electrical shock due to the sudden discharge of the capacitive charge through the person's body to the ground. After the initial discharge, a steady-state current can develop, with the magnitude of the current depending upon several factors. These factors include the strength of the electric field (dependent on the voltage of the transmission line and its height and geometry), the size of the object on the ground, and the extent to which the object is grounded (WCNOC 2006a).

Electric lines having voltages exceeding 98-kV alternating current to ground must comply with the NESC provision to have a clearance that limits the induced current due to electrostatic effects to 5 millamperes (mA) if the largest truck, vehicle, or equipment were short-circuited to ground. The three lines constructed to distribute power from WCGS were analyzed by evaluating the lines' configuration to determine where the potential for current-induced shock is the greatest. The electric field strength was calculated for each transmission line, then the induced currents were calculated (WCNOC 2006a). The analysis determined that the Wolf Creek – Rose Hill line had the capacity to induce 4.3 mA and the LaCygne-Benton lines had the capacity to induce 1.5 mA for a vehicle the size of a tractor trailer parked beneath the lines. Therefore, the lines conform to the NESC guidelines by not producing induced currents over 5 mA and preventing electric shock. Details of the analysis can be found in the "Calculation Package for Wolf Creek Transmission Lines Induced Current Analysis" (TTNUS 2005 in WCNOC 2006a). Westar also regularly conducts surveillance and maintenance activities to ensure that the ground clearances for the transmission lines do not change, which could increase the potential risks of electric shock.

The Staff has reviewed the available information, including the applicant's evaluation and computational results, the site visit, the scoping process, and other public sources of information. Based on this information, the Staff evaluated the potential impacts of electric shock resulting from operation of WCGS and its associated transmission lines. It is the Staff's conclusion that the potential impacts of electric shock during the renewal term would be SMALL and no additional mitigation is warranted.

4.2.2 Electromagnetic Fields-Chronic Effects

In the GEIS, the chronic effects of 60 hertz electromagnetic fields from power lines were not designated as Category 1 or 2, and a designation will not be made 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 (DOE). The 1999 report of the NIEHS and DOE Working Group (Portier and Wolfe 1999) contains the following conclusion:

> The NIEHS concludes that extremely low frequency-electromagnetic field exposure (ELF-EMF) 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 considers the GEIS finding of "not applicable" still appropriate and continues 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 WCGS in regard to radiological impacts are listed in Table 4-10. WCNOC stated in its ER that it is not aware of any new and significant information associated with the renewal of the WCGS OL. The NRC staff has not identified any new and significant information during its independent review of the WCGS ER, the site audit, the scoping process, or evaluation of other available information. Therefore, the NRC staff concludes that there would be no impacts related to these issues beyond those discussed in the GEIS. For these issues, the NRC 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 4-10. Category 1 Issues Applicable to Radiological Impacts of Normal Operations During the 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 NRC staff has not identified any new and significant information during its independent review of the WCNOC ER, the site audit, the scoping process, or evaluation of other available information. Therefore, the NRC staff concludes that there would be no impacts of radiation exposures to the public during the 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 NRC staff has not identified any new and significant information during its independent review of the WCGS ER, the site audit, the scoping process, or evaluation of other available information. Therefore, the NRC staff concludes that there would be no impacts of occupational radiation exposures during the 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, which are applicable to socioeconomic impacts during the renewal term are listed in Table 4–11. As stated in the GEIS, the impacts associated with these Category 1 issues were determined to be SMALL, and plant-specific mitigation measures would not be sufficiently beneficial to be warranted.
The NRC staff reviewed and evaluated the WCGS ER, scoping comments, other available information, and visited the WCGS site in search of new and significant information that would change the conclusions presented in the GEIS. No new and significant information was identified during this review. Therefore, it is expected that there would be no impacts related to these Category 1 issues during the renewal term beyond those discussed in the GEIS.

Table 4-11. Category 1 Issues Applicable to Socioeconomics During the Renewal Term

ISSUE—10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Section
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

The results of the review and brief statement of GEIS conclusions, as codified in Table B-1 of 10 CFR Part 51, Subpart A, Appendix B, for each of the socioeconomic Category 1 issues are provided below.

- 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.

  No new and significant information was identified during the review. Therefore, it is expected that there would be no impacts on public safety, social services, and tourism and recreation during the 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.

  No new and significant information was identified during the review. Therefore, it is expected that there would be no impacts on education during the 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.

  No new and significant information was identified during the review. Therefore, it is expected that there would be no aesthetic impacts during the 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.

  No new and significant information was identified during the review. Therefore, it is expected that there would be no aesthetic impacts of transmission lines during the renewal term beyond those discussed in the GEIS.

Table 4–12 lists the Category 2 socioeconomic issues, which require plant-specific analysis, and an additional issue, environmental justice, which was not addressed in the GEIS.

Table 4-12. Category 2 Issues Applicable to Socioeconomics and Environmental Justice During the 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
SOCIOECONOMICS			
Housing impacts	4.7.1	I	4.4.1
Public services: public utilities	4.7.3.5	I	4.4.2

Table 4-12. (cont'd)

ISSUE—10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Section	10 CFR 51.53(c)(3)(ii) Subparagraph	SEIS Section
	SOCIOECONOMICS		
Off-site 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 were prepared. Therefore, environmental justice must be addressed in plant-specific reviews.

4.4.1 Housing Impacts

Appendix C of the GEIS presents a population characterization method based on two factors, sparseness and proximity (GEIS, Section C.1.4). Sparseness measures population density within 20 miles of the site, and proximity measures population density and city size within 50 miles. Each factor has categories of density and size (GEIS, Table C.1). A matrix is used to rank the population category as low, medium, or high (GEIS, Figure C.1).

According to the 2000 Census, approximately 13,095 people lived within 20 miles of WCGS, which equates to a population density of 10 persons per square mile (sq mi) (WCNOC 2006a). This density translates to the least sparse Category 1 (less than 40 persons per sq mi and no community with 25,000 or more persons within 20 miles). Approximately 176,301 people live within 50 miles of WCGS (WCNOC 2006a). This equates to a population density of 23 persons per sq mi. Applying the GEIS proximity measures, WCGS is classified as proximity Category 1 (no city with 100,000 or more persons and less than 50 persons per sq mi within 50 miles). Therefore, according to the sparseness and proximity matrix presented in the GEIS, the WCGS ranks of sparseness Category 1 and proximity Category 1 result in the conclusion that WCGS is located in a low population area.

Table B-1 of 10 CFR Part 51, Subpart A, Appendix B, states that impacts on housing availability are expected to be of small significance in medium or high-density population areas where growth-control measures are not in effect. Since WCGS is located in a low population area and Coffey and Lyon Counties are not subject to growth-control measures that would limit housing development, any WCGS employment-related impact on housing availability would likely be small. Since WCNOC has indicated that there would be no major plant refurbishment and no non-outage employees would be added to support WCGS operations during the license renewal term, employment levels at WCGS would remain relatively constant with no additional demand for housing during the license renewal term. In addition, the number of available housing units has kept pace with or exceeded the low growth in the area population. Based on this information, there would be no impacts on housing during the license renewal term, and no mitigation measures would be required.

4.4.2 Public Services: Public Utility Impacts

Impacts on public utility services are considered SMALL if there is little or no change in the ability of the system to respond to demand and thus there is no need to add capital facilities. Impacts are considered MODERATE if service capabilities are overtaxed during periods of peak demand. Impacts are considered LARGE if services (e.g., water, sewer) are substantially degraded and additional capacity is needed to meet ongoing demand. The GEIS indicated 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.

Analysis of impacts on the public water systems considered both facility demand and facility-related population growth. As previously discussed in Section 2.2.2, WCGS purchases water from Rural Water District 3, which purchases water from the City of Burlington and Public Wholesale District 12. WCGS uses less than one percent of the total combined capacity of the City of Burlington and Public Wholesale District 12. Water usage by WCGS has not stressed system capacities and is not currently an issue. WCNOC also has no plans to increase WCGS staffing due to refurbishment or new construction activities, and has identified no operational changes during the license renewal term that would increase facility water use.

WCGS operations during the license renewal term would not increase facility-related population demand for public water services. Given that WCNOC has indicated that there would be no major plant refurbishment, overall employment levels at WCGS would remain relatively constant during this period with no additional demand for public services. In addition, public water systems in the region would be adequate to provide the capacity required to meet the demand of residential and industrial customers in the area. Based on a review of available public water supply use and capacity information in the region, there would be no impact to public water and sewer services during the license renewal term, and no mitigation measures would be required.

4.4.3 Off-site Land Use During Operations

Off-site land use during the license renewal term is a Category 2 issue. Table B-1 of 10 CFR 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."

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.

Tax revenue can affect land use because it enables local jurisdictions to provide the public services (e.g., transportation and utilities) necessary to support development. Section 4.7.4.1 of the GEIS 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, tax-driven land-use changes during the plant's license renewal term would be SMALL, especially where the community has pre-established patterns of development and has provided adequate public services to support and guide development. Section 4.7.2.1 of the GEIS states that if tax payments by the plant owner are less than 10 percent of the taxing jurisdiction's revenue, the significance level would be SMALL. 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. 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.

Population-Related Impacts

Since WCNOC has no plans to add non-outage employees during the license renewal period; there would be no noticeable change in land use conditions in the vicinity of the WCGS site. Therefore, there would be no land use impacts during the license renewal term and no mitigation measures would be required.

Tax-Revenue-Related Impacts

As previously discussed in Section 2.2.8.6, WCNOC pays annual real estate taxes to Coffey County. From 2000 through 2006, WCNOC paid between $23.9 and $26.3 million annually in property taxes to Coffey County. This represented between 79 and 85 percent of the county's total annual tax revenue. Each year, Coffey County retains a portion of this tax money for county operations and disburses the remainder to school districts, fire districts, and the county's municipalities to fund their respective operating budgets. The local public school system, Unified School District Number 244, receives 38 to 46 percent of the property tax payment.

At present, the State of Kansas has taken no action on deregulation, which could, if enacted, affect tax payments to Coffey County. However, any changes to WCGS property tax rates due to deregulation would be independent of license renewal. Discontinuing the current level of tax revenues would have a significant negative economic impact on the county.

WCNOC has indicated that there would be no major plant refurbishment or license renewal-related construction activities necessary to support the continued operation of WCGS during the license renewal period. Accordingly, there would be no increase in the assessed value of WCGS and annual property taxes to Coffey County would remain relatively constant throughout the license renewal period. Based on this information, there would be no tax revenue-related land-use impacts during the license-renewal term and no mitigation measures would be required.

4.4.4 Public Services: Transportation Impacts During Operations

Table B-1, 10 CFR Part 51 states: "Transportation impacts (level of service) of highway traffic generated... during the term of the renewed license are generally expected to be of small significance. However, the increase in traffic associated with additional workers and the local road and traffic control conditions may lead to impacts of moderate or large significance at some sites." All applicants are required by 10 CFR 51.53(c)(3)(ii)(J) to assess the impacts of highway traffic generated by the proposed project on the level of service of local highways during the term of the renewed license.

Given that WCNOC has no plans to add non-outage employees during the license renewal period, there would be no noticeable change in traffic volume and levels of service on roadways in the vicinity of the WCGS site. Therefore, there would be no transportation impacts during the license renewal term and no mitigation measures would be required.

4.4.5 Historic and Archaeological Resources

The National Historic Preservation Act (NHPA) requires that Federal agencies take in to 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 operating license is an undertaking that could potentially affect historic properties. Therefore, according to the NHPA, the NRC is to make a reasonable effort to identify historic properties in areas of potential effects. 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.

4.4.5.1 Site Specific Cultural Resources Information

A review of the Kansas State Historical (KSHS) files shows that there are no National Register eligible or listed archaeological or above ground historic resources identified on the WCGS property. As noted in Section 2.2.9.2 two surveys of Wolf Creek and the WCGS plant area conducted in 1973 and 1974 resulted in the identification of 25 prehistoric archaeological sites, all of which were eventually determined to be ineligible for listing on the National Register (NRC 1982). This testing also concluded that there is no evidence of prehistoric occupation in the area around the station (NRC 1982).

There is potential for archaeological resources to be present on other portions of the WCGS site that have not been surveyed (i.e., the environmental education area, along the transmission line ROW, and along the shores of Coffey County Lake). As noted in Section 2.2.9.2, while five National Register listed resources have been identified in Coffey County, none are located within the boundaries of the WCGS.

4.4.5.2 Conclusions

No new facilities, service roads, or transmission lines are proposed for the WCGS as a part of this operating license renewal, nor are refurbishment activities proposed. Therefore, the potential impacts to National Register eligible historic or archaeological resources would be SMALL during the license renewal term and no mitigation measures would be required.

4.4.6 Environmental Justice

Executive Order (EO) 12898 (59 FR 7629) directs Federal agencies to identify and address, as appropriate, potential disproportionately high and adverse human health and environmental impacts on minority and low-income populations. Although the Executive Order is not mandatory for independent agencies such as the NRC, the NRC has voluntarily committed to undertake environmental justice reviews. In 2004, the Commission issued a *Policy Statement on the Treatment of Environmental Justice Matters in NRC Regulatory and Licensing Actions* (69 FR 52040) which states "The Commission is committed to the general goals set forth in EO. 12898, and strives to meet those goals as part of its NEPA review process."

The Council of Environmental Quality (CEQ) provides the following information in *Environmental Justice: Guidance Under the National Environmental Policy Act* (CEQ 1997a):

- Disproportionately High and Adverse Human Health Effects. Adverse health effects are measured in risks and rates that could result in latent cancer fatalities, as well as other fatal or nonfatal adverse impacts on human health. Adverse health effects may include bodily impairment, infirmity, illness, or death. Disproportionately high and adverse human health effects occur when the risk or rate of exposure to an environmental hazard for a minority or low-income population is significant (as defined by the National Environmental Policy Act [NEPA]) and appreciably exceeds the risk or exposure rate for the general population or for another appropriate comparison group (CEQ 1997a).

- Disproportionately High and Adverse Environmental Effects. A disproportionately high environmental impact that is significant (as defined by NEPA) refers to an impact or risk of an impact on the natural or physical environment in a low-income or minority community that appreciably exceeds the environmental impact on the larger community. Such effects may include ecological, cultural, human health, economic, or social impacts. An adverse environmental impact is an impact that is determined to be both harmful and significant (as defined by NEPA). In assessing cultural and aesthetic environmental impacts, impacts that uniquely affect geographically dislocated or dispersed minority or low-income populations or American Indian tribes are considered (CEQ 1997a).

The environmental justice analysis assesses the potential for disproportionately high and adverse human health or environmental effects on minority and low-income populations that could result from the operation of WCGS during the renewal term. In assessing the impacts, the following CEQ (1997a) definitions of minority individuals and populations and low-income population were used:

- Minority individuals. Individuals who identify themselves as members of the following population groups: Hispanic or Latino, American Indian or Alaska Native, Asian, Black or African American, Native Hawaiian or Other Pacific Islander, or two or more races, meaning individuals who identified themselves on a Census form as being a member of two or more races, for example, Hispanic and Asian.

- Minority populations. Minority populations are identified when (1) the minority population of an affected area exceeds 50 percent or (2) the minority population percentage of the affected area is meaningfully greater than the minority population percentage in the general population or other appropriate unit of geographic analysis.

- Low-income population. Low-income populations in an affected area are identified with the annual statistical poverty thresholds from the Census Bureau's Current Population Reports, Series P-60, on Income and Poverty.

4.4.6.1 Minority Population in 2000

Those census block groups (196) wholly or partly within the 50-mile (mi) radius of WCGS were reported in the 2000 census as having a minority population of 17,024 or 8.3 percent of the total population in these block groups. The largest minority group was that of Hispanic or Latino ethnicity (9,081 or 4.4 percent), and the largest single racial group was Black or African American (2,500 or 1.2 percent). However, "Other" minority racial groups and "Two or More" races together accounted for 8,155 or 4 percent (2.2 percent as "Other" racial groups and 1.8 percent "Two or More" racial groups). In Coffey County, 3.7 percent of the population are reported as minority, with Hispanic or Latino the largest minority group (1.5 percent) followed by individuals identifying themselves as belonging to two or more races (1.4 percent).

Census block groups with minority populations exceeding the 8.3 percent were considered minority block groups. Based on 2000 census data, Figure 4-1 shows 52 minority block groups within a 50-mi radius of WCGS that exceed this threshold.

4.4.6.2 Low-Income Populations 2000

According to 2000 census data, 20,150 individuals (10.0 percent) residing within a 50-mi radius of WCGS were identified as living below the Federal poverty threshold. (The 1999 Federal poverty threshold was $17,029 for a family of four.) The USCB reported median household income for Kansas in 1999 was $40,624, while 9.9 percent of the state population was determined to live below the 1999 Federal poverty threshold.

Coffey County had a lower median household income ($37,839) and a lower percentage (6.6 percent) of individuals living below the poverty level than the state. Woodson County had the lowest median household incomes ($25,335) while Douglas County had the highest percentage (15.9 percent) of individuals below the poverty within the 50-mi radius of WCGS.

Census block groups were considered low-income block groups if the percentage of the population living below the Federal poverty threshold exceeded 10.0 percent. Based on 2000 Census data, there were 90 block groups that exceeded this threshold. Figure 4-2 shows low-income block groups within a 50-mi radius of WCGS.

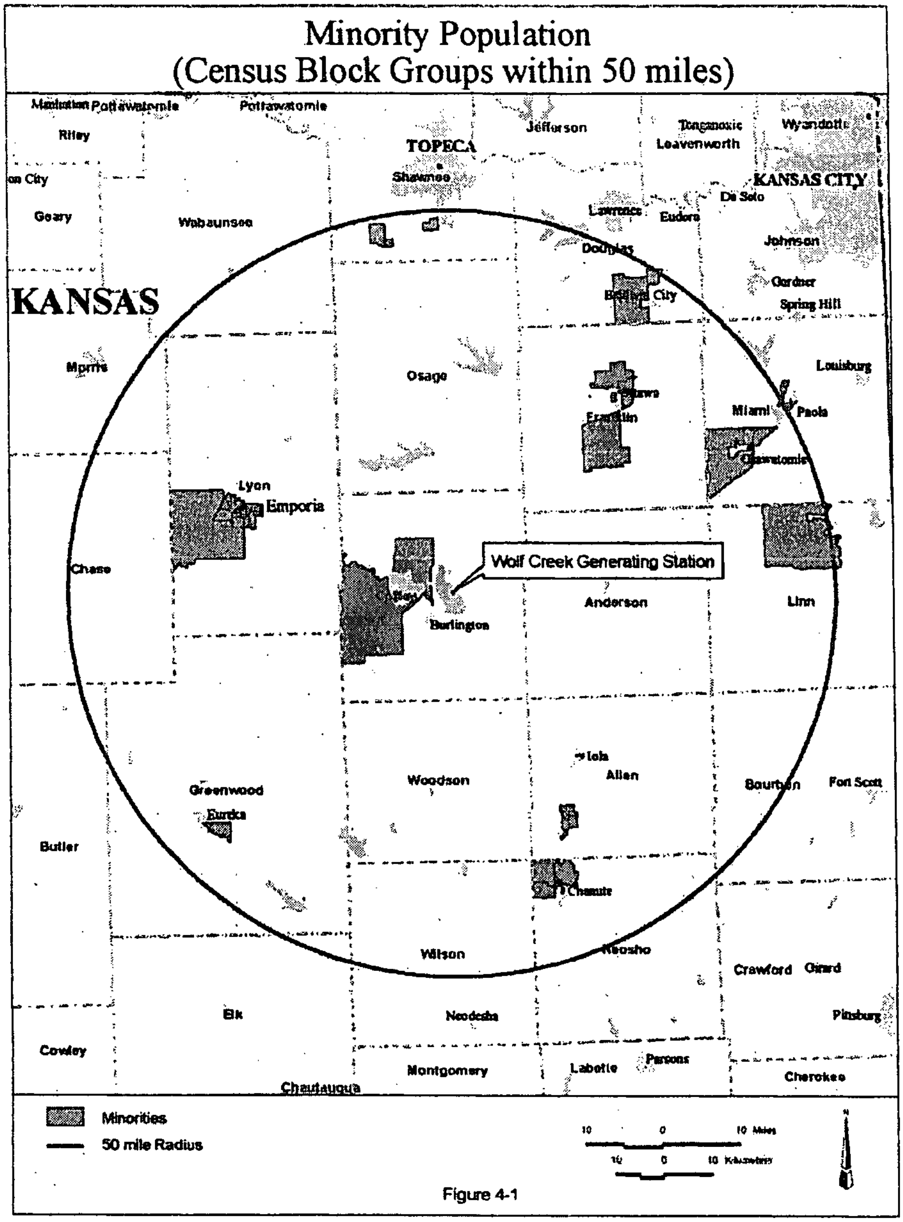

Figure 4-1. Minority block groups in 2000 within a 50-mi radius of WCGS

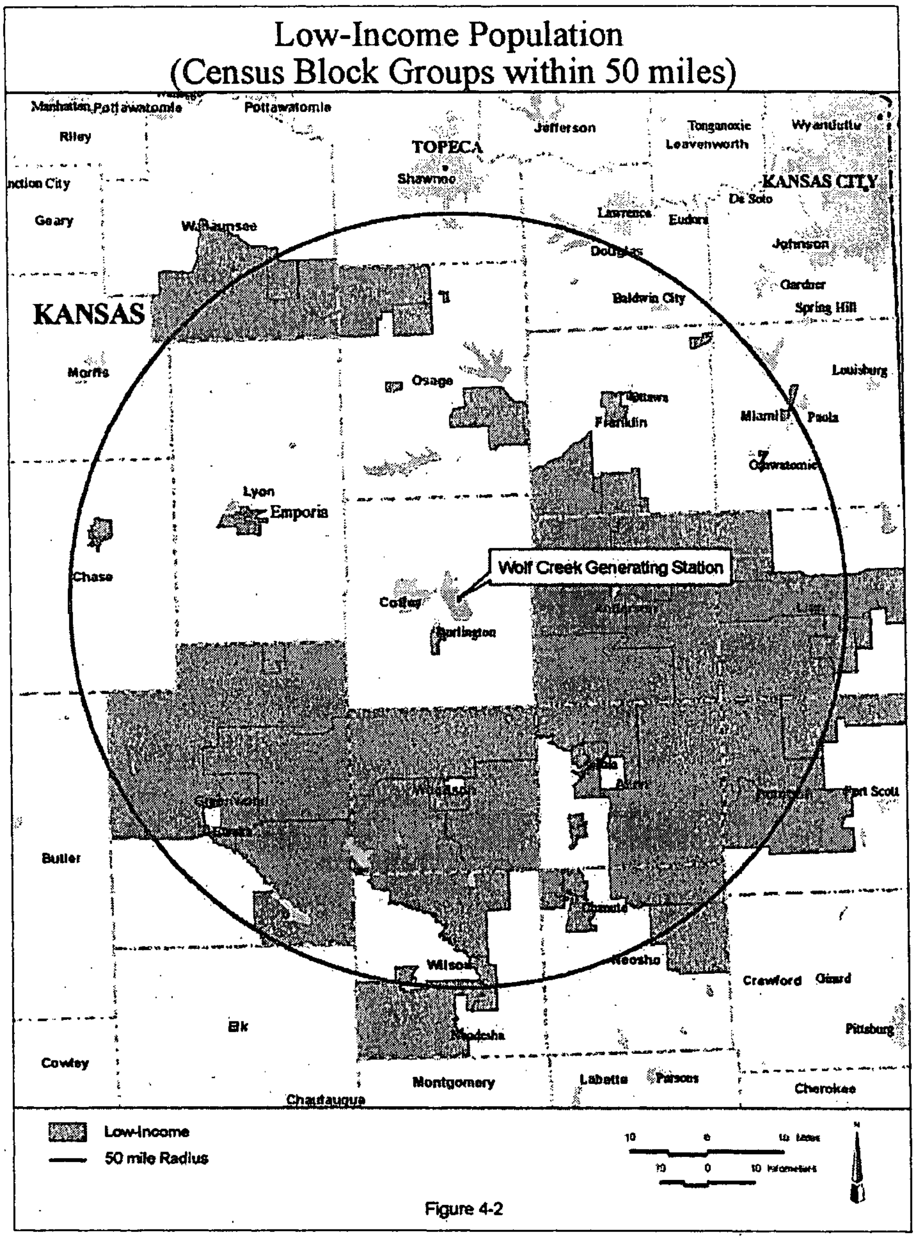

Figure 4-2. Low-income block groups with a 50-mi radius of WCGS

4.4.6.3 Analysis of Impacts

Consistent with the impact analysis for the public and occupational health and safety, the affected populations are defined as minority and low-income populations who reside within a 50-mi radius of WCGS. Based on the analysis of impacts for all resource areas presented in this DSEIS, there would be no high and adverse impacts from the operation of WCGS during the license renewal period.

NRC also analyzed the risk of radiological exposure through the consumption patterns of special pathway receptors, including subsistence consumption of fish, native vegetation, surface waters, sediments, and local produce; absorption of contaminants in sediments through the skin; and inhalation of plant materials. The special pathway receptors analysis is important to the environmental justice analysis because consumption patterns may reflect the traditional or cultural practices of minority and low-income populations in the area.

4.4.6.4 Subsistence Consumption of Fish and Wildlife

Section 4-4 of Executive Order 12898 (1994) directs Federal agencies, whenever practical and appropriate, to collect and analyze information on the consumption patterns of populations who rely principally on fish and/or wildlife for subsistence and to communicate the risks of these consumption patterns to the public. In this SEIS, NRC considered whether there were any means for minority or low-income populations to be disproportionately affected by examining impacts to American Indian, Hispanic, and other traditional lifestyle special pathway receptors. Special pathways that took into account the levels of contaminants in native vegetation, crops, soils and sediments, surface water, fish, and game animals on or near the WCGS site were considered.

WCNOC has a comprehensive Radiological Environmental Monitoring Program (REMP) at WCGS to assess the impact of site operations on the environment. Samples are collected from the aquatic and terrestrial pathways applicable to the site. The aquatic pathways include fish, surface waters and sediment. The terrestrial pathways include airborne particulates and radioiodine, milk, food products and direct radiation. During 2005, analyses were performed on collected samples of environmental media as part of the required REMP and showed no significant or measurable radiological impact from WCGS operations. Cesium-137 activity was detected in the samples obtained from the control location at John Redmond Reservoir and was attributed to fallout from past weapons testing. Activity due to plant operation was not evident in any shoreline sediment samples taken during 2005 and no unusual trends were noted. Tritium, attributable to WCGS operation, was detected in all surface water samples collected from Coffey County Lake during 2005. Tritium was the only isotope detected in surface water samples. All fish samples taken from Coffey County Lake had tritium activity detected (7,700 picoCurie per kilogram [pCi/kg] annual mean) and were attributable to plant operation. An adult consuming 21 kg of fish, at the maximum measured tritium concentration for 2005 (9,480 pCi/kg), would receive a committed effective dose equivalent of 0.013 millirem (mrem), which is well below NRC dose limits. No other radionuclides were detected in fish during the year (WCNOC 2006g).

The results of the 2005 REMP demonstrate that the routine operation at the WCGS site had no significant or measurable radiological impact on the environment. No elevated radiation levels were detected in the offsite environment as a result of plant operations and the storage of radioactive waste. The results of the REMP continue to demonstrate that the operation of the plant has not resulted in a significant measurable dose to a member of the general population or adversely impacted the environment as a result of radiological effluents (WCNOC 2006g). REMP continues to demonstrate that the dose to a member of the public from the operation of WCGS remains significantly below the federally required dose limits specified in 10 CFR Part 20, 40 CFR Part 190, and 10 CFR Part 72.

KDHE also conducts its own Environmental Radiation Surveillance (ERS) program of WCGS, which parallels (and partially overlaps) the WCNOC REMP. The purpose of the ERS program, instituted in 1985, is to detect, identify, and measure radioactive material released to the environment from the operation of WCGS (KDHE 2006b).

Similar to REMP, air, surface and ground water, milk, sediment and soil, fish, game animals, domestic meat, and terrestrial and aquatic vegetation samples are collected by KDHE from the environs surrounding WCGS. Analyses are performed by the Kansas Health and Environment Laboratories Radiochemistry Laboratory at Forbes Field on all collected samples. Game animal sampling is usually limited to the collection of edible meat portions from deer killed on the road. Sample portions of deer killed on the road are usually collected as available by WCNOC and split with KDHE for laboratory analysis (KDHE 2006b).

Based on recent monitoring results, concentrations of contaminants in native vegetation, crops, soils and sediments, surface water, fish, and game animals in areas surrounding WCGS have been quite low (at or near the threshold of detection) and seldom above background levels (WCNOC 2006g and KDHE 2006b). Consequently, no disproportionately high and adverse human health impacts would be expected in special pathway receptor populations in the region as a result of subsistence consumption of fish and wildlife and no mitigation would be required.

4.5 Groundwater Use and Quality

Category 1 issues in 10 CFR Part 51, Subpart A, Appendix B, Table B-1, that are applicable to WCGS groundwater use and quality are listed in Table 4-13. WCNOC stated in its ER that it is not aware of any new and significant information associated with the renewal of the WCGS OL (WCNOC 2006a). The Staff has not identified any new and significant information during its independent review of the WCGS ER, the Staff's site visit, the scoping process, or 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 GEIS concluded that the impacts are SMALL, and additional plant specific mitigation measures are not likely to be sufficiently beneficial to be warranted.

Table 4-13. Category 1 Issues Applicable to Groundwater Use and Quality During the 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, 4.8.1.2

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 groundwater use conflicts. As discussed in Section 2.2.2, WCGS does not use groundwater wells as a water source.

The Staff has not identified any new and significant information during its independent review of the WCGS ER, the site audit, the scoping process, or evaluation of other available information. Therefore, the Staff concludes that there are no groundwater use conflicts during the renewal term beyond those discussed in the GEIS.

The Category 2 issues related to groundwater use and quality during the renewal term that are applicable to WCGS are discussed in the sections that follow, and are listed in Table 4-14.

Table 4-14. Category 2 Issues Applicable to WCGS Groundwater Use and Quality During the 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 with cooling towers withdrawing makeup water from a small river)	4.8.1.3	A	4.5.1
Groundwater quality degradation (cooling ponds at inland sites)	4.8.3	D	4.5.2

4.5.1 Groundwater Use Conflicts

For plants with cooling pond systems that are supplied with make-up water from a small river with low flow, potential groundwater use conflicts are considered a Category 2 issue, thus requiring a site-specific assessment for license renewal review. Near WCGS, the Neosho River at Burlington has an average annual flow of approximately 1,603 cfs (Putnam and Schneider 2005, in WCNOC 2006a). This volume meets the NRC definition of a small river of 100,000 cfs (3.15×10^{12} cubic ft per year listed in 10 CFR Part 51.53(c)(3)(ii)(A)), resulting in water use conflicts being a potentially applicable issue for relicensing of WCGS. The Staff independently reviewed the WCGS ER, visited the site, consulted with Federal and State resource agencies, and reviewed the applicant's existing NPDES permit and existing literature related to water withdrawal from Wolf Creek and the Neosho River, and the potential for this withdrawal to impact the availability of groundwater within the alluvial aquifer system associated with these streams.

The GEIS considered groundwater water use conflicts to be a Category 2 issue because of the potential for withdrawal of water in a small river during low flow conditions to reduce the amount of recharge to the alluvial aquifers associated with that river. At WCGS, the groundwater resources that are present, and for which the potential impact has been evaluated, include the groundwater in the alluvial aquifer associated with the Wolf Creek drainage, the aquifer located between Wolf Creek and the Neosho River, and the alluvial aquifer associated with the Neosho River.

4.5.1.1 Aquifers Associated with Wolf Creek, and between Wolf Creek and Neosho River

The volume of water withdrawn from the Wolf Creek drainage system through appropriations is discussed in Section 4.1.1. Although WCGS is permitted to access the water associated with Wolf Creek to use for cooling, the facility also stores that water, as well as the make-up water from the Neosho River, in an unlined, man-made reservoir (Coffey County Lake) within the Wolf Creek drainage basin. Because Coffey County Lake is unlined, and is used to store water from both within and outside of the Wolf Creek basin, the net effect is actually to increase the elevation of the groundwater within the Wolf Creek basin. Prior to facility construction, an analysis by NRC predicted that groundwater elevations associated with Coffey County Lake would rise 45.8 ft within 100 ft of the lake 50 years after filling (NRC 1975). Groundwater elevations 2 miles from the lake were predicted to rise less than 0.4 ft (NRC 1975). Because of this rise in groundwater levels, groundwater availability within the Wolf Creek basin, and in at least a portion of the area between Wolf Creek and the Neosho River, has likely increased due to facility construction and operation. This increased availability of groundwater within the Wolf Creek basin will continue during the re-licensing period.

4.5.1.2 Aquifers Associated with Neosho River

The volume of water withdrawn from the Neosho River through appropriations and contract purchases is discussed in Section 4.1.1. During normal flow conditions, water would be withdrawn from the Neosho River through the two water appropriations (number 14,626 and number 19,882). The amount of water permitted to be withdrawn through these two mechanisms totals 225 cfs. However, based on the operational limitations of the pumping system, the maximum rate at which water can be withdrawn from the river during normal flow conditions is approximately 120 cfs (WCNOC 2006c). Both of the appropriations have an administrative limitation that only allows withdrawals that would maintain a flow of 250 cfs in the river. Therefore, the maximum withdrawal rate of 120 cfs would only occur when the overall flow rate exceeds 370 cfs, and would remove less than one-third of the available water in the river. Under normal flow conditions, the annual average flow rate is approximately 1,603 cfs (Putnam and Schneider 2005, in WCNOC 2006a), and withdrawals under the appropriations would remove less than 7.5 percent of the flow. Therefore, under normal flow conditions, withdrawal under the appropriations is unlikely to have an impact on groundwater levels in the alluvial aquifer.

The proportion of the overall flow removed for facility operations during low flow periods is expected to be much higher. As discussed in Section 4.1.1.3, NRC has concluded that withdrawal of water at rates of 41 cfs or more through the purchase contract mechanism, which would occur during periods of drought, could extend the duration and severity of low flow conditions in the river (NRC 1982). During these periods, the amount of water available to recharge the alluvial aquifers is expected to be substantially reduced already, due to the natural drought conditions, and this effect could be exacerbated by further water withdrawals by WCGS under the purchase contract. In such a situation, it is likely that the impact on the alluvial aquifers would be considered as part of the overall consideration of the "health, safety, or general welfare of the people of Kansas" referenced in the purchase contract. If this evaluation resulted in a determination that continuing withdrawals would have an adverse impact on the aquifers, then the state could terminate water sales to the facility.

4.5.1.3 Groundwater Users Potentially Impacted

Although the withdrawal of water could potentially reduce the amount of water available in the alluvial aquifers associated with the Neosho River, those aquifers do not act as a substantial source of water supply within the area. According to the Kansas Water Plan (KWO 2004), approximately 80 percent of the water use within the Neosho River basin is from surface water sources. Uses of groundwater within the local area primarily include domestic and livestock supply (WCNOC 2006a). No local municipalities obtain water from groundwater sources. The only known use of groundwater for industrial sources is from a single well owned by the Atchison Topeka and Santa Fe Railway located 15 miles west-northwest of WCGS (WCNOC 2006a). A review of the Kansas Geological Survey well location database identified a total of 92 wells located within 2 miles of the facility, and/or located between Coffey County Lake and the Neosho River (KGS 2007). However, it appears that only one of these wells is located downgradient of the facility, is listed as used for domestic purposes, and may potentially be still active.

4.5.1.4 Summary of Impacts Related to Groundwater Use Conflicts

The Staff has reviewed the potential effect of water withdrawals on the availability of groundwater in the local area near the facility. Because Coffey County Lake provides recharge to the groundwater, the availability of groundwater within the immediate local area of the facility has likely increased due to facility operation. For the Neosho River during periods of normal flow rates, the volume of water withdrawn from the Neosho River is likely to be low compared to the volume of water available for recharge, so impacts to groundwater availability are unlikely. During periods of drought, availability of groundwater resources would be impacted by the natural drought conditions, and continuing withdrawals of water using the purchase contracts could potentially extend the duration and severity of this impact. However, this impact would be considered by the state in determining whether to continue water sales to WCGS under the purchase contract during these periods. In general, groundwater use within the local area is limited to scattered domestic and livestock supply wells, and there are no municipalities or significant industrial users in the area that could be impacted by WCGS operations.
Based on a review of the available information relative to potential impacts of the use of cooling and service water on the availability of groundwater in the local area, the staff concludes that

the potential impacts from renewal of the operating license would be SMALL. The NRC staff has concluded that mitigation measures related to groundwater use conflicts during the license-renewal term for continued operation of WCGS are not necessary..

4.5.2 Groundwater Quality Degradation

For plants with cooling pond systems, potential degradation of groundwater quality is considered a Category 2 issue, thus requiring a site-specific assessment for license renewal review. The Staff independently reviewed the WCGS ER, visited the site, consulted with Federal and State resource agencies, and reviewed information from WCGS and KDHE monitoring programs to evaluate the potential for groundwater quality impacts.

In the GEIS, WCGS is specifically mentioned as one of nine facilities that operate man-made cooling ponds. The GEIS considered groundwater quality degradation from cooling ponds at these nine facilities to be a Category 2 issue because of the potential for degradation of surface water quality within the cooling ponds, and the likelihood that the ponds act as a source of recharge to the groundwater (NRC 1996). In the GEIS, the potential contaminants discussed included TDS, metals, and chlorinated organic compounds. Concentrations of TDS and metals are expected to potentially increase in the surface water in the ponds due to evaporation, while chlorinated organic compounds may be present due to the use of chlorine to prevent biofouling (NRC 1996). The GEIS analysis did not address radionuclides within the surface water, but the transport mechanism considered within the GEIS (groundwater recharge) would be applicable to these as well, if they were present in elevated concentrations in the cooling ponds. The GEIS analysis concluded that some contaminants could reach offsite areas, but that because offsite groundwater monitoring was not a standard practice, no actual data existed indicating that offsite impacts had occurred at any of the nine facilities with cooling ponds (NRC 1996).

At WCGS, Coffey County Lake is a cooling pond that may have elevated contaminant concentrations, and from which these contaminants may migrate to local groundwater by infiltration. The following subsections present and evaluate the known information regarding the water quality in Coffey County Lake, the potential for that water to infiltrate to groundwater, and the potential for that groundwater to migrate and cause impacts to off-site resources.

4.5.2.1 Water Quality in Coffey County Lake

The existing surface water quality studies associated with WCGS are discussed in Sections 2.2.2 and 2.2.3. Surface water quality in Coffey County Lake and Wolf Creek is evaluated and regulated with respect to a variety of parameters (Total Suspended Solids, Total Residual Oxidant, oil and grease, pH, chloride, nitrate, sulfate, and ammonia) through the facility's NPDES permit. A review of the monitoring results associated with this permit shows that there is no substantial impact to water quality in Coffey County Lake or Wolf Creek, with respect to the parameters that are regulated by the permit. Therefore, there is no potential for groundwater quality degradation with respect to these parameters.

Radiological parameters within the surface water are not regulated by the NPDES permit. Surface water sampling is conducted as part of the annual radiological monitoring programs performed by both WCGS and KDHE, and includes periodic sampling and radiological analysis of surface water within Coffey County Lake and the Neosho River. As discussed in Section 2.2.3., these studies have documented a steady increase in the concentration of tritium within the surface water in Coffey County Lake, with detections attributable to facility operations and identified shortly after operations began (WCNOC 2006b, KDHE 2006a). The pre-operational estimate for the ultimate tritium concentration in the water in Coffey County Lake was 23,000 pCi/liter (NRC 1982). This value exceeds the Kansas Department of Health and Environment criteria for domestic drinking water of 20,000 picoCuries per liter (pCi/L) tritium (KDHE 2004). Although the water in Coffey County Lake is not used as a drinking water source, infiltration and offsite migration of water containing 23,000 pCi/L tritium could potentially result in human exposure to degraded groundwater.

4.5.2.2 Potential for Infiltration to Groundwater

As discussed in Section 4.5.1.1, water within Coffey County Lake is expected to provide recharge to the groundwater, with a pre-construction estimate that groundwater elevations associated with Coffey County Lake would rise 45.8 ft within 100 ft of the lake 50 years after filling (NRC 1975). Groundwater elevations 2 miles from the lake were predicted to rise less than 0.4 ft (NRC 1975).

Although sampling of groundwater production wells is performed as part of the annual programs by WCNOC and KDHE (WCNOC 2006b, KDHE 2006a), these monitoring programs do not include evaluation of groundwater elevations. According to WCGS personnel, no effort has been made to measure groundwater elevations or evaluate the pre-construction estimates regarding infiltration rates.[c] In addition, the sampling programs have typically consisted of the sampling of 3 downgradient wells, all more than 2 miles from the site, and all of unknown depth

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(c) Minutes from a meeting held on March 13, 2007 discussing tritium in surface and groundwater. Participants included: NRC, Earth Tech, WCNOC and others. (Accession No. ML072250572).

and construction. All wells sampled are pre-existing production wells associated with houses and farms, and none were installed for the specific purpose of evaluating migration of water from Coffey County Lake. Therefore, these monitoring programs are limited in their ability to evaluate actual infiltration and migration of tritium from Coffey County Lake.

Based on the design and characteristics of Coffey County Lake, it is probable that water containing elevated concentrations of tritium has been released to groundwater beneath the lake. Prior to facility construction and operation, an NRC analysis concluded that the groundwater recharge would result in a groundwater mound beneath Coffey County Lake (NRC 1975). In addition, boreholes and wells that were installed as part of the pre-construction investigation of the lake area may act as a conduit allowing more rapid seepage than originally predicted (WCNOC 1980). According to the 1980 Environmental Report for the Operating License, at least 4 wells within the area inundated by the lake were not plugged prior to flooding. Although no direct data exists to show the extent of infiltration, the fact that the lake is unlined and unplugged monitoring wells were inundated make it likely that infiltration has occurred, and that a mound currently exists.

4.5.2.3 Potential for Groundwater Impacts

The direction and rate of migration of this water would be influenced by the local topography and the regional groundwater flow pattern, both suggesting a direction of flow to the west and southwest, towards the Neosho River. The normal operating elevation of the water in Coffey County Lake is approximately 1,087 ft above MSL (WCNOC 2006c), while the elevation of the Neosho River directly west of the facility is approximately 983.5 ft above MSL (USGS 1979). Therefore, there is a hydraulic head of more than 100 ft over a distance of approximately 1.2 miles between Coffey County Lake and the Neosho River, in the direction of regional groundwater flow.

The rate of flow of groundwater was estimated by NRC prior to facility operation, based on hydrogeologic data collected during siting studies for the facility. The two rock units exposed in the bottom of the Coffey County Lake are the Plattsmouth Limestone Member, and the Jackson Park Shale Member (NRC 1975). The calculated time for the cooling lake water to move a distance of 1 mile through these rock units was estimated to be 6,000 years for the Plattsmouth Limestone Member and 1,020 years for the Jackson Park Shale Member (NRC 1975).

A review of the Kansas Geological Survey well location database identified a total of 92 wells located within 2 miles of the facility, and/or located between Coffey County Lake and the Neosho River (KGS 2007). Only one of these wells is a domestic well that may currently be operational, so there is currently a limited number of groundwater users situated in locations that could potentially be affected. Three existing wells in this area are subject to periodic sampling and tritium analysis under the REMP program, and none of these wells has been found to be impacted. However, additional residential wells could be installed in the area in the future, and no mechanism currently exists to evaluate impacts to newly installed wells. Therefore, while it is likely that no current residential wells are impacted due to groundwater quality degradation, such impacts could occur in the future.

4.5.2.4 Summary of Impacts Related to Groundwater Quality Degradation

The Staff has reviewed the potential impacts due to groundwater degradation associated with facility operation. Water quality within Coffey County Lake is known to include rising concentrations of tritium, and due to the unlined nature of the lake, this water is available to infiltrate to groundwater. In addition, the existing groundwater monitoring programs operated by WCNOC and KDHE are not specifically designed to identify and evaluate migration of impacted water from Coffey County Lake. Although, groundwater use within the local area is limited, and there are no municipalities or significant industrial users in the area that could be impacted by WCGS operations, there is no mechanism to evaluate future impacts to newly installed wells.

Based on a review of the available information relative to potential impacts from groundwater quality degradation, the staff concludes that the potential impacts from renewal of the operating license would be SMALL to MODERATE.

The NRC staff has identified potential mitigation measures, which may help reduce adverse impacts related to groundwater quality degradation during the license-renewal term for continued operation of WCGS. Such mitigation measures include implementation of a groundwater investigation program designed to confirm the pre-construction predictions regarding the rate of infiltration and groundwater flow. Due to the uncertainties regarding these issues, the staff has concluded that implementation of such measures may be beneficial enough to be warranted.

4.6 Threatened or Endangered Species

Potential impacts to 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 4-15.

Table 4-15. Category 2 Issues Applicable to Threatened or Endangered Species During the 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 are present and whether they would be adversely affected by continued operation of the nuclear facility during the license renewal term. The presence of threatened or endangered species in the vicinity of the WCGS site is discussed in Sections 2.2.5.4 and 2.2.6.4. On December 7, 2006, the Staff contacted the FWS to request information on threatened and endangered species and the impacts of license renewal (NRC 2006). In response, on January 29, 2007, the FWS provided additional information regarding Federally listed species that have been observed or may occur in the vicinity of WCGS and its associated transmission line ROWs as well as the concerns that the FWS has regarding those species (FWS 2007a). The FWS stated in this letter that formal consultation is not required unless the proposed action may adversely affect the listed species. Although the NRC staff does not believe that license renewal would adversely affect the Federally listed species, the Staff has prepared a biological assessment (BA) that documents its review. The BA is provided in Appendix E of this SEIS.

4.6.1 Aquatic Species

Of the rare aquatic species recorded as occurring in Coffey, Greenwood, or Butler Counties, Section 2.2.5.4 identified one Federally listed species (the Neosho madtom) as having been confirmed in the vicinity of WCGS or along the associated transmission line ROW. The Neosho madtom occurs in the Neosho River both upstream and downstream of its confluence with Wolf Creek. Other than the madtom, no aquatic species that is Federally listed as threatened or endangered is known to occur or to have designated critical habitats in the vicinity of the WCGS site or along the associated transmission line ROW.

The populations of the Neosho madtom that potentially are affected by WCGS are those inhabiting the Neosho River from the John Redmond Dam downstream, extending past the Wolf Creek confluence. Factors associated with WCGS operations that potentially could affect this species in this reach of the river include: (1) reduction in Neosho River flow due to makeup water withdrawals, (2) increase in Neosho madtom mortality due to entrainment and/or impingement via the MUSH, and (3) toxic effects from chemical constituents in surface water of Coffey County Lake and the Neosho River. Each of these factors is addressed below.

(1) As explained in detail in Section 4.1.1, the State of Kansas has established MDS levels in the Neosho River that are protective of rare aquatic species. The worst-case MDS established for the Neosho River at Iola is 40 cfs from July to March. The MDS increases to 60 cfs in April and 200 cfs in May and June if the reservoir is in flood pool, in order to maintain flows supportive of fish spawning in the river; otherwise, the MDS in April through June is 40 cfs (KWAA 2004). Calculation by the applicant of preferred flow conditions for the Neosho madtom indicated that its needs would be met under the worst-case MDS of 40 cfs measured at Iola (WCNOC 2007a). Therefore, the MDS is expected to be protective of populations of this species in the Neosho River below John Redmond Dam during relatively brief periods of drought. However, it should be noted that severe, extended droughts prior to construction of WCGS, such as in the 1950s, have reduced Neosho River flows to well below 40 cfs for extended periods. Should such a drought occur during the renewal period, this species would be affected as they have been historically, because the MDS could not be met during a prolonged drought (FWS 1991). Because WCGS is permitted to continue water withdrawals during these periods, the withdrawals could contribute to the duration and severity of drought conditions. Water withdrawals from the Neosho River during low flow events or drought conditions could adversely affect the habitat of the Neosho madtom.

(2) The MUSH intake in the Neosho River generally is operated only as necessary to provide makeup water to maintain the pool at Coffey County Lake. Therefore, under conditions of normal or higher rainfall, the MUSH would be utilized only sparingly, and entrainment and impingement of organisms from the Neosho River would be minimized. Entrainment is discussed in detail in Section 4.1.2. A 1981 study of larval fish drift in the Neosho River included sample locations upstream of John Redmond Reservoir, in the tailwaters of John Redmond Dam, and at Burlington. The only *Noturus* species collected and identified were two individuals at the upstream location, and these were not believed to be the Neosho madtom (Wedd 1985). No data are available regarding the species of fish eggs and larvae that have been entrained by the intake since 1982. However, available lines of evidence indicate that entrainment of the Neosho madtom is very unlikely.

The impingement of healthy juvenile and adult fish at the MUSH is expected to be minimal because the operational intake velocity of up to approximately 0.5 fps is low in comparison to the stream flows in habitats where the Neosho madtom and other native fish occur (WCNOC 2006e). In the MUSH vicinity, Neosho River flows typically range from 0.8 to 4.9 fps (Wedd 1985). Thus, impingement of adult fish is expected to occur rarely and then only when the fish are in a weakened condition or dead and unable to avoid even the low current velocity near the MUSH intake (WCNOC 2006e). In addition, the Neosho madtom was not among the species impinged in a 1 year impingement study at the MUSH conducted between November 1980 and October 1981 (Koester

1982). These lines of evidence indicate that the potential for Neosho madtom larvae, juveniles, or adults to be present at the intake and subject to entrainment or impingement is very low.

(3) Contaminant concentrations in the aquatic environment at WCGS are monitored on an ongoing basis by WCNOC and KDHE. These agencies operate sampling programs to evaluate any potential effects of facility operations on surface water, sediment, and aquatic life. Samples collected to monitor for potential releases of radionuclides to surface water include surface water samples, drinking water samples, shoreline sediment samples, bottom sediment samples, aquatic vegetation samples, and fish tissue samples. A summary of surface water and sediment quality, including a description of contaminants detected in surface water and sediment, is presented in Section 2.2.3, Water Quality. The results of analyses of plant and fish tissue and results from toxicity tests on water samples collected at WCGS are summarized in Section 2.2.5.2. These studies have not found toxic effects levels of any of the constituents evaluated in Coffey County Lake. Given that discharges from Coffey County Lake to Wolf Creek are limited and infrequent, the potential for chemicals that have entered surface water from WCGS operations to reach the Neosho River and result in concentrations that would be toxic to fish, mussels, or other aquatic organisms is negligible.

The potential for concentrations of metals to accumulate in cooling ponds as a result of corrosion within the cooling system is an issue that was evaluated in the GEIS and determined to be a Category 1 issue. However, to address possible concerns related to this issue and its potential to affect the Neosho madtom, Neosho mucket, and other wildlife, the concentrations of relevant metals were examined by the applicant. The average concentrations of chromium, copper, iron, mercury, and nickel in Coffey County Lake in 2005 and 2006 were compared to the concentrations of these metals in the Neosho River at Leroy, approximately 10 miles downstream of the Coffey County Lake dam (WCNOC 2007a). Only copper, iron, and nickel were detected, and the concentrations of each of these metals was higher in the Neosho River at Leroy than in Coffey County Lake. The concentrations of these three metals in both the river and Coffey County Lake were well below their respective National Recommended Water Quality Criteria for the protection of freshwater aquatic life under continuous (chronic) exposure conditions (EPA 2006). Therefore, the potential for risk to aquatic organisms or their predators from metals in Coffey County Lake or the Neosho River is expected to be minimal.

Given that compliance with existing water use agreements is expected and that no change in operations, expansion of existing facilities, or disturbance of additional land is anticipated, these rare aquatic species are unlikely to be adversely affected during the renewal period.

4.6.2 Terrestrial Species

Four species that are Federally listed as threatened or endangered have been recorded as occurring currently or historically in Coffey, Butler, or Greenwood Counties: the piping plover (*Charadrius melodus*), whooping crane (*Grus americana*), least tern (*Sterna antillarum*), and Mead's milkweed (*Asclepias meadii*). Consequently, these species may have a potential to occur in the vicinity of the WCGS site or along the associated transmission line ROWs if suitable habitat is present. Because there is no planned expansion of existing facilities, change in ROW maintenance procedures, or disturbance of additional land anticipated during the renewal period, these species, if present, are unlikely to be adversely affected by future operations.

As discussed in Section 2.2.6.4.5, Mead's milkweed potentially may occur in tall grass prairie communities in Coffey County, and such communities are present on WCGS property and within transmission line ROWs. However, surveys to determine its presence have not been performed. If present, it would not be expected to be adversely affected by continuation of current land management activities during the renewal period.

Of the rare terrestrial species recorded as occurring in Coffey, Greenwood, or Butler Counties, Section 2.2.6.4 identified one Federally listed species (the least tern) as having been confirmed in the vicinity of WCGS or along the associated transmission line ROW. Least terns were recorded at Coffey County Lake in the 1980s, but nesting has not been observed there (WCNOC 2006a). With the exception of this species, no other terrestrial species that is Federally listed as threatened or endangered has been recorded as occurring in the vicinity of the WCGS site or along the associated transmission line ROWs.

Three of the Federally listed species are birds (piping plover, whooping crane, and least tern), which potentially could be injured or killed as a result of collisions with transmission lines and towers. As discussed in Section 4.2, the issue of bird collisions with power lines was evaluated in the GEIS and determined to be a Category 1 issue because the impacts are expected to be of small significance at all sites. However, this issue was raised by the FWS as a possible concern in its consultation letter regarding the proposed action (FWS 2007). The issue is evaluated herein with regard to the rare bird species, as their populations potentially are the most susceptible. An Avian Protection Plan (WCNOC 2006h) has been completed for WCGS that assesses the facility's potential impacts on birds, particularly the bald eagle (*Haliaeetus leucocephalus*), which has recently been delisted from the endangered species list. This plan identifies improvements to minimize impacts, and presents contingency plans to address possible future needs for additional activities. The plan includes as an attachment a review of bird collision data for transmission facilities at WCGS that was completed as part of a survey program recommended by the NRC in 1982 to determine if mitigation was warranted (WCNOC 2006h).

The bird collision survey (WCNOC 2006h) included searches for dead birds along transmission lines crossing Coffey County Lake and the area of the Lime Sludge Pond. The Coffey County Lake search areas were Firing Range Cove, which is east of the facility and traversed by two 345-kV lines and one 69-kV line, and Cemetary Cove, which is north of the facility and traversed by one 345-kV line. These were considered the areas where collisions by waterfowl and other water birds were most likely to occur. The survey focused on waterfowl and bald eagle collisions, but all bird species were included. The dead bird surveys began in February 1983 and continued through February 1988. The timing of the surveys included the winter-spring migration seasons during each year, with surveys occurring mainly in January, February, April, November, and December. Prior to dead bird searches in each area, live birds present in the area were identified and counted from November 1985 through February 1988 (WCNOC 2006h). In addition, more detailed live-bird surveys of waterfowl, other water birds, and bald eagles using habitats throughout Coffey County Lake were performed during the migratory season from October 1987 through March 1988 (WCNOC 1988).

Comparison of the dead and live bird data revealed no relationship between collision frequency and bird usage of Coffey County Lake or Lime Sludge Pond. Total transmission line collisions were estimated by adjusting the total number of dead birds found to account for search bias, scavenger removal bias, and crippling bias. The estimated percentage of the total number of birds counted using Coffey County Lake each year that died in collisions ranged from 0.2 to 0.5 percent, values which were comparable to those reported in other avian collision assessments. No substantial increases or decreases were noted between pre-operational and operational seasons. Based on these small percentage losses due to collisions relative to other mortality rates for waterfowl and water birds, it was concluded that the effects from collisions with WCGS transmission lines were insignificant to populations of unlisted waterfowl and other birds. No bald eagles or other listed threatened or endangered species were found during the dead bird searches (WCNOC 1988). Based on these surveys, it can be concluded that collisions with transmission lines at WCGS do not pose a substantial risk to listed threatened or endangered avian species that might be attracted to the water or shoreline of Coffey County Lake or the Lime Sludge Pond (such as the piping plover, least tern, and whooping crane), or more common birds.

Elsewhere along the transmission line ROW, there are no other habitats where these three Federally listed bird species would be likely to be attracted and become susceptible to a substantial risk of collision mortalities, with the possible exception of the whooping crane. As discussed in Section 2.2.6.4, the only self-sustaining wild population of the whooping crane migrates through central Kansas in the spring (March - April) and fall (October - November)

(KDWP 2004). Two areas in central Kansas, Cheyenne Bottoms State Waterfowl Management Area in Barton County and Quivira National Wildlife Refuge in Stafford, Reno, and Rice Counties, have been Federally designated as critical habitat for migrating whooping cranes (FWS 2007b). These two critical habitats are on the approximate center line of a 200-mi-wide migration corridor that crosses central Kansas in a north-south orientation. The corridor encompasses approximately 94 percent of all sightings through 1999 (CWS and FWS 2007). The two critical habitats are located more than 160 miles west of WCGS and 80 miles northwest of the western terminus of the WCGS – Rose Hill transmission line ROW. WCGS is approximately 60 miles east of the migration corridor; however, the terminal end of the transmission line ROW extends approximately 30 miles inside the corridor to the Rose Hill Substation. The FWS Region 6 website indicates no current records of the whooping crane in Coffey, Butler, or Greenwood Counties (FWS 2007c), but KDWP designates Coffey and Greenwood Counties as being within the known historic range of the whooping crane (KDWP 2004). Collisions with power lines are a major cause of whooping crane mortality during migration, and 60 to 80 percent of losses occur during migration (CWS and FWS 2007). However, no dead or living whooping cranes have been found in the bird surveys at WCGS, and none have been reported along the terminal segment of the WCGS – Rose Hill transmission line that is within the migration corridor in Butler County. Therefore, it appears that this transmission line is unlikely to pose a substantial risk to individual whooping cranes or the population.

4.6.3 Conclusions

The Staff reviewed information from the site audit, WCNOC's ER, other reports, and information from the FWS and KDWP. The Staff concludes that the impacts on Federally listed threatened or endangered species of an additional 20 years of operation and maintenance of WCGS and associated transmission lines and ROW would be SMALL if no water use conflicts exist. However, if SMALL to MODERATE impacts occur due to water use conflicts (see Section 4.1.1), impacts to the Neosho madtom could be SMALL to MODERATE. During low-flow events or drought conditions, there could be a reduction in the habitat available in the river to the Neosho madtom. Although formal consultation is not required by the FWS, a BA (Appendix E) was developed to document the evaluation of the potential impacts of continued operation of WCGS on Federally listed species that, according to the FWS, may occur in the project area.

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

The Staff has not identified new and significant information on environmental issues listed in 10 CFR Part 51, Subpart A, Appendix B, Table B-1, related to operation during the renewal term. The Staff also determined that information provided during the public comment period did not identify any new issue that requires site-specific assessment. The Staff reviewed the discussion of environmental impacts associated with operation during the renewal term in the GEIS and has conducted its own independent review, including public scoping meetings, to identify issues with 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 the potential for cumulative impacts of operations of WCGS during the renewal term. For the purposes of this analysis, past actions are those related to the resources at and since 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 renewal license term. The geographical area over which past, present, and future actions would occur is dependent on the resource evaluated and is described below for each resource.

The impacts of the proposed action, as described in previous sections of Chapter 4, are combined with other past, present, and reasonably foreseeable future actions at WCGS 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 (CEQ 1997b). 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 on Aquatic Resources

As discussed in Section 4.1, the Staff found no new and significant information that would indicate that the conclusions regarding any of the aquatic resources potentially affected by

WCGS are inconsistent with the conclusions in the GEIS (NRC 1996). The Staff has determined that the effects of the proposed action would have a SMALL to MODERATE impact on aquatic resources associated with the Neosho River due to water use conflicts. The Staff has determined that individually the effects of the proposed action would have a SMALL impact due to impingement, entrainment, and heat shock, with one exception, impingement in the Neosho River could be SMALL to MODERATE if water use impacts are SMALL to MODERATE.

There are a variety of natural and anthropogenic factors that may influence aquatic biota in the area potentially affected by WCGS, including fishing mortality, entrainment and impingement from the CWIS and MUSH, heat shock from the cooling water discharge, contaminants, environmental changes associated with changes in regional water use, and habitat modification and loss. In addition, changes to water and sediment quality from runoff, urbanization, and industrial activities may act as stressors on the biological environment. To evaluate the impacts of these other stressors on aquatic resources and, in turn, to be able to elucidate the cumulative impacts of the continued operation of WCGS, the Staff consulted with State and Federal resource agencies, reviewed the applicant's ER and other environmental reports, conducted an independent search for other potential stressors in the project area, and considered public comments.

Coffey County Lake was originally designed and developed to be a cooling impoundment for WCGS. This is still the primary function of this lake; however, in recent years recreational fishing has also been allowed on the lake. Direct or indirect impacts associated with usage of the lake for recreational fishing may include harvesting of predator fish that are necessary for control of gizzard shad, release of pollutants from boats (gasoline, waste), or the introduction of invasive species such as the zebra mussel (*Dreissena polymorpha*). However, WCGS in conjunction with the Coffey County sheriff maintains strict access to the lake. A creel survey is in place to determine the types and sizes of fish harvested from the lake. In addition, all boats are inspected for the presence of invasive species prior to launching in the lake. Thus, it is unlikely that recreational fishing would have an adverse impact on the lake. Fishing is allowed on the Neosho River in the vicinity of the MUSH; however, the river in this area downstream of the dam is shallow and only a very short distance from the dam. Therefore, the likelihood of significant fishing pressure in this area is minimal.

There is no residential, commercial, or industrial development on the lake with the exception of the WCGS and a small boat ramp and associated docking structures on the west side of the lake. Consequently, due to the limited development on the lake and the WCGS implementation of riparian buffers on the lake to address potential impacts associated with agricultural activities, non-point source runoff in the form of contaminants or soil erosion is minimal.

The combined effects of entrainment and impingement may have an impact on the fisheries in Coffey County Lake. This effect is difficult to assess as only a limited set of impingement data has been collected, and almost no data are available on entrainment by the CWIS. However WCGS has had an annual fishery monitoring program in place since the facility first went on line, and this program, while not providing direct evidence, has indicated that the CWIS is not having a detectable impact on aquatic resources in the lake. The combined effects of entrainment and impingement may also have an impact on the aquatic biota in the Neosho River. However, this impact is likely to be small as the MUSH is only operated sporadically throughout the year and is located immediately downstream of the John Redmond Dam.

The thermal discharge from the CWIS is likely having an effect on the aquatic resources in the lake; however, this effect is likely to be localized in the area near the discharge. This impact may be beneficial for some aquatic organisms in that the warmer temperatures may encourage a longer growing season. However, aquatic organisms in the discharge area of the lake may be negatively affected should the heated discharge be disrupted during the winter months, as this likely would result in cold shock. The extent of losses attributable to this localized phenomenon is expected to be minimal in relation to the numbers and biomass of aquatic organisms in Coffey County Lake.

Changes in regional water usage, either man-made (through increased water withdrawals or changes in allocations) or natural (drought), may also have a detrimental effect on aquatic organisms. As discussed in Section 4.1.1, it has been documented that water withdrawal may occur during periods when the flow rate in the Neosho River is below the MDS established to be protective of aquatic resources. If withdrawals are made during the re-licensing period at times of drought when the river flow is below the 40 cfs level, then the duration and severity of impacts to aquatic resources may be increased.

As described above, the NRC staff considered the many potential factors that may affect the aquatic resources, associated with Coffey County Lake during the license renewal term. These factors are not expected to have a significant impact on these resources; thus, the cumulative impacts on aquatic resources in Coffey County Lake would be expected to be SMALL. Due to the potential impacts associated with water use conflicts in the Neosho River, the cumulative impacts of the proposed action on aquatic resources, including threatened and endangered species, in the Neosho River are expected to be SMALL to MODERATE during the license renewal term.

4.8.2 Cumulative Impacts on Terrestrial Resources

This section analyzes past, present, and future actions that could result in adverse cumulative impacts to terrestrial resources including threatened and endangered species, such as wildlife populations, the size and distribution of habitat areas, and aquatic resources such as streams, wetlands, and floodplains. For purposes of this cumulative effects analysis, the geographic area considered in the evaluation includes the WCGS site and its associated transmission line ROWs.

The transmission line ROWs do not cross any State or Federal parks, wildlife refuges, or wildlife management areas. Riparian and wetland communities are a small component of the natural communities present within the transmission line ROWs. Major rivers and associated watersheds traversed by the Wolf Creek – Rose Hill transmission line include the Neosho River, primarily in Coffey County, the Verdigris and Fall Rivers, primarily in Greenwood County, and the Walnut River, primarily in Butler County. The portion of the La Cygne – Benton transmission line rerouted around Coffey County Lake in conjunction with the construction of WCGS is approximately 7.7-mi long and mainly on WCGS property. Westar, the owner of the transmission lines, follows ROW management procedures that were designed to be protective of sensitive ecological resources, including wildlife habitat, wetlands, and floodplains. The maintenance procedures minimize disturbance of wildlife and wetlands and prevent potential off-site effects, such as erosion, on surrounding areas with other land uses.

Maintenance and operation of the transmission system are not expected to destabilize or noticeably alter the existing terrestrial or freshwater aquatic environment. Likewise, operation of WCGS is not likely to have a detectable effect on terrestrial species located in the vicinity of the WCGS site or the transmission line ROW. No other Federal or non-Federal activities have been identified that would have an adverse effect on terrestrial species in the area. The Staff concludes that the incremental contribution to cumulative impacts on terrestrial resources including threatened and endangered species resulting from continued operation of WCGS and its associated transmission line ROW would be SMALL.

The Staff has not identified any mitigation measures that would be appropriate for reducing the impacts on threatened and endangered species.

4.8.3 Cumulative Human Health Impacts

The continued operation of WCGS is not likely to result in significant cumulative impacts due to microbiological organisms because, no pathogenic species of amoeba *Naegleria* has been found in the water or sediment from the intake structures, swimming is not allowed, and KDHE has indicated that there have not been any reports of illness from thermophillic pathogens associated with Coffey County Lake. On the basis of these considerations, NRC staff has determined that the cumulative impacts to public health from microbiological organisms, resulting from operation of the WCGS cooling water discharge system to the aquatic environment or in the vicinity of the site, will be SMALL and no additional mitigation is warranted.

The NRC staff has determined that the electric-field-induced currents from the WCGS transmission lines are well below the NESC recommendations for preventing electric shock from induced currents. Therefore, the WCGS transmission lines do not significantly affect the overall potential for electric shock from induced currents within the analysis area. With respect to chronic effects of electromagnetic fields, although the NRC staff considers the GEIS finding of "not-applicable" to be appropriate in regard to WCGS, the WCGS transmission lines do not significantly contribute to the regional exposure of ELF-EMF. Therefore, the NRC staff has determined that the cumulative impacts of the continued operation of the WCGS transmission lines will be SMALL and no additional mitigation is warranted.

The radiological dose limits for protection of the public and workers have been developed by the EPA and NRC to address the cumulative impact of acute and long-term exposure to radiation and radioactive material. These dose limits are codified in 40 CFR Part 190 and 10 CFR Part 20. For the purpose of this analysis, the area within a 50-mi radius of the WCGS site was included. The REMP conducted by WCNOC in the vicinity of the Wolf Creek site measures radiation and radioactive materials from all sources, including Wolf Creek; therefore, the monitoring program measures cumulative radiological impacts. There are no other nuclear power plants within a 50-mi radius of Wolf Creek.

Monitoring results for the 5 year period from 2002 to 2006 were reviewed as part of the cumulative impacts assessment (WCNOC 2003b, WCNOC 2004b, WCNOC 2005b, WCNOC 2006i, WCNOC 2007d). Additionally, in Sections 2.2.7 and 4.3, the Staff concluded that impacts of radiation exposure to the public and workers (occupational) from operation of Wolf Creek during the renewal term are SMALL. The NRC and the State of Kansas would regulate any future actions in the vicinity of the Wolf Creek site that could contribute to cumulative radiological impacts.

Therefore, the Staff concludes that cumulative radiological impacts of continued operations of WCGS are SMALL and that no further mitigation measures are warranted.

4.8.4 Cumulative Socioeconomic Impacts

As discussed in Section 4.4 of this SEIS, the continued operation of WCGS during the license renewal term would have no impact on socioeconomic conditions in the region beyond those already being experienced. Since WCNOC has indicated that there would be no major plant refurbishment, overall expenditures and employment levels at WCGS would remain relatively constant with no additional demand for housing, public utilities, and public services. In addition, since employment levels and the value of WCGS would not change, there would be no population and tax revenue-related land use impacts. There would also be no disproportionately high or adverse health or environmental impacts on minority and low-income populations in the region. Based on this and other information presented in this SEIS, there would be no cumulative socioeconomic impacts from WCGS operations during the license renewal term and no mitigation would be required.

4.8.5 Cumulative Impacts on Groundwater Use and Quality

WCGS does not use groundwater in their operations and is not proposing to change this during the re-licensing period, so the facility has no direct impact on the availability of local groundwater. In addition, groundwater use within the local area is limited to scattered domestic and livestock supply wells, and there are no municipalities or significant industrial users in the area that could be impacted by WCGS operations. Potable water for local residents and towns is obtained from surface water sources, and WCNOC does not plan an increase in employment in the local area, so continued operations will not increase the demand for groundwater.
The development and operation of a cooling pond (Coffey County Lake) does have the potential to impact local groundwater quality through seepage. If contaminant concentrations were to build up in the surface water in the lake, downward infiltration and migration of this water could have the potential to transport this contamination through a wide area and to groundwater users. The primary flow direction would be to the west toward the Neosho River, and discharge of groundwater into the river could potentially impact aquatic resources in the river.

An additional potential source of groundwater contamination in this area is the Coffey County Landfill, which is located close to the western edge of Coffey County Lake. This landfill opened in 2001, and is therefore subject to current liner construction and groundwater monitoring requirements.

No site-specific monitoring data have been collected to evaluate the extent of surface water infiltration from Coffey County Lake to the groundwater. In addition, analytical data for the surface water within the lake is limited to radiological parameters and to general chemistry parameters associated with the facility NPDES permit. The radiological analyses indicate that tritium concentrations have increased in the lake since operations began and may be approaching the pre-construction estimate of 23,000 pCi/L(NRC 1982).

These data suggest that water quality within the lake is not completely known, but degradation of water quality due to tritium has been documented. In addition, the actual infiltration rate to groundwater is not known. However, pre-construction models based on hydrogeological data collected before the filling of Coffey County Lake predicted that the rate of groundwater migration would be very slow, and that off-site groundwater users would not be impacted. Also, a recent review of groundwater well data indicates that there is only one groundwater well near the facility that may still be used for domestic supply purposes. This well is located between Coffey County Lake and the Neosho River. It is possible that additional residential wells could be installed in this area in the future, and no mechanism currently exists that would require a determination of impacts to those new wells.

On the basis of this analysis, the Staff concludes that the cumulative impact to groundwater resources during the license renewal period would be SMALL to MODERATE during the license renewal term. A potential mitigation measure would be the implementation of a groundwater investigation program designed to confirm the pre-construction predictions regarding the rate of infiltration and groundwater flow.

4.8.6 Conclusions Regarding Cumulative Water Use Impacts

As discussed in Section 4.1.1, there are uncertainties regarding the availability of water during the relicensing period. Through the period of operations from 1982 to present, there have been no conflicts because there have been no significant droughts such as the 50-year drought that occurred in the 1950s, and the availability of water within the conservation pool of John Redmond Reservoir still has the necessary capacity to provide supply to all users. However, during the relicensing period, the likelihood of a 50-year drought occurring increases, and currently undefined actions will be necessary to extend the operational life of John Redmond Reservoir or otherwise develop alternate water sources.

Other factors affecting cumulative water use impacts include the volume of demand from other water uses in the basin, and the availability of water storage within the basin. These additional uses include water supply provided to residents within the Neosho River Basin, and the MDS established within the Neosho River. Demand from these uses is likely to increase in the future. The availability of water storage within the basin is known to be currently decreasing due to siltation in the conservation pool of John Redmond Reservoir as well as other reservoirs within the basin, although this decrease may be reversed by future re-allocation or dredging actions. Because the water use impacts from the relicensing action are deemed to range from SMALL to MODERATE, future water demands are likely to increase, and future water storage capacity is decreasing, the Staff concludes that cumulative impacts on water use are SMALL to MODERATE, and future mitigation will likely be warranted.

4.8.7 Conclusions Regarding Cumulative Impacts

The NRC staff considered the potential impacts resulting from the operation of WCGS and maintenance of the transmission line ROW since WCGS was constructed and went on line through the end of the license renewal term and resulting from other past, present, and future actions in the vicinity of WCGS. The Staff's determination is that the cumulative impacts resulting from the incremental contribution of WCGS operation and maintenance of transmission line ROW would be SMALL for all resources with the exception of aquatic resources, water use conflicts, and groundwater quality degradation. Aquatic resources and surface water availability would experience SMALL to MODERATE cumulative impacts due to the potential for surface water use conflicts, and groundwater quality could experience SMALL to MODERATE cumulative impacts due to the potential for infiltration and migration of tritium-impacted water from Coffey County Lake.

4.9 Summary of Impacts of Operations During the Renewal Term

Neither WCNOC nor the NRC staff is aware of information that is both new and significant related to any of the applicable Category 1 issues associated with the WCGS operation during the 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 15 Category 2 issues applicable to WCGS operation during the renewal term and for environmental justice and chronic effects of electromagnetic fields. For 12 issues and environmental justice, the Staff concluded that the potential environmental impact of renewal term operations of WCGS would be of SMALL significance in the context of the standards set forth in the GEIS and that additional mitigation would not be warranted. For water use impacts, the Staff concluded that there was not enough information to determine what actions will be taken in the future to ensure the availability of a water source during the re-license term. The available information documents that the current water source (John Redmond Reservoir) is reaching the end of its design life, and additional actions by USACE, WCGS, or some other entity will be required to either extend the life of the reservoir or provide a different source of water. These actions may or may not have impacts, and there may or may not be mitigation measures required for those impacts. Therefore, the Staff concludes that water use impacts would be SMALL to MODERATE.

The Staff concluded that impacts to aquatic organisms in both Coffey County Lake and the Neosho River during the renewal term would be SMALL, if no water use impacts exist. However, if SMALL to MODERATE impacts occur due to water use conflicts, impingement impacts in the Neosho River could be SMALL to MODERATE. Similarly if SMALL to MODERATE impacts occur due to water use conflicts, impacts to a Federally-threatened species, the Neosho madtom, in the Neosho River could be SMALL to MODERATE.

The Staff concluded that impacts due to groundwater quality degradation could be SMALL to MODERATE due to the potential for infiltration and migration of tritium-impacted water in Coffey County Lake.
Research is continuing in the area of chronic effects of electromagnetic fields, and a scientific consensus has not been reached. Therefore, the Staff did not conduct an evaluation of this issue.

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. The Staff concluded that cumulative impacts of WCGS license renewal would be SMALL for all potentially affected resources, with the exception of aquatic resources, water use conflicts, and groundwater quality, for which impacts would be SMALL to MODERATE.

4.10 References

10 CFR Part 20. Code of Federal Regulations, Title 10, *Energy*, Part 20, "Standards for Protection Against Radiation."

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 72. Code of Federal Regulations, Title 10, *Energy*, Part 72, "Licensing Requirements for the Independent Storage of Spent Nuclear Fuel, High-Level Radioactive Waste, and Reactor Related Greater than Class C Waste."

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

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

40 CFR Part 423. Code of Federal Regulations, Title 40, *Protection of Environment*, Part 423, "Steam Electric Power Generating Point Source Category."

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

Brock, T. D. 1974. *Biology of Microorganisms*. Prentice-Hall, Inc., Englewood Cliffs, New Jersey.

Canadian Wildlife Service and U.S. Fish & Wildlife Service (CWS and FWS). 2007. *International Recovery Plan: Whooping Crane* (*Grus americana*), Third Revision. Accessed at: http://www.fws.gov/endangered. June 2007.

Carlson, D. R. 1975. Sanitary Engineer, Water Pollution and Control, State of Kansas Department of Health and Environment, Topeka, Kansas. Letter dated April 10 to G. Koester, Kansas Gas and Electric Company, Wichita, Kansas.

Carlson, D. R. 1976. Sanitary Engineer, Water Pollution Control, State of Kansas Department of Health and Environment, Topeka, Kansas. Letter dated February 3 to M. Miller, Environmental Coordinator, Kansas Gas and Electric Company, Wichita, Kansas.

Clean Water Act of 1977 (CWA). 33 USC 1326 et seq. (common name of the Federal Water Pollution Control Act of 1977).

Colvin, M. A. 1993. *Ecology and Management of White Bass: A Literature Review.* Missouri Department of Conservation, Dingell-Johnson Project F-1-R-42, Study I-31, Job 1, Final Report.

Council on Environmental Quality. (CEQ). 1997a. *Environmental Justice: Guidance Under the National Environmental Policy Act.* Executive Office of the President, Washington, DC.

Council on Environmental Quality. (CEQ). 1997b. Considering Cumulative Impacts Under the National Environmental Policy Act. Executive Office of the President, Washington, DC.

EA Engineering, Science, and Technology, Inc. (EA). 1985. *Assessment of Cold Shock Potential for Six Target Species from the Wolf Creek Cooling Lake.* Prepared for Kansas Gas and Electric Company, Wichita, Kansas.

EA Engineering, Science, and Technology, Inc. (EA). 1988. *Wolf Creek Generating Station Operational Phase Environmental Monitoring Program, Final Report.* Prepared for Wolf Creek Nuclear Operating Corporation. Great Plains Regional Office.

Ecological Analysis, Inc. (EAI). 1981. *Wolf Creek Generating Station Operational Phase Environmental Monitoring Program, Final Report.* Wolf Creek Nuclear Operating Corporation, Wichita, Kansas. June.

Ecological Analysts, Inc. (EAI). 1982. *Wolf Creek Generating Station Construction Environmental Monitoring Program, February 1981 - January 1982*, EA Report KGE11, prepared for Kansas Gas and Electric Company.

Edison Electric Institute. 2007. "Electric Companies and Vegetation Management." Accessed at: http://www.eei.org/industry_issues/environment/landvegetation_management/index.htm on June 20, 2007.

Environmental Protection Agency (EPA). 2006. "National Recommended Water Quality Criteria." Office of Water.

Executive Order 12898. "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations." *Federal Register*, Volume 59, Number 32, Washington DC, February 16, 1994.

Fish and Wildlife Service (FWS). 1991. *Neosho Madtom Recovery Plan*. FWS Region 6, Denver, CO. p. 42.

Fish and Wildlife Service (FWS). 2007a. Letter from Michael J. LeValley, Field Supervisor, Kansas Ecological Services Field Office, FWS, Manhattan, Kansas, to Chief, Rules and Directives Branch, NRC, Washington, DC. Response to December 7, 2006 letter from NRC requesting information on federally listed, proposed, and candidate species and critical habitat that may be in the vicinity of WCGS and its transmission line ROW. January 29, 2007.

Fish & Wildlife Service (FWS). 2007b. Species Information, Threatened and Endangered Species System (TESS), Species Profiles. Accessed at: http://ecos.fws.gov/tess_public/StartTESS.do. June 2007.

Fish & Wildlife Service (FWS). 2007c. Mountain-Prairie Region, Endangered Species Program. Accessed at: http://www.fws.gov/mountain%2Dprairie/endspp/. June 2007.

Gray, M. W. 1974. Director, Division of Environment, State of Kansas Department of Health and Environment, Topeka, Kansas. Letter dated December 13 to G. Koester, Kansas Gas and Electric Company, Wichita, Kansas.

Haines, D. E. 2000. "Biological Control of Gizzard Shad Impingement at a Nuclear Power Plant." *Environmental Science & Policy*, 3: S275-S281.

Hazelton Environmental Sciences. 1979. Final Report of Construction Environmental Monitoring Program Wolf Creek Generating Station, March 1978 – February 1979, Project No. 8917, prepared for Kansas Gas and Electric Company.

Hazelton Environmental Sciences. 1980. Final Report of Construction Environmental Monitoring Program Wolf Creek Generating Station, March 1979 – February 1980, Project No. 9001, prepared for Kansas Gas and Electric Company.

Kansas Department of Health and Environment (KDHE). 2004. *Kansas Surface Water Quality Standards: Numeric Criteria*. May 18, 2004.

Kansas Department of Health and Environment (KDHE). 2006a. *Report of Radiological Environmental Monitoring of the Environs Surrounding Wolf Creek Generating Station, July 2005 to June 2006*. Topeka, Kansas.

Kansas Department of Health and Environment (KDHE). 2006b. *Report of Radiological Environmental Monitoring and the Environs Surrounding Wolf Creek Generating Station, July 2004 – June 2005.* Division of Environment, Bureau of Air and Radiation, Radiation and Asbestos Control section. Topeka, Kansas.

Kansas Department of Wildlife and Parks (KDWP). 2004. Threatened and Endangered Species, Species Information. Accessed at: http://www.kdwp.state.ks.us/news/otherservices/threatenedandendangered_species/threatened and endangered species/speciesinformation. June 2007.

Kansas Gas & Electric Company (KG&E). 1975. "Information on Facility Exemption from Discharge of Heat." Letter from G. Koester, Kansas Gas and Electric, Wichita, Kansas to M. Gray, Kansas Department of Health and Environment, Topeka, Kansas. April 4, 1975.

Kansas Gas & Electric Company (KG&E). 1981. *Wolf Creek Generating Station, Makeup Screenhouse Impingement Monitoring Report, November 1980 – October 1981.*

Kansas Geological Survey (KGS). 2007. *KGS Water Wells Query Answer, Coffey County.* Accessed at: http://abyss.kgs.ku.edu/pls/abyss on June 8, 2007.

Kansas Water Appropriation Act (KWAA). 2004. Statutes K.S.A. 82A-701 through 82A-737, and K.S.A. 42-313, 42-314 as Amended 2004. Accessed at: http://www.accesskansas.org/kda/dwr/laws-rules/kwaa.pdf on March 1, 2007.

Kansas Water Office (KWO). 2001. "Minimum Desirable Steamflows". Accessed at: http://www.kwo.org/reports%20&%20publications/fact%20sheets/no_12_minimum_desirable_streamflow.pdf on March 1, 2007.

Kansas Water Office (KWO). 2004. "Kansas Water Plan, Neosho Basin Section". Accessed at: http://www.kwo.org/kansas%20water%20plan/neo_basin/111804.pdf on January 3, 2007.

Kansas Water Office (KWO). 2007. *John Redmond Lake Reservoir Fact Sheet.* Accessed at: http://www.kwo.org/reservoirinformation/reservoirfactsheets/john_redmond_lake.pdf on June 12, 2007).

Koester, G. L. 1974. Kansas Gas and Electric, Letter of November 14 to M. Gray, State of Kansas Department of Health and Environment, Topeka, Kansas.

Koester, G. L. 1975. Kansas Gas and Electric, Letter of April 4 to M. Gray, Director, Division of Environment, State of Kansas Department of Health and Environment, Topeka, Kansas.

Koester, G. L. 1982. Letter from G.L. Koester, Kansas Gas and Electric Company to U.S. NRC transmitting the Makeup Screenhouse Impingement Monitoring Report, November 1980 – October 1981. March 19.

Mettee M. F., P. E. O'Neil, and J. M. Pierson. 1996. *Fishes of Alabama and the Mobile Basin.* Oxmoor House. Birmingham, Alabama.

Moles, K. J. 2007. *Wolf Creek 2006 Annual Environmental Operating Report.* Wolf Creek Nuclear Operating Corporation. April 17, 2007. RA 07-0044.

Mosher,T. D. 2000. *Assessment of a 254-mm Minimum Length Limit for Crappie in Three Northeastern Kansas Reservoirs.* Final Report. Kansas Department of Wildlife and Parks. Federal Aid Project No. FW-9-12 and F-30-R-1.

Muoneke, M. I., C. C. Henry, and O. E. Maughan. 1992. "Population Structure and Food Habits of White Crappie *Pomoxis annularis Rafinesque* in a Turbid Oklahoma Reservoir." *Journal of Fish Biology.* Volume 1, p. 647. October.

Nalco Environmental Sciences. 1976. *Final Report of Preconstruction Environmental Monitoring Program WCGS, March 1975 - February 1976.* Kansas Gas and Electric Company. Wichita, Kansas. May.

Nalco Environmental Sciences. 1977. *Final Report of Preconstruction Environmental Monitoring Program WCGS, March 1976 - February 1977.* Kansas Gas and Electric Company. Wichita, Kansas. May.

Nalco Environmental Sciences. 1978. *Final Report of Preconstruction Environmental Monitoring Program WCGS, March 1977 - February 1978.* Kansas Gas and Electric Company. Wichita, Kansas. May.

National Electrical Safety Code (NESC). 1997. Institute of Electrical and Electric Engineers, New York.

Nuclear Regulatory Commission (NRC). 1975. *Final Environmental Statement related to Construction of Wolf Creek Generating Station, Unit 1.* NUREG-175/096, Washington, DC.

Nuclear Regulatory Commission (NRC). 1982. *Final Environmental Statement Related to the Operation of Wolf Creek Generating Station, Unit No. 1.* NUREG-0878, Washington, DC.

Nuclear Regulatory Commission (NRC). 1984. Wolf Creek Generating Station, Unit No. 1 Environmental Protection Plan, Appendix B to Facility Operating License No NPF-42.

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

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

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, DC.

Nuclear Regulatory Commission (NRC). 2006. Letter to Mike LeValley, Project Leader, U.S. Fish and Wildlife Service, Manhattan, Kansas: Request for list of protected species within the area under evaluation for the Wolf Creek Generating Station License Renewal Application review. December 7.

Nuclear Regulatory Commission (NRC). 2007. Letter from NRC to Wolf Creek Nuclear Operating Corporation Regarding Summary of Environmental Site Audit Related to the Review of the License Renewal Application for Wolf Creek Generating Station, Unit 1. April 27.

Putnam, J. E., and D. R. Schneider. 2005. *Water Resources Data – Kansas, Water Year 2004.* Water-Data Report KS-04-1. U.S. Geological Survey, Lawrence, Kansas.

Portier, C. J., and M. S. Wolfe, eds. 1999. *Assessment of Health Effects from Exposure to Power-Line Frequency Electric and Magnetic Field.* Working Group Report, National Institute of Environmental Health Sciences of the National Institutes of Health. p. 508.

Staab, E. C. 2007. Letter from Eric C. Staab, Industrial Programs Section, Bureau of Water, Kansas Department of Health and Environmental, Topeka, KS, to Kevin J. Molec, WCNOC, Burlington, KS, regarding WCGS 316(b) Water Transfer Information, NPDES Permit No. I-NE07-P002. January 23.

State of Kansas Department of Agriculture, Division of Water Resources. 1977a. "Approval of Application and Permit to proceed, Appropriation of Water for Beneficial Use File Number 20,275." August, 1977.

State of Kansas Department of Agriculture, Division of Water Resources. 1977b. "Approval of Application and Permit to proceed, Appropriation of Water for Beneficial Use File Number 14,626." August, 1977.

State of Kansas Department of Agriculture, Division of Water Resources. 1977c. "Approval of Application and Permit to proceed, Appropriation of Water for Beneficial Use File Number 19,882." August, 1977.

State of Kansas Water Resources Board. 1976. "Water Purchase Contract Number 76-2."

TetraTech NUS (TTNUS). 2005. "Calculation Package for Wolf Creek Transmission Lines Induced Current Analysis." Aiken, South Carolina. May.

U.S. Army Corp of Engineers (USACE). 2002. *Draft Supplement to the Final Environmental Impact Statement Prepared for the: Reallocation of Water Supply Storage Project: John Redmond Lake, Kansas.*

U.S. Census Bureau (USCB). 2000. Census of Population and Housing 2000, Summary File 3, Tables P6 and P7. Accessed at: http://factfinder.census.gov in July 2007.

U.S. Geological Survey (USGS). 1979. *Burlington Quadrangle, 7.5 Minute Series Topographic Map*, Photorevised 1979.

Wedd, G. R. 1985. "Observations on Neosho River Larval Fish in Coffey County, Kansas." *The Emporia State Research Studies*, Volume XXXIV, Number 1. pp. 5-56.

Westar Energy, Inc. (Westar). Undated. Docket Number WCNOC-082. "Transmission Line Vegetation Management Program".

Wolf Creek Generating Station (WCGS). 1980. *Wolf Creek Generating Station Unit No. 1, Environmental Report, Operating License Stage - Volume 1.* Burlington, Kansas.

Wolf Creek Nuclear Operating Corporation (WCNOC). 1987a. *Evaluation of the Environmental Effects of Higher-than-Postulated Condenser Delta T's,* LI 87-0092, Interoffice correspondence from Brad Loveless to TE: 42072, February 12.

Wolf Creek Nuclear Operating Corporation (WCNOC). 1987b. "Naegleria fowleri Test Results"; LI 87-0627, interoffice correspondence from Greg Wedd to Distribution, October 16, 1987, with attached letter and data table from R. L.Tyndall, Microbial Monitoring, Clinton, Tennessee, to Brad Loveless, Wolf Creek Nuclear Operating Corporation, Burlington, Kansas, September 20, 1987.

Wolf Creek Nuclear Operating Corporation (WCNOC). 1988. *Wolf Creek Generating Station 1987-1988 Operational Wildlife Monitoring Report.* Engineering and Technical Services, Environmental Management Group. November.

Wolf Creek Nuclear Operating Corporation (WCNOC). 1993. Wolf Creek Generating Station Aquatic Monitoring, 1992 Reports and 1993 Plans. Internal document. March 1993.

Wolf Creek Nuclear Operating Corporation (WCNOC). 2003a. *Wolf Creek Generating Station Annual Environmental Operating Report 2002.* Burlington, Kansas.

Wolf Creek Nuclear Operating Corporation (WCNOC). 2003b. *2002 Annual Radiological Environmental Operating.* Burlington, Kansas.

Wolf Creek Nuclear Operating Corporation (WCNOC). 2004a. *Wolf Creek Generating Station Annual Environmental Operating Report 2003.* Burlington, Kansas.

Wolf Creek Nuclear Operating Corporation (WCNOC). 2004b. *2003 Annual Radiological Environmental Operating.* Burlington, Kansas.

Wolf Creek Nuclear Operating Corporation (WCNOC). 2005a. *Wolf Creek Generating Station, Annual Environmental Operating Report 2004.* Burlington, Kansas.

Wolf Creek Nuclear Operating Corporation (WCNOC). 2005b. *2004 Annual Radiological Environmental Operating.* Burlington, Kansas.

Wolf Creek Nuclear Operating Corporation (WCNOC). 2006a. *Applicant's Environmental Report; Operating License Renewal Stage.* Appendix E of License Renewal Application, Wolf Creek Generating Station Unit 1, Docket Number. 50-482, Facility Operating License No. NPF-42, (Revision 0).

Wolf Creek Nuclear Operating Corporation (WCNOC). 2006b. *Wolf Creek Generating Station Annual Environmental Operating Report 2005.* Burlington, Kansas.

Wolf Creek Nuclear Operating Corporation (WCNOC). 2006c. Enclosure 1 to WM 06-0046 An Assessment of the Potential Impacts on the Flow of the Neosho River Related to the Operating License Renewal for Wolf Creek Generating Station. Contained in: Letter from Matthew W. Sunseri, Wolf Creek Nuclear Operating Corporation to U.S. Nuclear Regulatory Commission regarding Docket Number 50-482: Supplementary Environmental Information to Support the Application for Renewed Operating License for Wolf Creek Generating Station. WM 06-0046. November 17, 2006.

Wolf Creek Nuclear Operating Corporation (WCNOC). 2006d. Enclosure 2 to WM 06-0046, *An Assessment of the Impact on Fish and Shellfish Resources from Entrainment Related to the Operating License Renewal for Wolf Creek Generating Station, Unit No. 1.* Contained in: Letter from Matthew W. Sunseri, Wolf Creek Nuclear Operating Corporation to U.S. Nuclear Regulatory Commission regarding Docket 50-482: Supplementary Environmental Information to Support the Application for Renewed Operating License for Wolf Creek Generating Station. WM 06-0046. November 17, 2006.

Wolf Creek Nuclear Operating Corporation (WCNOC). 2006e. Enclosure 3 to WM 06-0046, *An Assessment of the Potential Impacts on Fish and Shellfish Resources from Impingement Related to the Operating License Renewal for Wolf Creek Generating Station, Unit No. 1.* Contained in: Letter from Matthew W. Sunseri, Wolf Creek Nuclear Operating Corporation to U.S. Nuclear Regulatory Commission regarding Docket Number 50-482: Supplementary Environmental Information to Support the Application for Renewed Operating License for Wolf Creek Generating Station. WM 06-0046. November 17, 2006.

Wolf Creek Nuclear Operating Corporation (WCNOC). 2006f. Enclosure 4 to WM 06-0046, *An Assessment of the Impact on Fish and Shellfish Resources from Heat Shock Related to the Operating License Renewal for Wolf Creek Generating Station, Unit Number 1.* Contained in: Letter from Matthew W. Sunseri, Wolf Creek Nuclear Operating Corporation to U.S. Nuclear Regulatory Commission regarding Docket Number 50-482: Supplementary Environmental Information to Support the Application for Renewed Operating License for Wolf Creek Generating Station. WM 06-0046. November 17, 2006.

Wolf Creek Nuclear Operating Corporation (WCNOC). 2006g. Wolf Creek Generating Station 2005 Annual Radiological Environmental Operating Report. Burlington, Kansas.

Wolf Creek Nuclear Operating Corporation (WCNOC). 2006h. *Avian Protection Plan at Wolf Creek Generating Station.* August. 43 pp.

Wolf Creek Nuclear Operating Corporation (WCNOC). 2006i. *2005 Annual Radiological Environmental Operating.* Burlington, Kansas.

Wolf Creek Nuclear Operating Corporation (WCNOC). 2007a. *Biological Assessment of Potential Impact to the Neosho Madtom and Neosho Mucket Due to License Renewal of Wolf Creek Generating Station.* Burlington, Kansas. March.

Wolf Creek Nuclear Operating Corporation (WCNOC). 2007b. "Docket Number 50-482: Response to NRC Request for Additional Information Related to Wolf Creek Generating Station License Renewal Application." Item Number M56. Letter from Terry J. Garrett, Wolf Creek Nuclear Operating Corporation, to NRC Document Control Desk, Washington, DC, May 9, 2007.

Wolf Creek Nuclear Operating Corporation (WCNOC). 2007c. "Docket Number 50-482: Response to NRC Request for Additional Information Related to Wolf Creek Generating Station License Renewal Application." Item Number R57. Letter from Terry J. Garrett, Wolf Creek Nuclear Operating Corporation, to NRC Document Control Desk, Washington, DC, May 9, 2007.

Wolf Creek Nuclear Operating Corporation (WCNOC). 2007d. *2006 Annual Radiological Environmental Operating.* Burlington, Kansas.

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 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 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: 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 and severe accidents, as discussed below.

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[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 U.S. Nuclear Regulatory Commission (NRC) approval to operate a nuclear power facility, an applicant for an initial operating license (OL) 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.

Design-basis accidents (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 Part 50 and Part 100 (10 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 OL. The results of these evaluations are found in license documentation such as the applicant's Final Safety Analysis Report (FSAR), the NRC staff's Safety Evaluation Report (SER), the Final Environmental Statement (FES), and Section 5.1 of this Supplemental Environmental Impact Statement (SEIS). A 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 period. 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 Wolf Creek Generating Station (WCGS), is listed in Table 5-1.

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

ISSUE–10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Sections
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.

Wolf Creek Nuclear Operating Corporation (WCNOC) stated in its Environmental Report (ER) (WCNOC 2006a) that it is not aware of any new and significant information associated with the renewal of the WCGS OL. The NRC staff has not identified any new and significant information during its independent review of the WCGS ER, the site visit, the scoping process, evaluation of other available information. Therefore, the NRC staff concludes that there are no impacts related to DBAs 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, regardless of off-site consequences. In the GEIS, the NRC staff assessed the impacts of severe accidents 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.

Severe accidents initiated by external phenomena, such as tornadoes, floods, earthquakes, fires, and sabotage, traditionally have not been discussed in quantitative terms in FESs and were not specifically considered for the WCGS site in the GEIS. However, in the GEIS, the NRC staff did evaluate existing impact assessments performed by the NRC and by the industry at 44 nuclear plants in the United States and concluded that the risk from beyond-design-basis earthquakes at existing nuclear power plants is SMALL. The GEIS for license renewal performed a discretionary analysis of terrorist acts in connection with license renewal, and concluded that the core damage and radiological release from such acts would be no worse than the damage and release expected from internally initiated events. In the GEIS, the Commission concludes that the risk from sabotage and beyond-design-basis earthquakes at existing nuclear power plants is small and, additionally, that the risks from other external events are adequately addressed by a generic consideration of internally initiated severe accidents. (GEIS, Vol. 1, p. 5-18).

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 groundwater, and societal and economic impacts from severe accidents are small for all plants. However, alternatives to mitigate severe accidents must be considered for all plants that have not considered such alternatives..

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 WCGS, is listed in Table 5-2.

Table 5-2. Category 2 Issues Applicable to Postulated Accidents During the 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 NRC staff has not identified any new and significant information with regard to the consequences from severe accidents during its independent review of the WCGS ER (WCNOC 2006a), the site visit, the scoping process, or evaluation of other available information. Therefore, the NRC 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 NRC staff has reviewed severe accident mitigation alternatives (SAMAs) for WCGS. The results of its review are discussed in Section 5.2.

5.2 Severe Accident Mitigation Alternatives

Section 51.53(c)(3)(ii)(L) requires that license renewal applicants consider alternatives to mitigate severe accidents if the Staff has not previously evaluated 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 Wolf Creek

Generating Station (WCGS); therefore, the remainder of Chapter 5 addresses those alternatives.

5.2.1 Introduction

This section summarizes the SAMA evaluation conducted by Wolf Creek Nuclear Operating Corporation (WCNOC) and the NRC staff's review of this evaluation. The NRC staff performed its review with contract assistance from Information Systems Laboratories, Inc. The NRC staff's review is available in full in Appendix G; the SAMA evaluation is available in full in WCNOC's ER.

The SAMA evaluation for WCGS was conducted with a four-step approach. In the first step WCNOC quantified the level of risk associated with potential reactor accidents using the plant-specific probabilistic safety assessment (PSA) and other risk models.

In the second step WCNOC examined the major risk contributors and identified possible ways (SAMAs) of reducing that risk. Common ways of reducing risk are changes to components, systems, procedures, and training. WCNOC initially identified 19 potential SAMAs for WCGS. WCNOC screened out 4 SAMAs from further consideration because they were determined to provide no measurable benefit or to have estimated costs that would exceed the dollar value associated with completely eliminating all severe accident risk at WCGS. The remaining 15 SAMAs were subjected to further evaluation.

In the third step WCNOC estimated the benefits and the costs associated with each of the remaining SAMAs. Estimates were made of how much each SAMA could reduce risk. Those estimates were developed in terms of dollars in accordance with NRC guidance for performing regulatory analyses (NRC 1997). The cost of implementing the proposed SAMAs was 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 cost (a positive cost-benefit). WCNOC found three SAMAs to be potentially cost-beneficial in the baseline analysis, and four additional SAMAs to be potentially cost-beneficial when analysis uncertainties are considered (WCNOC 2006b).

The potentially cost-beneficial 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. WCNOC's SAMA analyses and the NRC's review are discussed in more detail below.

5.2.2 Estimate of Risk

WCNOC submitted an assessment of SAMAs for WCGS as part of the ER (WCNOC 2006b). This assessment was based on the most recent WCGS 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 WCGS Individual Plant Examination (IPE) (WCNOC 1992) and Individual Plant Examination of External Events (IPEEE; WCNOC 1995).

The baseline core damage frequency (CDF) for the purpose of the SAMA evaluation is approximately 3.0×10^{-5} per year. This CDF is based on the risk assessment for internally-initiated events. WCNOC did not include the contribution to risk from external events within the WCGS risk estimates; however, it did account for the potential risk reduction benefits associated with external events by increasing the estimated benefits for internal events by a factor of two. The breakdown of CDF by initiating event is provided in Table 5-3.

Table 5-3. WCGS Core Damage Frequency

Initiating Event	CDF (Per Year)	% Contribution to CDF
Loss of Offsite Power	1.7×10^{-5}	57
Small LOCA	7.0×10^{-6}	23
Interfacing System LOCA	1.9×10^{-6}	6
Very Small LOCA	1.3×10^{-6}	4
Steam Generator Tube Rupture	8.7×10^{-7}	3
Transients With Power Conversion Systems Available	3.9×10^{-7}	1
Reactor Vessel Failure	3.0×10^{-7}	1
Steamline Break	2.4×10^{-7}	1
Transients Without Power Conversion Systems Available	1.8×10^{-7}	1
Loss of Vital DC Bus NK04	1.5×10^{-7}	1
Medium LOCA	1.4×10^{-7}	<1
Loss of Vital DC Bus NK01	1.2×10^{-7}	<1
Loss of All Service Water	8.6×10^{-8}	<1

Table 5-3. (cont'd)

Initiating Event	CDF (Per Year)	% Contribution to CDF
Loss of Component Cooling Water	5.8×10^{-8}	<1
Feedwater Line Break	3.3×10^{-8}	<1
Large LOCA	2.8×10^{-8}	<1
Total CDF (internal events)	**3.0×10^{-5}**	**100**

As shown in Table 5-3, events initiated by loss of offsite power and small break loss of coolant accident (LOCA) are the dominant contributors to CDF. Although not separately reported, station blackout (SBO) sequences contribute 1.7×10^{-5} per year (about 55 percent of the total internal events CDF), while anticipated transient without scram (ATWS) sequences are not present in the dominant sequences.

WCNOC estimated the dose to the population within 80 km (50 mi) of the WCGS site to be approximately 0.0327 person-Sv (3.27 person-rem) per year. The breakdown of the total population dose by containment release mode is summarized in Table 5-4. Interfacing system LOCA (ISLOCA) and containment failures within the early time frame (less than 6 hours following accident initiation) dominate the population dose risk at WCGS.

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

Containment Release Mode	Population Dose (Person-Rem[1] Per Year)	% Contribution
Early Containment Failure	0.18	5
Late Containment Failure	0.10	3
Containment Bypass – Steam Generator Tube Ruptures (SGTR)	0.05	2
Containment Bypass - ISLOCA	2.71	83
Containment Bypass - Isolation Failure	Negligible	<1
Intact Containment	0.23	7
Total	**3.27**	**100**

[1]One person-Rem = 0.01 person-Sv

The NRC staff has reviewed WCNOC'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 candidate SAMAs. Accordingly, the Staff based its assessment of offsite risk on the CDFs and offsite doses reported by WCNOC.

5.2.3 Potential Plant Improvements

Once the dominant contributors to plant risk were identified, WCNOC searched for ways to reduce that risk. In identifying and evaluating potential SAMAs, WCNOC considered insights from the plant-specific PSA, and SAMA analyses performed for other operating plants that have submitted license renewal applications. WCNOC identified 19 potential risk-reducing improvements (SAMAs) to plant components, systems, procedures and training.

WCNOC removed 4 SAMAs from further consideration because they were determined to provide no measurable benefit or to have estimated costs that would exceed the dollar value associated with completely eliminating all severe accident risk at WCGS. A detailed cost-benefit analysis was performed for each of the 15 remaining SAMAs.

The Staff concludes that WCNOC used a systematic and comprehensive process for identifying potential plant improvements for WCGS, and that the set of potential plant improvements identified by WCNOC is reasonably comprehensive and, therefore, acceptable.

5.2.4 Evaluation of Risk Reduction and Costs of Improvements

WCNOC evaluated the risk-reduction potential of the remaining 15 SAMAs. The SAMA evaluations were performed using realistic assumptions with some conservatism.

WCNOC estimated the costs of implementing the 15 candidate SAMAs through the application of engineering judgement, and use of other licensees' 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 contingency costs associated with unforeseen implementation obstacles.

The Staff reviewed WCNOC'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 somewhat conservative (i.e., the estimated risk reduction is similar to or somewhat higher than what would actually be realized). Accordingly, the Staff based its estimates of averted risk for the various SAMAs on WCNOC's risk reduction estimates.
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 found the cost estimates to be consistent with estimates provided in support of other plants' analyses.

The Staff concludes that the risk reduction and the cost estimates provided by WCNOC are sufficient and appropriate for use in the SAMA evaluation.

5.2.5 Cost-Benefit Comparison

The cost-benefit analysis performed by WCNOC was based primarily on NUREG/BR-0184 (NRC 1997) and was executed consistent with this guidance. NUREG/BR-0058 has recently been revised to reflect the agency's revised policy on discount rates. Revision 4 of NUREG/BR-0058 states that two sets of estimates should be developed – one at three percent and one at seven percent (NRC 2004). WCNOC provided both sets of estimates (WCNOC 2006b).

WCNOC identified three potentially cost-beneficial SAMAs in the baseline analysis contained in the ER (using a three percent discount rate). The potentially cost-beneficial SAMAs are:

- SAMA 2 - Modify controls and operating procedures to permit the diesel generators at the Sharpe Station to be more rapidly aligned to the WCGS emergency buses in SBO events.

- SAMA 4, Case 2 - Proceduralize operator actions to perform local isolations of any valves that fail to close remotely in an interfacing system LOCA.

- SAMA 5 - Modify procedures to open emergency diesel generator room doors to provide alternate room cooling given failure of the heating ventilation and air-conditioning (HVAC) supply fan.

WCNOC performed additional analyses to evaluate the impact of parameter choices and uncertainties on the results of the SAMA assessment (WCNOC 2006b). If the benefits are increased by a factor of 1.9 to account for uncertainties, four additional SAMA candidates were determined to be potentially cost-beneficial:

- SAMA 1 - Install a permanent, dedicated generator for the normal charging pump (NCP) in order to provide reactor coolant pump seal cooling in SBO events.

- SAMA 3 - Provide the capability to cross-tie between 4kV AC buses in the event of a loss of power to one bus.

- SAMA 13 - Install an alternative fuel oil tank with gravity feed capability to address fuel oil transfer failure events.

- SAMA 14 - Install a permanent, dedicated generator for the NCP (similar to SAMA 1), and a motor-driven auxiliary feedwater (AFW) pump and battery charger to address SBO events in which the turbine-driven AFW pump is unavailable.

The Staff concludes that, with the exception of the potentially cost-beneficial SAMAs discussed above, the costs of the SAMAs evaluated would be higher than the associated benefits.

5.2.6 Conclusions

The Staff reviewed WCNOC's analysis and concluded that the methods used and the implementation of those methods were sound. The treatment of SAMA benefits and costs support the general conclusion that the SAMA evaluations performed by WCNOC are reasonable and sufficient for the license renewal submittal. Although the treatment of SAMAs for external events was somewhat limited by the unavailability of an external event PSA, the likelihood of there being cost-beneficial enhancements in this area was minimized by improvements that have been realized as a result of the IPEEE process, and increasing the estimated SAMA benefits for internal events by a factor of two to account for potential benefits in external events.

Based on its review of the SAMA analysis, the Staff concurs with WCNOC's identification of areas in which risk can be further reduced in a cost-beneficial manner through the implementation of all or a subset of potentially cost-beneficial SAMAs. Given the potential for cost-beneficial risk reduction, the Staff considers that further evaluation of these SAMAs by WCNOC is warranted. However, none of the potentially cost-beneficial SAMAs relate to adequately managing the effects of aging during the period of extended operation. Therefore, they need not be implemented as part of the license renewal pursuant to 10 CFR Part 54.

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 73. Code of Federal Regulations, Title 10, *Energy,* Part 73, "Physical Protection of Plants and Materials."

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

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

Nuclear Regulatory Commission (NRC). 1997. Regulatory Analysis Technical Evaluation Handbook. NUREG/BR-0184, Washington, DC.

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, DC.

Nuclear Regulatory Commission (NRC). 2004. Regulatory Analysis Guidelines of the U.S. Nuclear Regulatory Commission. NUREG/BR-0058, Rev. 4, Washington, DC.

Wolf Creek Nuclear Operating Corporation (WCNOC). 1992. Letter from Bart D. Withers, WCNOC to U.S. Nuclear Regulatory Commission Document Control Desk. Subject: Docket Number 50-482: Wolf Creek Generating Station Individual Plant Examination. September 28, 1992.

Wolf Creek Nuclear Operating Corporation (WCNOC). 1995. Letter from Robert C. Hagan, WCNOC to U.S. Nuclear Regulatory Commission Document Control Desk. Subject: Docket Number 50-482: Final Response to Generic Letter 88-20. Supplement 4 (IPEEE Submittal). June 27, 1995.

Wolf Creek Nuclear Operating Corporation (WCNOC). 2006a. *Applicant's Environmental Report; Operating License Renewal Stage.* Appendix E of License Renewal Application, Wolf Creek Generating Station Unit 1, Docket Number 50-482, Facility Operating License Number NPF-42, (Revision 0).

Wolf Creek Nuclear Operating Corporation (WCNOC). 2006b. Letter from Terry J. Garrett, WCNOC to U.S. Nuclear Regulatory Commission Document Control Desk. Subject: Docket Number 50-482: Application for Renewed Operating License, September 27, 2006.

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 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 [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; 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 Wolf Creek Generating Station (WCGS). The generic potential impacts of the radiological and nonradiological environmental impacts of the uranium fuel cycle and transportation of nuclear fuel and wastes are described in detail in the GEIS 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 Transportation of Fuel and Waste to and from One Light-Water-Cooled Nuclear Power Reactor." The U.S. Nuclear Regulatory

[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.

Commission (NRC) 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 WCGS 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 During the Renewal Term

ISSUE—10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Section
URANIUM FUEL CYCLE AND WASTE MANAGEMENT	
Off-site radiological impacts (individual effects from other than the disposal of spent fuel and high level waste)	6.2.1; 6.2.2.1; 6.2.2.3; 6.2.3; 6.2.4
Off-site radiological impacts (collective effects)	6.2.2.1; 6.2.3; 6.2.4
Off-site radiological impacts (spent fuel and high level waste disposal)	6.2.2.1; 6.2.2.2; 6.2.3; 6.2.4
Nonradiological impacts of the uranium fuel cycle	6.2.2.6; 6.2.2.7; 6.2.2.8;
	6.2.2.9; 6.2.3; 6.2.4
Low-level waste storage and disposal	6.2.2.2; 6.4.2; 6.4.3
Mixed waste storage and disposal	6.4.5
On-site spent fuel	6.4.6
Nonradiological waste	6.5
Transportation	6.3, Addendum 1

Wolf Creek Nuclear Operating Corporation (WCNOC) stated in its Environmental Report (ER) (WCNOC 2006) that it is not aware of any new and significant information associated with the renewal of the WCGS operating license. The Staff has not identified any new and significant information during its independent review of the WCGS ER (WCNOC 2006), the site audit, the scoping process, or 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 off-site 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, for each of these issues follows:

- Off-site 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 WCNOC ER (WCNOC 2006), the site audit, the scoping process, or evaluation of other available information. Therefore, the Staff concludes that there are no off-site radiological impacts (individual effects) of the uranium fuel cycle during the renewal term beyond those discussed in the GEIS.

- Off-site 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, 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 one 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 of the uncertainty, some judgement as to the regulatory NEPA (National Environmental Policy Act of 1969, as amended) 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 WCNOC ER (WCNOC 2006), the Staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the Staff concludes that there are no off-site radiological impacts (collective effects) from the uranium fuel cycle during the renewal term beyond those discussed in the GEIS.

- Off-site 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 off-site 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" (NAS 1995), 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 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 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 per year. The lifetime individual risk from 100 millirem annual dose limit 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, U.S. Environmental Protection Agency's (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 of 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 HLW. 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 off-site radiological impacts from license renewal related to disposal of spent nuclear fuel and HLW.

The 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 HLW and spent fuel disposal component of the fuel cycle, there is some uncertainty with respect to regulatory limits for off-site releases of radioactive nuclides for the current candidate repository site. However, prior to promulgation of the affected provisions of the Commission's regulations, it was assumed that limits would be developed in line with the 1995 NAS report, *Technical Bases for Yucca Mountain Standards* (NAS 1995), 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 would be 100 mrem per year or less.
>
> Despite the current uncertainty with respect to these rules, some judgment as to the 1969 NEPA implications of off-site radiological impacts of spent fuel and HLW 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 WCNOC ER (WCNOC 2006), the site audit, the scoping process, or evaluation of other available information. Therefore, the Staff concludes that there are no off-site radiological impacts related to spent fuel and HLW disposal during the renewal term beyond those discussed in the GEIS.

- <u>Nonradiological impacts of the uranium fuel cycle</u>. 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 WCNOC ER (WCNOC 2006), 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 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 WCNOC ER (WCNOC 2006), the site audit, the scoping process, or evaluation of other available information. Therefore, the Staff concludes that there are no impacts of low-level waste storage and disposal associated with the 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 nonradiological 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 WCNOC ER (WCNOC 2006), the site audit, the scoping process, or evaluation of other available information. Therefore, the Staff concludes that there are no impacts of mixed waste storage and disposal associated with the 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 WCNOC ER (WCNOC 2006), the site audit, the scoping process, or evaluation of other available information. Therefore, the Staff concludes that there are no impacts of on-site 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 WCNOC ER (WCNOC 2006), the site, the scoping process, or evaluation of other available information. Therefore, the Staff concludes that there are no nonradiological waste impacts during the 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 (megawatt-days per metric ton of uranium) 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.

  WCGS meets the fuel-enrichment and burnup conditions set forth in Addendum 1 to the GEIS. The Staff has not identified any new and significant information during its independent review of the WCNOC ER (WCNOC 2006), the site audit, the scoping process, or evaluation of other available information. Therefore, the Staff concludes that there are no impacts of transportation 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."

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

Joint Resolution 87, 2002. Public Law 107-200, 116 Stat 735.

National Academy of Sciences (NAS). 1995. *Technical Bases for Yucca Mountain Standards*. Washington, DC.

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

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

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, DC.

Wolf Creek Nuclear Operating Corporation (WCNOC). 2006. *Applicant's Environmental Report – Operating License Renewal Stage, Wolf Creek Generating Station. Docket Number 50-482.* Burlington, Kansas.

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 on Decommissioning of Nuclear Facilities: Supplement 1, 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 NUREG-0586, Supplement 1 identifies a range of impacts for each environmental issue.

The incremental environmental impacts associated with decommissioning activities resulting from continued plant operation 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 issue could be applied to all plants and whether additional mitigation measures would be warranted. Issues were 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 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; therefore, additional plant-specific review of these issues is required. There are no Category 2 issues related to decommissioning.

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[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 Wolf Creek Generating Station (WCGS) decommissioning following the renewal term are listed in Table 7-1. Wolf Creek Nuclear Operating Corporation (WCNOC) stated in its Environmental Report (ER) (WCNOC 2006) that it is aware of no new and significant information regarding the environmental impacts of WCGS license renewal. The Staff has not identified any new and significant information during its independent review of the WCGS ER (WCNOC 2006), the 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 WCGS Following the Renewal Term

ISSUE—10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Section
DECOMMISSIONING	
Radiation doses	7.3.1
Waste management	7.3.2
Air quality	7.3.3
Water quality	7.3.4
Ecological resources	7.3.5
Socioeconomic impacts	7.3.7

A brief description of the Staff's review and the GEIS conclusions, as codified in Table B-1, 10 CFR Part 51, 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 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 WCGS ER (WCNOC 2006), the 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 WCGS ER (WCNOC 2006), the 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 WCGS ER (WCNOC 2006), the 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 WCGS ER (WCNOC 2006), the 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 WCGS ER (WCNOC 2006), the 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 WCGS ER (WCNOC 2006), the 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."

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

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, DC.

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

Wolf Creek Nuclear Operating Corporation (WCNOC). 2006. *Applicant's Environmental Report – Operating License Renewal Stage, Wolf Creek Generating Station. Docket Number 50-482.* Burlington, Kansas.

8.0 Environmental Impacts of Alternatives to License Renewal

This chapter examines the potential environmental impacts associated with denying the renewal of an operating license (OL) (i.e., the no-action alternative); the potential environmental impacts from electric generating sources other than Wolf Creek Generating Station (WCGS); the possibility of purchasing electric power from other sources to replace power generated by WCGS 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 WCGS. 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 the Council on Environmental Quality 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.

8.1 No-action Alternative

The NRC's regulations implementing the National Environmental Policy Act of 1969, as amended (NEPA), specify that the no-action alternative be discussed in an NRC environmental impact statement (EIS) (see 10 CFR Part 51, Subpart A, Appendix A[4]). For license renewal, the no-action alternative refers to a scenario in which the NRC would not renew the OL for WCGS and Wolf Creek Nuclear Operating Corporation (WCNOC) would then cease plant operations by the end of the current license and initiate decommissioning of the plant.

WCNOC will be required to shut down WCGS and comply with NRC decommissioning requirements in 10 CFR Part 50.82 whether or not the OL is renewed. If the WCGS OL is renewed, shutdown of the facility and decommissioning activities will not be avoided, but will be postponed for up to an additional 20 years.

The environmental impacts associated with decommissioning, following a license renewal period 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, Chapter 7 of this supplemental EIS (SEIS), and the *Final 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 will occur when the unit shuts down regardless of whether the license is renewed or not (see Table 8-1 presented at the end of Section 8.1). Plant shutdown will result in a net reduction in power production capacity. The power not generated by WCGS during the license renewal term would likely be replaced by (1) power supplied by other producers using generating technologies that may differ from that employed at WCGS, (2) demand-side management (DSM) and energy conservation, or (3) some combination of these options. The environmental impacts of these options are discussed in Section 8.2. While these options are alternatives to license renewal, they also constitute potential consequences of the no-action alternative.

8.1.1 Land Use

In Chapter 4 of this SEIS, the Staff concluded that the impacts of continued plant operation on land use would be SMALL. On-site 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. In the near term, the transmission lines associated with WCGS will likely be retained until final disposition of the dormant facility and site are ascertained. In the long term, it is possible that the transmission lines that extend from the on-site switchyard to major transmission corridors will be removed, at which point right-of-way (ROW) maintenance will cease and the ROW will revert to the conditions found in adjacent areas. Also, as a result of plant shutdown, there would be a reduction in uranium mining activity positively impacting approximately 1,165 acres (ac). Therefore, the Staff concludes that the impacts on land use from plant shutdown would be SMALL.

8.1.2 Ecology

In Chapter 4 of this SEIS, the Staff concluded that ecological impacts of continued plant operation were generally SMALL, except during times of water use conflicts. During low-flow and drought event, impacts may become SMALL to MODERATE for impingement of aquatic

[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.

organisms, and for one aquatic threatened and endangered species when WCGS uses water from the Neosho River below John Redmond Reservoir to increase water levels in Coffey County Lake. Cessation of operations will eliminate cooling water intake flow and the facility's thermal plume. Therefore; the environmental impacts to aquatic species, including threatened and endangered species, associated with cessation of operations are generally positive.

The impacts of plant closure on the terrestrial ecosystem range between negative and positive depending on final disposition of the WCGS site. Currently, there is an active management program on the property that preserves habitat and controls invasive species. Cessation of that program with plant closure would have a negative impact. The Staff concludes that overall ecological impacts from shutdown of the plant would be SMALL.

8.1.3 Water Use and Quality - Surface Water

In Chapter 4 of this SEIS the Staff concluded that impacts of continued plant operation on surface water use and quality were SMALL to MODERATE due to potential water use conflicts associated with the availability of water from the current water supply (John Redmond Reservoir) during the re-licensing period. When the plant stops operating there will be an immediate reduction in the consumptive use of water because of the elimination of the cooling water intake, which would reduce water use conflicts by reducing the need for water from John Redmond Reservoir. In addition, the shutdown of WCGS would result in a decrease in the amount of heat discharged to Coffey County Lake and the tritium concentrations in Coffey County Lake would stop increasing and gradually decay. Therefore, the Staff concludes that the impacts on surface water use and quality from plant shutdown would be SMALL.

8.1.4 Water Use and Quality - Groundwater

In Chapter 4 of this SEIS, the Staff determined that impacts of continued plant operation on groundwater use and quality were SMALL to MODERATE due to potential infiltration and migration of Coffey County Lake water that has elevated tritium concentrations. When the plant stops operating there will be a gradual reduction in the tritium concentration in the lake water and groundwater, which would eventually eliminate any potential impacts. Therefore, the Staff concludes that groundwater use and quality impacts from shutdown of the plant would be SMALL.

8.1.5 Air Quality

In Chapter 4 of this SEIS, the Staff found the impacts of continued plant operation 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 traveling to the WCGS site. The Staff concludes that the impact on air quality from shutdown of the plant would be SMALL.

8.1.6 Waste

The impacts of waste generated by continued plant operation are discussed in Chapter 6 of this SEIS. The impacts of low-level and mixed waste from plant operation are characterized as SMALL. When WCGS stops operating, the plant will stop generating high-level waste and generation of low-level and mixed waste associated with plant operation will decline. Therefore, the Staff concludes that impacts of waste generated after shutdown of the plant would be SMALL.

8.1.7 Human Health

In Chapter 4 of this SEIS, the Staff concluded that the impacts of continued plant operation on human health are SMALL. After cessation of operations, the amount of radioactive material released to the environment in gaseous and liquid forms, which are within regulatory limits, will be reduced. Therefore, the Staff concludes that the impact of shutdown of the plant on human health would also be SMALL. In addition, the variety of potential accidents at the plant will be reduced to a limited set associated with shutdown events and fuel handling. In Chapter 5 of this SEIS, the Staff concluded that impacts of accidents during operation are SMALL. Therefore, the Staff concludes that the impacts of potential accidents following shutdown of the plant would be SMALL.

8.1.8 Socioeconomics

In Chapter 4 of this SEIS, the NRC staff concluded that the socioeconomic impacts of continued plant operation would be SMALL. Should the plant shut down, there would be immediate socioeconomic impacts due to the loss of jobs (approximately 1,525 permanent and long-term contract employees) and there may also be an immediate reduction in property tax revenues for Coffey County. These impacts may, however, be partially offset as a result of projected regional economic growth. The NRC staff concludes that the socioeconomic impacts of plant shutdown would be LARGE. See Appendix J to NUREG-0586, Supplement 1 (NRC 2002), for additional discussion of the potential impacts of plant shutdown.

8.1.9 Socioeconomics (Transportation)

In Chapter 4 of this SEIS, the Staff concluded that the impacts of continued plant operation on transportation would be SMALL. Cessation of operations will be accompanied by reduced traffic in the vicinity of the plant. Most of the reduction will be associated with a reduction in plant workforce, but there will also be a reduction in shipment of maintenance materials to and from the plant. Therefore, the Staff concludes that the impacts of plant closure on transportation would be SMALL.

8.1.10 Aesthetics

In Chapter 4 of this SEIS, the Staff concluded that the aesthetic impacts of continued plant operation would be SMALL. Plant structures and other facilities are likely to remain in place until decommissioning. Upon decommissioning the number of on-site structures would be reduced. Since no net changes would occur after shut down and before decommissioning, the Staff concludes that the aesthetic impacts of plant closure would be SMALL.

8.1.11 Historic and Archaeological Resources

In Chapter 4 of this SEIS, the Staff concluded that the impacts of continued plant operation on historic and archaeological resources would be SMALL. On-site 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. The transmission lines associated with the project may ultimately be removed once the facility stops operating and, should this occur, maintenance of the transmission line ROWs will cease. Therefore, the Staff concludes that the impacts on historic and archaeological resources from plant shutdown would be SMALL.

8.1.12 Environmental Justice

In Chapter 4 of this SEIS, the Staff concluded that the environmental justice impacts 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. Although the Staff concluded that the socioeconomic impacts of plant shutdown would be LARGE, the impacts of plant shutdown are likely to be felt across the entire community and are not expected to be significantly disproportionate to minority and low-income populations. The Staff concludes that the environmental justice impacts of plant shutdown would be SMALL. See Appendix J to NUREG-0586, Supplement 1 (NRC 2002), for additional discussion of these impacts.

Table 8-1. Summary of Environmental Impacts of the No-action Alternative

Impact Category	Impact	Comment
Land Use	SMALL	Impacts are expected to be SMALL because plant shutdown is expected to result in few changes to off-site and on-site land use, and transition to alternate uses is expected over an extended timeframe.
Ecology	SMALL	SMALL to MODERATE negative impacts to aquatic ecology of Coffey County Lake will cease, while positive terrestrial impacts of conservation management in transmission corridors will also terminate. The overall impact is SMALL.

Table 8-1. (cont'd)

Impact Category	Impact	Comment
Water Use and Quality-Groundwater	SMALL	Impacts are expected to be SMALL as slow aquifer flow rates reduce possible effects from surface water intrusion.
Air Quality	SMALL	Impacts are expected to be SMALL because emissions related to plant operation and worker transportation will decrease.
Waste	SMALL	Impacts are expected to be SMALL because generation of high-level waste will stop, and generation of low-level and mixed waste will decrease.
Human Health	SMALL	Impacts are expected to be SMALL because radiological doses to workers and members of the public, which are within regulatory limits, will be reduced.
Socioeconomics	LARGE	Impacts are expected to be LARGE because of a decrease in employment and tax revenues.
Socioeconomics (Transportation)	SMALL	Impacts are expected to be SMALL because the decrease in employment would reduce traffic.
Aesthetics	SMALL	Impacts are expected to be SMALL because plant structures will remain after plant shutdown.
Historic and Archaeological Resources	SMALL	Impacts are expected to be SMALL because shutdown of the plant will not change land use.
Environmental Justice	SMALL	Impacts are expected to be SMALL because there are no significant disproportionate impacts to minority or low income populations.

8.2 Alternative Energy Sources

This section discusses the environmental impacts associated with developing alternative sources of electric power to replace power generated by WCGS. The order of alternative energy sources presented in this section does not imply which alternative would be most likely to occur or which is expected to have the least environmental impacts.

The following central generating station alternatives are considered in detail:

- Coal-fired generation at either Wolf Creek or an alternate site (Section 8.2.1)

- Natural gas-fired generation at either Wolf Creek or an alternate site (Section 8.2.2)
- Nuclear generation at either Wolf Creek or an alternate site (Section 8.2.3)

The alternative of purchasing power to replace WCGS is discussed in Section 8.2.4. Other power generation alternatives and conservation alternatives are discussed in Section 8.2.5. In section 8.2.6, the environmental impacts of a combination of generation and conservation alternatives are discussed.

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* 2007 *with Projections to* 2030, EIA projects that natural gas-fired plants will account for approximately 36 percent of new electric generating capacity between the years 2006 and 2030 (DOE/EIA 2007). This technology is designed primarily to supply peak and intermediate electric generating capacity, but combined-cycle gas-fired systems can also be used to meet baseload[b] requirements. EIA projects that coal-fired plants will account for approximately 54 percent of new capacity additions during this period. Coal-fired plants are generally used to meet baseload requirements. EIA projects that renewable energy sources - primarily wind, biomass gasification, and municipal solid waste units - will account for six percent of capacity additions. EIA's bases projections of capacity additions on the assumption that providers of new generating capacity will seek to minimize cost while meeting applicable environmental requirements. According to EIA, advanced coal-fired and advanced combined-cycle generating facilities will be approximately competitive with each other in 2015, on a total evaluated cost of production basis, while advanced coal-burning facilities will likely gain a competitive edge by 2030 (DOE/EIA 2007). EIA indicates that oil-fired plants will account for little or none of the new generating capacity additions in the United States during the 2004 to 2030 time frame because of high fuel costs (DOE/EIA 2007).

EIA also projects that about 12.5 gigawatts of new nuclear power generating capacity will be constructed prior to 2030. Of this capacity growth, 9 gigawatts are related to the availability of production tax credits under the Energy Policy Act of 2005 (EPACT2005; DOE/EIA 2007). Several site licensing applications are currently under review by the NRC and nuclear operating companies have announced their intention to submit reactor license applications beginning in late 2007. In response to industry interest in constructing new reactors, NRC has established a reactor licensing program organization to manage reactor and site licensing applications

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[b] A baseload plant normally operates to supply all or part of the minimum continuous load of a system and consequently produces electricity at an essentially constant rate. Nuclear power plants are commonly used for baseload generation; and generally run near full load.

(NRC 2001). As a result of EIA's projections, EPACT2005's incentives, and NRC's organizational capacity, a new nuclear plant alternative for replacing power generated by WCGS is considered in this SEIS and resulting impacts are presented in Section 8.2.3.

Since WCGS has a net electric output of 1,165 megawatts electric (MW[e]), the Staff evaluated the impacts of coal, natural gas, and new nuclear alternatives having comparable capabilities. WCGS is situated on a 9,818 ac site of which approximately 4,700 ac are upland areas potentially available for development. Consequently, NRC staff expects that any of the three technologies being evaluated could be developed at either Wolf Creek or at a hypothetical, unspecified alternate site. Thus, impacts of the alternative technologies are presented below for both siting options.

While the alternate site considered here need not be situated in Kansas, the availability of transmission-line capacity to deliver output from a relatively remote location to current WCGS customers could constrain siting choices. For instance, a recent DOE analysis (DOE 2006) concludes that transmission-line constraints currently exist in the Southwest Power Pool Region, which encompasses essentially all of the State of Kansas. In particular, the DOE analysis notes that a congestion pattern exists in electricity flows from Nebraska and West Kansas into Central Kansas. It is possible that these transmission congestion patterns would influence selection of an alternate site.

8.2.1 Coal-Fired Generation

The assumptions and numerical values used in Section 8.2.1 are based on the Staff's independent assessment and on information provided by WCNOC in the WCGS Environmental Report (ER) (WCNOC 2006). Where information from the WCGS ER was used, it was independently reviewed by the Staff and compared to environmental impact information in the GEIS. Impacts of a coal-fired alternative evaluated by the Staff assume that the new plant would have a gross electrical capacity of 1,234 MW(e). This differs somewhat from the approach taken in the ER since the Staff assumed that the coal-fired alternative would have the same net electrical output as WCGS, rather than a smaller output based on commercially-available gas-fired unit sizes. As in the ER, staff estimated that on-site power demand would be approximately six percent of net output. While the WCGS OL renewal period is only 20 years, the Staff considers the impact of operating a coal-fired alternative for a full 40 years, since 40 years is the expected operating life of a new coal-fired plant.

Based on Table 8-1 of the GEIS, a pulverized coal-fired facility requires approximately 1.7 ac of land per MW(e). Based on this relationship, a 2,098 ac site would be needed to replace WCGS with an equivalent capacity coal-fired facility. As the existing site includes approximately 4,700 ac of upland area, the Staff concludes there is sufficient land area at WCGS to support operations of the alternative. Thus, the coal-fired alternative is analyzed below for both an alternate site and for the WCGS site. It should be noted that several of the newer coal utilization technologies (e.g., coal-fired integrated gasification combined cycle systems) could be accommodated on smaller sites than would the conventional pulverized coal concept evaluated here.

Based on information supplied by WCNOC, the coal-fired plant would consume approximately 5.4 million tons/year (yr) of pulverized bituminous coal with an ash content of approximately 5.53 percent (WCNOC 2006). WCNOC, in the ER, assumes a heat rate[c] of 10,200 British thermal units per kilowatt-hour (BTU/kWh) and a capacity factor[d] of 0.85. After combustion, 99.9 percent of the ash would be collected and either disposed on-site or, as suggested by WCNOC, sold for beneficial reuse. In addition, approximately 112,000 tons of sludge from sulfur dioxide (SO_2) scrubbers would also be disposed on-site. These scrubbers would consume 38,000 tons of lime annually.

Coal and lime would be delivered to the generating station by rail. A rail spur would be constructed to bring coal onto the WCGS site from a nearby rail line. Output of the new coal-fired facility would be transmitted from the WCGS site via the existing transmission lines. Development of a coal-fired facility at an alternate site would necessitate construction of a new transmission line to connect that plant to the regional transmission grid.

For purposes of this section, the Staff assumes that a coal-fired plant located at an alternate site would use a closed-cycle cooling system while a coal-fired plant at the WCGS site would utilize Coffey County Lake for condenser cooling purposes.

The overall impacts of the coal-fired generating facility are discussed in the following sections and summarized in Table 8-2, at the end of this section (Section 8.2.1.1). The implications of constructing a new coal-fired plant at an alternate site will depend on the actual location and characteristics of that site; staff will generally evaluate impacts below.

8.2.1.1 Land Use

According to the GEIS, constructing a 1,234 MW(e) coal-fired generating facility would entail disruption of approximately 2,100 ac for coal storage, rail yards and waste disposal facilities. However, since a coal-fired facility at the WCGS site would use some of the existing plant features such as the switch yard, transmission lines, and administrative complex, it is likely that less than the projected 2,100 ac of land would be needed. As a result of the substantial site

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(c) Heat rate is a measure of generating station thermal efficiency. In English units, It is generally expressed in British thermal units (BTUs) per net kilowatt-hour (kWh). It is computed by dividing the total BTU content of the fuel burned for electric generation by the resulting kWh generation.

(d) The capacity factor is the ratio of electricity generated, for the period of time considered, to the energy that could have been generated at continuous full-power operation during the same period.

area that would be dedicated to and disrupted by coal-fired operations, the Staff views this alternative as having potentially MODERATE to LARGE land-use impacts.

Construction of a 1,234 gross MW(e) pulverized coal-fired alternative at an alternate site could also impact up to 2,100 ac of land (NRC 1996). Additional land would be needed to bring a rail spur onto the alternate site, as well as, for a transmission line or lines to deliver the plant's output to the nearest transmission inter-tie. Depending on the length of transmission line and rail line routing, this alternative would result in MODERATE to LARGE land-use impacts on and in the vicinity of the alternate site.

Additionally, for the coal-fired alternative, land use changes would occur at an undetermined coal mining area where approximately 41 square miles (sq mi) (26,240 ac) would be affected for mining coal and disposing of mining wastes to support a 1234 MW(e) coal-fired power plant (the GEIS estimates that approximately 34 sq mi (21,760 ac) would be disturbed for a 1,000 MW(e) coal-fired plant [NRC 1996]).

8.2.1.2 Ecology

NRC staff assumes that a coal-fired plant on the WCGS site would use Coffey County Lake for condenser cooling purposes. In Chapter 4 of this SEIS, the Staff concluded that ecological impacts of continued operation of WCGS were SMALL, except during times of water use conflicts. Since a coal-fired generating station of comparable output to WCGS would utilize approximately the same volume of cooling water as the current WCGS plant, it is expected that impacts from long term operation of an open cooling cycle coal-fired plant at WCGS will be approximately equal to those resulting from the current operation of WCGS. However, terrestrial impacts of coal-fired operations at WCGS would be significant due to the disruption of somewhat less than 2,100 ac at the WCGS site which would result in habitat loss and fragmentation. Overall the Staff considers the ecological impacts of coal-fired operations at the WCGS to be MODERATE to LARGE.

Siting a coal-fired plant at an alternate site would introduce construction and operating impacts. Ecological resources would be altered due to the need to convert roughly 2,100 ac of land to industrial use (generating facilities, coal storage, ash and scrubber sludge disposal). Even if some of the site had been previously disturbed, it is expected that impacts of developing a 2,100 ac area would include wildlife habitat loss, reduced productivity, habitat fragmentation, and reduction in on-site biological diversity.

Use of a nearby surface water resource to provide cooling tower makeup would have some impact on local aquatic resources. Construction and maintenance of a transmission line and rail spur would incrementally add to the terrestrial ecological impacts. Overall, the Staff concludes that ecological impacts at an alternate site would be MODERATE to LARGE.

8.2.1.3 Water Use and Quality

8.2.1.3.1 Surface Water

For coal-fired operations at the WCGS, water withdrawn from Coffey County Lake for condenser cooling purposes would represent the principal use of surface water. In Chapter 4 the Staff concluded that impacts of such withdrawals for cooling the existing plant would be SMALL to MODERATE. Impacts of water withdrawals to support coal-fired operations would be approximately the same as for the existing nuclear facility. The coal-fired alternative would still result in water use conflicts associated with water availability from the John Redmond Reservoir. However, with the shutdown of the current WCGS, tritium concentrations in Coffey County Lake would stop increasing and gradually decay. Discharges to surface water during coal-fired operations could result from coal pile runoff, runoff from coal ash and scrubber byproduct disposal areas, and from in-plant processes. Both the use of surface waters and discharge to surface waters would be regulated by the State of Kansas. Overall the Staff concludes that the potential impacts to surface water resources and water quality would be SMALL to MODERATE.

For coal-fired operations at an alternate site, impacts to surface waters would result from withdrawal of water for various operating needs of the facility. These operating needs would include cooling tower makeup and possibly auxiliary cooling for equipment and potable water requirements. Discharges to surface water could result from cooling tower blowdown, coal pile runoff, and runoff from coal ash and scrubber byproduct disposal areas. Both the use of surface waters and discharges to surface waters would be regulated by the state within which the coal-fired facility is located.

NRC staff expects that any new coal-fired facility would comply with requirements of the discharge permits issued for its operation. Thus discharges from the plant would be legally obligated to conform to applicable water quality standards. Overall, the Staff concludes that the potential impacts to surface water resources and water quality would be SMALL to MODERATE for a replacement coal-fired facility located at an alternate site.

8.2.1.3.2 Groundwater

Potential impacts to groundwater quality at either WCGS or an alternate site, under a coal burning scenario, may occur as a result of seepage to groundwater from coal storage areas and on-site ash and scrubber sludge disposal areas. In all cases, it is expected that a coal-fired facility would comply with a groundwater use and discharge permit issued by the State having jurisdiction over the plant. Therefore, the Staff concludes that the potential impacts to groundwater resources would be SMALL to MODERATE.

8.2.1.4 Air Quality

The air quality impacts of a pulverized coal-fired facility vary considerably from those of a comparable nuclear plant, due to emissions of sulfur oxides (SO_x), nitrogen oxides (NO_x), particulates, carbon monoxide (CO), hazardous air pollutants (e.g., mercury) and naturally occurring radioactive materials.

WCGS is located in Coffey County, Kansas which is in the Southeast Kansas Intrastate Air Quality Control Region. Coffey County has been designated an attainment area (i.e., meets the National Ambient Air Quality Standards promulgated by the U.S. Environmental Protection Agency [EPA] and found in 40 CFR Part 50) for all criteria pollutants. The EPA has various regulatory requirements for visibility protection in 40 CFR Part 51, Subpart P, including a specific requirement for review of any major stationary source in an area designated as attainment or unclassified under the Clean Air Act (CAA). These requirements would apply to both a new coal-burning plant at the WCGS site and also at an alternate site depending on the attainment status of the region within which the alternate site is situated.

A new coal-fired generating plant located in Kansas would need a Prevention of Significant Deterioration permit issued under Title 1, Part C, of the CAA. The project would also need an operating permit under Title V of the CAA. The plant would be required to comply with the New Source Performance Standards for such plants as set forth in 40 CFR Part 60 Subpart Da. Those standards establish limits for particulate matter and opacity (40 CFR 60.42a), SO_2 (40 CFR 60.43a), and NO_X (40 CFR 60.44a).

Section 169A of the CAA (42 USC 7401) establishes a national goal of preventing future and remedying existing impairment of visibility in mandatory Class I Federal areas when impairment results from man-made air pollution. EPA issued a regional haze rule on July 1, 1999 (64 FR 35714) (EPA 1999). The rule specifies 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]). If a coal-fired plant were located close to a mandatory Class I area (there are none in Kansas but Class I areas are found in adjoining states), additional air pollution control requirements could be imposed.

Air quality impacts for various pollutants are as follows:

Sulfur oxides emissions. WCNOC indicates in its ER that a coal-fired plant would use a hydrated lime-wet scrubbing system for flue gas desulfurization (WCNOC 2006). A new coal-fired power plant would be subject to the requirements in Title IV of the CAA. Title IV was enacted to reduce emissions of SO_x 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_x emissions and imposes controls on SO_x emissions through a system of marketable allowances. EPA issues one allowance for each ton of SO_x that a unit is allowed to emit.

New units do not receive allowances, but are required to have allowances to cover their SO_x emissions. Owners of new units must, therefore, acquire allowances from owners of other power plants or reduce SO_x 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_x emissions, although it might contribute to the local SO_x burden.

Regardless, SO_x emissions would be greater for the coal alternative than the OL renewal alternative. The Staff estimates that the coal-fired alternative would emit approximately 2,060 tons/yr of SO_x.

Nitrogen oxides emissions. Title IV of the CAA directed EPA to establish technology-based emission limitations for NO_x emissions (see Section 407), rather than a market-based allowance system as used for SO_x emissions. A new coal-fired power plant would be subject to the new source performance standards for such plants at 40 CFR 60.44a(d)(1). That regulation, issued September 16, 1998 (63 FR 49453 [EPA 1998]), limits the discharge of any gases that contain nitrogen oxides (expressed as nitrogen dioxide [NO_2]) to 200 nanograms per joule of gross energy output (1.6 pound/megawatt-hour [MWh]), based on a 30-day rolling average.

The Staff estimates that using the technology referenced in the WCNOC ER (low NO_x burners, overfire air and selective catalytic reduction [SCR]) the total annual NO_x emissions for a new coal-fired power plant would be approximately 1,355 tons, less than the amount allowed by Title IV of the CAA. However, even with these control technologies, NO_x emissions would be greater than for the OL renewal alternative since a nuclear power plant releases essentially no NO_x during normal operations.

Particulate emissions. The Staff estimates that the total annual stack emissions would include 150 tons of filterable total suspended particulates and 55 tons of particulate matter having an aerodynamic diameter less than or equal to 10 microns (PM_{10}) (40 CFR 50.6). As indicated in the WCGS ER, fabric filters or electrostatic precipitators would be used for particulate control. In addition to flue emissions, coal-handling equipment would introduce fugitive particulate emissions from coal piles, reclamation equipment, conveyors, and other sources. Particulate emissions would be greater under the coal alternative than the OL renewal alternative.

Fugitive dust would also be generated during the construction of a coal-fired plant and construction vehicles and motorized equipment would further contribute to construction phase air emissions. These emissions would be short-lived and intermittent and construction crews would likely mitigate some impacts through dust control measures.

Carbon monoxide emissions. The Staff estimates that the total CO emissions from coal combustion would be approximately 1,355 tons/yr. The level of CO emissions from a coal-fired plant would be substantially greater than those resulting from the OL renewal alternative.

Hazardous air pollutants including mercury. In December 2000, the EPA issued regulatory findings on emissions of hazardous air pollutants from electric utility steam-generating units (EPA 2000a). EPA determined that coal- 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, and mercury (EPA 2000a). 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 (EPA 2000a). Accordingly, on March 15, 2005, EPA issued the Clean Air Mercury Rule to permanently cap and reduce mercury emissions from coal-fired power plants (EPA 2007).

Uranium and thorium. Coal contains uranium and thorium, among other naturally occurring elements. According to Alex Gabbard of Oak Ridge National Laboratory, uranium concentrations are generally in the range of 1 to 10 parts per million (ppm) and thorium concentrations are generally about 2.5 times this level (Gabbard 1993). The U.S. Geological Survey (USGS) indicates that Western and Illinois Basin coals contain uranium and thorium at roughly equal concentrations, mostly between 1 and 4 ppm, but also indicates that some coals may contain concentrations as high as 20 ppm of both elements (USGS 1997). Gabbard indicates that a 1000 MW(e) coal-fired plant could release roughly 4.7 MT (5.2 tons) of uranium and 11.6 MT (12.8 tons) of thorium to the atmosphere (Gabbard 1993). Both USGS and Gabbard indicate that almost all of the uranium, thorium, and most decay projects remain in solid coal wastes, especially in the fine glass spheres that constitute much of the coal's fly ash. Modern emissions controls, such as those included for this coal-fires alternative, allow for recovery of greater than 99% of these solid wastes (EPA 1998), thus retaining most of the coal's radioactive elements in solid form rather than releasing it to the atmosphere. Even after concentration in coal waste, the level of radioactive elements remains relatively low – typically 10 to 100 ppm – and consistent with levels found in naturally occurring granitic rocks, shales, and phosphate rocks (USGS 1997). The levels of uranium and thorium contained in coal wastes and discharged to the environment exceed the levels of uranium and thorium released to the environment by WCGS.

Carbon dioxide. A coal-fired plant would also have unregulated carbon dioxide (CO_2) emissions that could contribute to global warming. The level of emissions from a coal-fired plant would be greater than the OL renewal alternative.

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. The appropriate characterization of air impacts from coal-fired generation would be MODERATE. The impacts would be clearly noticeable, but would not destabilize air quality.

8.2.1.5 Waste

Coal combustion generates waste in the form of ash and scrubber sludge. A 1,234 gross MW(e) coal-fired plant would generate approximately 416,000 tons of such waste annually for 40 years. If the waste were entirely disposed on-site, approximately 231 ac of land area would be required over the 40-yr plant life. The NRC staff notes that the applicant indicated that 50 percent of the ash generated by coal burning could be sold thereby reducing the on-site disposal burden. Impacts of on-site waste disposal 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 other uses.

In May 2000, the EPA issued a "Notice of Regulatory Determination on Wastes From the Combustion of Fossil Fuels (65 FR 32214 [EPA 2000b]). EPA concluded that some form of national regulation is warranted to address coal combustion waste products because: (a) the composition of these wastes could present danger to human health and the environment under certain conditions; (b) EPA has identified 11 documented cases of proven damages to human health and the environment by improper management of these wastes in landfills and surface impoundments; (c) 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 (d) 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 (RCRA). In addition to the waste streams generated during plant operations, considerable debris would be generated during construction of a coal-fired facility. The volume of construction debris would likely be greater at an alternate site than WCGS since the land at WCGS has already been disturbed and many of the necessary structures are already in place. Crews would likely dispose of land-clearing debris onsite.

For all of the preceding reasons, the Staff considers the impacts of managing waste generated by a coal facility (construction and operating phases) to be MODERATE – the impacts would be clearly noticeable, but would not destabilize any important resource.

8.2.1.6 Human Health

Coal-fired power generation introduces risks to workers from fuel and limestone mining, from fuel and lime/limestone transportation, and from disposal of coal combustion waste. In addition, there are public health risks from inhalation of stack emissions that can be widespread and difficult to quantify. The coal alternative also introduces the risk of coal-pile fires and attendant inhalation risks.

In the GEIS, the Staff stated that there could be human health impacts (cancer and emphysema) from inhalation of toxins and particulates, but it did 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 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 recently 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 burning coal are characterized as SMALL.

8.2.1.7 Socioeconomics

Construction of a coal-fired facility at either the WCGS site or an alternate site would take approximately four years. The work force would be expected to vary between 1,000 and 2,000 workers during the 4-year construction period (NRC 1996). During construction, the surrounding communities would experience demands on housing and public services that could have MODERATE impacts unless some of the work force is composed of local residents. After construction, the host community would be impacted by the loss of the construction jobs and, in the case of WCGS, a loss of 1,525 permanent and long term contract employees. However, this loss would be partially offset by the approximately 250 permanent jobs associated with the new generating station. Socioeconomic impacts would be greater at rural sites such as the

WCGS site where infrastructure and labor are not readily available to support construction activities. Also, property tax revenue would dramatically increase for communities near the alternate site and would diminish for communities near WCGS. The Staff considers the most appropriate characterization of non-transportation socioeconomic impacts of developing a new coal-fired generating facility to be MODERATE to LARGE, with the WCGS site experiencing the larger impact due to the overall loss of permanent and long-term contract employees.

During the 4-year construction period of the coal-fired unit, up to 2,000 construction workers would be working at the site. The addition of these workers would increase traffic on highways and local roads that lead to the construction site. The impact of this additional traffic could have a MODERATE impact on nearby roadways, particularly if the alternate site is in a rural area. Impacts associated with plant operating personnel commuting to work are considered SMALL.

For rail transportation of coal and lime to the alternate site, impacts are likely to range from MODERATE to LARGE. On average, approximately two, 70-car trains per day would deliver coal to the new generating station and two, 10-car trains per week would deliver lime to the facility. Overall, transportation impacts associated with coal and lime delivery would be MODERATE to LARGE.

8.2.1.8 Aesthetics

The boiler house and associated air pollution control equipment at a new coal-fired facility could be up to 200 feet (ft) in height and a typical exhaust stack would be somewhere in the range of 400 to 600 ft high. Construction of a coal-fired facility at the WCGS site would necessitate running a rail spur onto the site so that coal and lime could be shipped to the plant and coal wastes transported off-site. However, aesthetic impacts of new transmission lines would be avoided at WCGS as would the visual intrusion associated with closed-cycle cooling. At both sites, the power plant would be noticeable at night due to its 24-hour operating schedule and the need for on-site safety lighting. Aesthetic impacts of a coal-fired facility on the WCGS site are expected to be MODERATE.

At an alternate site, cooling towers would be installed with the likely technologies being either mechanical draft (approximately 75 ft tall) or natural draft type (approximately 400 ft tall). The cooling towers and associated plume would be visible from a considerable distance.
Beyond near-site aesthetic impacts, development of a new coal-fired facility at an alternate site would entail construction of a new transmission line and a new rail spur to bring coal and lime to the plant. The rail spur and transmission line could extend many miles distance off-site to tie-in points with existing rail and transmission systems. The visual intrusion of these two linear elements, particularly the transmission line, could be significant. Consequently, the overall aesthetic impacts of a new coal-fired facility at an alternate site are expected to be MODERATE to LARGE.

Coal-fired generation would introduce mechanical sources of noise that would be audible off-site. Sources contributing to total noise produced by plant operations are classified as continuous or intermittent. Continuous sources include the mechanical equipment associated with normal plant operations. Intermittent sources include the coal handling equipment, solid-waste disposal systems, outside loudspeakers, and commuting activities of plant employees. Noise impacts associated with rail delivery of coal and lime to the generating station site would be most significant for residents living along the new rail spur leading to the plant. Although passing trains significantly raise noise levels near rail corridors, the short duration of the noise tends to mitigate impacts. Thus, the impact of elevated noise levels on residents in the vicinity of the generating facility and the rail line is considered MODERATE at either the WCGS site or the alternate site.

8.2.1.9 Historic and Archaeological Resources

Before construction at either the WCGS 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 cultural resources. The studies would likely be needed for all areas of potential disturbance at the proposed plant site and along associated corridors where new construction would occur (e.g., roads, transmission corridors, rail lines, or other right-of-ways (ROWs). Since the WCGS land is already disturbed and a support infrastructure already exists, the potential impacts of new plant construction on cultural resources at the WCGS site would be expected to be less than at an alternate site. However, historic and archaeological resource impacts can generally be effectively managed and therefore, are considered SMALL for both the WCGS site and an alternate site.

8.2.1.10 Environmental Justice

Although the Staff concluded that the socioeconomic impacts of construction of a coal-fire generating plant at either the WCGS site or an alternate site would be MODERATE to LARGE, no environmental pathways or locations have been identified that would result in disproportionately high and adverse environmental impacts on minority and low-income populations if a replacement coal-fired plant were built at the WCGS site. Thus, impacts of the coal-fired alternative at the WCGS site would be SMALL. Impacts of constructing a coal-fired facility at an alternate site would depend upon the site chosen and the nearby population distribution. Therefore, it is expected that impacts at an alternate site could be SMALL to LARGE.

Table 8-2. Summary of Environmental Impacts of Coal-Fired Generation at the WCGS Site (Once-Through-Cooling) and at an Alternate Site (Closed-Cycle Cooling)

Impact Category	WCGS Site - Open Cycle Cooling		Alternate Site - Cooling Towers	
	Impact	Comments	Impact	Comments
Land Use	MODERATE to LARGE	Less than 2,100 ac for plant, offices, coal handling, waste disposal and rail access.	MODERATE to LARGE	Approximately 2,100 ac for plant, offices, coal handling, waste disposal and rail access, including the additional land requirements for transmission lines and cooling towers.
Ecology	MODERATE to LARGE	Similar cooling water use as current operations; additional terrestrial impacts would occur due to habitat loss and fragmentation associated with new construction.	MODERATE to LARGE	Significantly reduced cooling water requirements but impacts due to habitat loss and fragmentation associated with new construction.
Water Use and Quality-Surface Water	SMALL to MODERATE	Potential discharges from coal storage and waste disposal.	SMALL to MODERATE	Uses significantly less cooling water than once through cooling system; potential discharges from coal storage and waste disposal areas.
Water Use and Quality-Groundwater	SMALL to MODERATE	Potential discharges from coal handling and waste disposal areas.	SMALL to MODERATE	Same as for WCGS site.

Table 8-2. (cont'd)

Impact Category	WCGS Site - Open Cycle Cooling		Alternate Site - Cooling Towers	
	Impact	Comments	Impact	Comments
Air Quality	MODERATE	• Sulfur oxides (2,060 tons/yr) • Nitrogen oxides (1,355 tons/yr) • Carbon monoxide (1,355 tons/yr) • Particulates TSP (150 tons/yr) PM_{10} (55 tons/yr) Small amounts of mercury and other hazardous air pollutants and naturally occurring radioactive materials - mainly uranium and thorium.	MODERATE	Same emissions as would occur at the WCGS site.
Waste	MODERATE	Annually 412,000 tons of ash and scrubber waste produced; half of ash can be recycled. Total waste disposal area of approximately 231 ac.	MODERATE	Comparable waste production to that at WCGS site.
Human Health	SMALL	Impacts uncertain but considered SMALL because the plant will have to comply with health-based emissions standards.	SMALL	Same as at the WCGS site.

Table 8-2. (cont'd)

Impact Category	WCGS Site - Open Cycle Cooling: Impact	WCGS Site - Open Cycle Cooling: Comments	Alternate Site - Cooling Towers: Impact	Alternate Site - Cooling Towers: Comments
Socioeconomics	MODERATE to LARGE	Approximately 1,000 to 2,000 construction work force. Loss of 1,525 current employees only partially replaced by 250 new employees. Loss of WCGS tax base would be partially replaced by new facility.	MODERATE to LARGE	Approximately 1,000 to 2,000 construction work force reduced to 250 permanent employees upon startup of new facility. However, all 1,525 employees at WCGS would loose their jobs and majority of Coffey County tax base would be lost.
Socioeconomics (Transportation)	MODERATE to LARGE	Transportation impacts associated with construction workers and shipments of coal and lime to plant site.	MODERATE to LARGE	Same as for WCGS site.
Aesthetics	MODERATE	Impacts due to boiler house, stack and on-site coal handling operations.	MODERATE to LARGE	Cooling towers, cooling tower plume and transmission lines add to impacts.
Environmental Justice	SMALL	Impacts on minority and low-income communities should be similar to those experienced by the	SMALL to LARGE	Impacts depend on population distribution at the site.

8.2.2 Natural Gas-Fired Generation

In this section, the Staff examined the environmental impacts of constructing a natural gas-fired alternative for both the WCGS site and an alternate site. The Staff assumed that a gas-fired plant at the WCGS site would use Coffey County Lake for cooling while a gas-fired plant located at an alternate site would utilize closed cycle cooling.

The assumptions and numerical values used in Section 8.2.2 are based on the Staff's independent assessment and on information provided by WCNOC in the WCGS ER (WCNOC 2006). Where staff used information from the ER, they independently reviewed and compared it to environmental impact information in the GEIS. Impacts of the gas-fired alternative evaluated by the Staff assume that the new plant would have a gross electrical capacity of 1,212 MW(e); this is larger than the capacity assumption WCNOC made in the ER.

WCNOC assumed that a replacement natural gas-fired plant would use combined-cycle technology (WCNOC 2006). The natural gas-fired facility described by WCNOC in the ER is a combined-cycle plant; it would include a gas turbine followed by a heat-recovery boiler, which uses waste heat from gas-fired turbines to generate steam. The steam would then turn a steam turbine-generator. Furthermore, WCNOC uses two standard-sized gas-fired combined-cycle units with net capacities of 585 MW(e) and heat rates of 5,940 BTU/kWh in their analysis. The Staff considers the combined-cycle technology to be a reasonable choice for the gas-fired replacement system but that the capacity selected by WCNOC underestimates impacts of this technology. Consequently, the Staff has evaluated impacts of a hypothetical 1,212 gross MW(e) gas-fired combined-cycle facility (consisting of multiple units) which would essentially fully replace the capacity of the WCGS OL. Staff estimated the gross capacity of the gas-fired facility based on the assumption that 4 percent of the plant's output would be consumed on-site.

The Staff has assumed that approximately 75 ac would be needed to construct a new gas-fired complex at the WCGS site and approximately 100 ac at an alternate site. This would include land for the power block and associated infrastructure. Since the WCGS site does not have a natural gas supply that can support power plant operations, it will be necessary to construct a tie-in to the nearest gas pipeline. WCNOC states in the ER that approximately 10 miles of new pipeline would be needed to connect WCGS to the nearest transmission line and that 60 ac of land would be disrupted for pipeline construction.

Some of the existing infrastructure at WCGS can be used to serve operations of the gas-fired alternative. Most significantly this would include the transmission lines that currently transmit electric power from the plant to the regional electric grid. At an alternate site, it is almost certain that a new transmission line would need to be constructed to deliver the plant's output.

In performing the impact analysis in Section 8.2.2 the Staff reviewed information provided by WCNOC, environmental information in the GEIS, and data available in the technical literature. Although the OL renewal period is only 20 years, the Staff considered the impact of operating the natural gas-fired alternative for 40 years. This assumption was used to maintain consistency between the alternative evaluations, even though a combined-cycle plant may have a shorter life expectancy.

The overall impacts of a natural gas-fired system located at either the WCGS site or an alternate site are discussed below and summarized in Table 8-3, at the end of this section (Section 8.2.2.1).

8.2.2.1 Land Use

Should a gas-fired generating facility be built at WCGS, existing facilities and infrastructure would be used to the extent practicable, limiting the amount of new construction that would be required. Specifically, the Staff assumed that the natural gas-fired replacement plant would use the switchyard, offices, and transmission lines from the existing WCGS. Some of the land that would be used has been previously disturbed. At WCGS, the Staff assumed that approximately 75 ac would be needed for the plant and associated infrastructure. There would be an additional temporary impact of up to approximately 60 ac to bring natural gas to the WCGS site from the nearest gas transmission line.

The Staff estimates that approximately 100 ac would be needed to construct a gas-fired complex, using closed cycle cooling, at an alternate site. It is likely that a gas-fired alternative at an alternate site would require additional infrastructure, including high voltage electric transmission lines and a natural gas pipeline. Constructing a gas pipeline would result in some temporary off-site land disturbance.

Regardless of where the gas-fired replacement plant is built, additional offsite land would be required for natural gas wells and collection stations. In the GEIS, the Staff estimated that 3,600 ac would be needed for gas wells and collection stations to support a 1,000 MW(e) plant or about 4,300 ac for a 1,212 MW(e) facility (NRC 1996). Overall, land-use impacts of the gas-fired alternative are considered to be MODERATE at the WCGS site and MODERATE to LARGE at an alternate site.

8.2.2.2 Ecology

At the WCGS site, a gas-fired alternative would continue to use of Coffey County Lake for cooling purposes. The gas-fired alternative is more thermally efficient than the existing WCGS, and thus requires less cooling water. The Staff concludes that water use may not decrease sufficiently to eliminate water use conflicts during low-flow conditions in the Neosho River, so aquatic ecological impacts of a gas-fired alternative would be SMALL to MODERATE. With regard to the terrestrial ecological impacts of building a gas-fired alternative, additional land clearing would be necessary to develop the gas-fired complex. This could entail some loss of natural habitat with a corresponding impact to terrestrial species. Also, bringing a natural gas pipeline onto the WCGS site may result in some further disturbance to undeveloped areas but it is expected that most of the pipeline construction would be in or along roadways and, therefore, would not be expected to impact terrestrial species. Overall, the ecological impacts of developing a gas-fired facility at the WCGS site are considered SMALL to MODERATE.

Ecological impacts at an alternate site would depend on the nature of the land converted to industrial usage and the length of gas and electric transmission lines that would be constructed to support plant operations. Construction of transmission lines would be expected to have temporary ecological impacts, with continued impacts from ROW maintenance. Ecological impacts at the plant site and along transmission corridors could include impacts to threatened and endangered species, wildlife habitat loss and reduced productivity, habitat fragmentation, and a local reduction in biological diversity.

Some aquatic ecological impacts would also be expected due to withdrawal of surface water for cooling tower makeup and for other in-plant needs. Overall, the ecological impacts of developing a gas-fired facility at an alternate site are considered MODERATE.

8.2.2.3 Water Use and Quality

8.2.2.3.1 Surface Water

Since the natural gas-fired facility described by WCNOC in the ER is a combined-cycle plant, the net result is improved plant efficiency and a significant overall reduction in the amount of waste heat that would be discharged to the environment in comparison to an equivalent capacity nuclear plant. Consequently, the gas-fired alternative would require considerably less cooling water than would the current WCGS. The gas-fired alternative may still result in water use conflicts associated with water availability from the John Redmond Reservoir and the Neosho River. In addition to cooling water discharges, a number of process waste streams could be discharged from the gas-fired complex. However, with the shutdown of the current WCGS, tritium concentrations in Coffey County Lake would stop increasing and gradually decay. All discharges would be regulated through a State-issued National Pollutant Discharge Elimination System (NPDES) permit. Finally, some erosion and sedimentation would probably occur during construction of the gas-fired plant (NRC 1996). Overall, the surface water use and quality impacts of implementing the natural gas-fired alternative at the WCGS site are considered SMALL to MODERATE since water use conflicts associated with water availability from the John Redmond Reservoir and the Neosho River could still occur.

The Staff assumed that a natural gas-fired plant at an alternate site would employ a closed cycle cooling system. The Staff assumed that surface water would be used for cooling tower makeup and that the withdrawal rate of makeup water would be relatively small compared to an open-cycle system. The impact on surface water would depend on the volume of water needed for makeup and the characteristics of the receiving water body. Discharge to any surface water body would be regulated by the State of Kansas through the State-issued discharge permit. Overall the Staff expects that impacts to surface waters of constructing and operating a gas-fired complex at an alternate site would be SMALL.

8.2.2.3.2 Groundwater

In Chapter 4 of this SEIS, the Staff concluded that impacts of the use of cooling and service water on the availability of groundwater in the local area are SMALL. We would expect that a comparable capacity gas-fired alternative would also not use groundwater and, consequently, impacts to groundwater would be expected to be SMALL for a gas-fired replacement using once through cooling.

At an alternate site, groundwater could be used for general plant purposes including as a potable water supply. Groundwater withdrawals would require a permit from either the State or a local permitting authority and impacts on groundwater would depend on the volume required and the characteristics of the water source. However, the Staff considers the likely impacts to groundwater of a gas-fired facility operating at an alternate site to be SMALL, provided the plant does not use groundwater for cooling tower makeup.

8.2.2.4 Air Quality

Natural gas is a relatively clean-burning fuel. A new gas-fired generating plant located at either the WCGS or an alternate site would likely need a Prevention of Significant Deterioration permit and an operating permit under the CAA. A new combined-cycle natural gas power plant would also be subject to the new source performance standards for such units at 40 CFR Part 60, Subparts Da and GG. These regulations establish emission limits for particulates, opacity, SO_x, and NO_x.

In addition, EPA has various regulatory requirements for visibility protection in 40 CFR 51, Subpart P, including a specific requirement for review of any new major stationary source in an area designated attainment or unclassified under the CAA. Coffey County is a CAA attainment area and, therefore, a gas-fired replacement at the WCGS site would be subject to review under 40 CFR 51, Subpart P.

Section 169A of the CAA establishes a national goal of preventing future and remedying existing impairments of visibility in mandatory Class I Federal areas when impairment results from man-made air pollution. EPA issued a new regional haze rule in on July 1, 1999 (64 FR 35714 [EPA 1999]). The rule specifies 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]). If a natural gas-fired plant were located close to a mandatory Class I area, additional air pollution control requirements could be imposed. There are no designated Class I areas in Kansas; however, EPA's regional haze rule could apply to a gas-fired complex at an alternate site.

The Staff projects the following emissions for the natural gas-fired alternative:

SO_x – 91 tons/yr
No_x – 292 tons/yr
CO – 61 tons/yr
PM_{10} – 51 tons/yr

A natural gas-fired plant would also have unregulated CO_2 emissions that could contribute to global warming (NRC 1996).

In December 2000, EPA issued regulatory findings on emissions of hazardous air pollutants from electric utility steam-generating units (EPA 2000b). Natural gas-fired power plants were found by EPA to emit arsenic, formaldehyde, and nickel (EPA 2000a). Unlike coal and oil-fired plants, EPA did not determine that emissions of hazardous air pollutants from natural gas-fired power plants should be regulated under Section 112 of the CAA.

Construction activities for a gas-fired complex at either the WCGS site or an alternate site would result in temporary fugitive dust emissions. Fugitive dust emissions would also occur along the construction route for a new gas pipeline. These emissions would be short lived and intermittent and construction crews would likely mitigate some impacts through dust control measures. In addition, exhaust emissions would be released from vehicles and motorized equipment used during the construction process.

The overall air quality impact of a new natural gas-fired complex sited at either the WCGS site or an alternate site is considered MODERATE.

8.2.2.5 Waste

There will be spent SCR catalyst from NO_x emissions control and small amounts of solid-waste products (i.e., ash) from burning natural gas. In the GEIS, the Staff concluded that waste generation from gas-fired technology would be minimal (NRC 1996). Gas-firing results in very few combustion by-products because of the clean nature of the fuel. Waste-generation impacts would be so minor that they would not noticeably alter any important resource attribute. Construction-related debris would be generated during construction activities. Overall, impacts associated with waste generation at either the WCGS site or an alternate site would be SMALL for a natural gas-fired facility.

8.2.2.6 Human Health

In Table 8-2 of the GEIS, the Staff identifies cancer and emphysema as potential health risks from gas-fired plants (NRC 1996). The risk may be attributable to NO_x emissions that contribute to ozone formation, which in turn contribute to health risks. NO_x emissions from any gas-fired plant would be regulated by a State air quality control agency, subject to New Source Performance Standards (NSPS), as well as Title IV, Section 407, of the CAA. Human health effects from gas-fired operations are not expected to be detectable and, therefore, the impacts on human health of the natural gas-fired alternative sited at either the WCGS site or an alternate site are considered SMALL.

8.2.2.7 Socioeconomics

Construction of a natural gas-fired plant would take approximately 3 years. Peak employment would be approximately 600 workers (NRC 1996). At the WCGS site the Staff assumed that construction would take place while WCGS continues operation and would be completed by the time the nuclear plant permanently ceases operations. During construction, communities surrounding either the WCGS or the alternate site would experience demands on housing and public services that could have MODERATE impacts. After construction, nearby communities could be impacted by the loss of jobs. The current WCGS work force (1,525 permanent and long-term contract employees) would decline through a decommissioning period to a minimal maintenance staff. The gas-fired plant would introduce a replacement tax base at WCGS or a new tax based at an alternate site and approximately 200 new permanent jobs.

In the GEIS (NRC 1996), the Staff concluded that socioeconomic impacts from constructing a natural gas-fired plant would not be very noticeable and that the small operational work force would have the lowest socioeconomic impacts of any nonrenewable technology. Compared to the coal-fired and nuclear alternatives, the smaller size of the construction work force, the shorter construction time frame, and the relatively small operations work force would mitigate socioeconomic impacts of a new plant. For these reasons, socioeconomic impacts associated with construction and operation of a natural gas-fired power plant at an alternate site would be SMALL to MODERATE, depending on the characteristics of the population near the site. However, the loss of a net 1,525 permanent jobs at the WCGS site could have a LARGE socioeconomic impact in the immediate WCGS locale.

Transportation impacts associated with construction and operating personnel commuting to the plant site would depend on the population density and transportation infrastructure in the vicinity of the site. Overall the Staff expects that transportation impacts would be SMALL at either the WCGS site or an alternate site.

8.2.2.8 Aesthetics

The gas-fired facility's turbine building (approximately 100 ft tall) and exhaust stacks (approximately 250 ft tall) would be visible during daylight hours from adjacent properties, though they are not significantly taller than the visible structures of the existing facilities (e.g., the domed reactor containment building is approximately 234 ft tall and the turbine building is approximately 150 ft tall). For the closed cycle cooling option at an alternate site, the cooling tower and its evaporative plume can be expected to be visible from the nearby communities. Noise and light from the plant would be detectable in the immediate plant vicinity. Overall, the aesthetic impacts associated with the gas-fired facility at WCGS are categorized as SMALL. At an alternate site the cooling tower, the tower plume and the new transmission line would be expect to result in MODERATE to LARGE aesthetic impacts. However, the utilization of mechanical draft cooling towers could reduce the aesthetic impacts.

8.2.2.9 Historic and Archaeological Resources

Before construction begins studies would likely be needed to identify, evaluate, and address mitigation of the potential impacts of the new plant on cultural resources. The studies would likely be needed for all areas of potential disturbance at the proposed plant site and along associated corridors where new construction would occur. Because the gas-fired alternative occupies relatively little land, impacts to cultural resources can be effectively managed under current laws and regulations and are likely to be SMALL at either the WCGS site or an alternate site.

8.2.2.10 Environmental Justice

No environmental pathways or locations have been identified that would result in disproportionately high and adverse environmental impacts on minority and low-income populations if a replacement natural gas-fired plant were built at either the WCGS site or an alternate site. Some impacts on housing availability and prices during construction might occur, but it is not expected this would disproportionately affect minority and low-income populations. Closure of WCGS would result in a decrease in employment of approximately 1,325 permanent jobs if a gas-fired alternative were located at the WCGS site. If the plant were located elsewhere, surrounding communities would lose 1,525 jobs. Although the Staff concluded that the socioeconomic impacts of construction of a gas-fired generating plant at either the WCGS site or an alternate site would be MODERATE to LARGE, no environmental pathways or locations have been identified that would result in disproportionately high and adverse environmental impacts on minority and low-income populations. Therefore, environmental justice impacts of terminating nuclear operations at WCGS and replacing its output with a gas-fired facility at the same site are expected to be SMALL. Impacts at an alternate site would depend on the site chosen and the nearby population distribution, but are likely to be SMALL to MODERATE.

Table 8-3. Summary of Environmental Impacts of Natural Gas-Fired Generation at WCGS Site (Once-Through-Cooling) and at an Alternate Site (Closed-Cycle Cooling)

Impact Category	WCGS Site Impact	WCGS Site Comments	Alternate Site Impact	Alternate Site Comments
Land Use	MODERATE	75 ac for powerblock, offices, roads, parking areas. Additional temporary impact of approximately 60 ac for construction of underground gas pipeline.	MODERATE to LARGE	100 ac for plant and additional area for gas and electric transmission lines.
Ecology	SMALL to MODERATE	Reduced water withdrawals from Coffey County Lake.	MODERATE	Construction and long-term impacts of plant and transmission lines.
Water Use and Quality-Surface Water	SMALL to MODERATE	Uses less cooling water than comparable nuclear plant, but could still result in some water use conflicts.	SMALL	Cooling towers use relatively little water; impacts depend on water volume needed and water body characteristics.
Water Use and Quality-Groundwater	SMALL	Plant would likely not use groundwater.	SMALL	Impacts depend on volume withdrawn; groundwater not likely to be used as cooling water.
Air Quality	MODERATE	• Sulfur oxides (91 tons/yr) • Nitrogen oxides (292 tons/yr) • Carbon monoxide (61 tons/yr) • PM_{10} particulates (51 tons/yr) Some hazardous air pollutants.	MODERATE	Same emissions as for WCGS site.

Table 8-3. (cont'd)

Impact Category	WCGS Site Impact	WCGS Site Comments	Alternate Site Impact	Alternate Site Comments
Waste	SMALL	Small amount of ash produced.	SMALL	Same as at WCGS site.
Human Health	SMALL	Impacts considered to be minor.	SMALL	Same as at WCGS site.
Socioeconomics	MODERATE to LARGE	Impacts of 600 construction jobs at peak; reduction in permanent work force by 1,325; partial tax base preserved.	MODERATE to LARGE	Impacts of 600 construction jobs and 200 new permanent jobs; enhanced tax base. However, all 1,525 employees at WCGS would loose their jobs and the majority of Coffey County tax base would be lost.
Socioeconomics (Transportation)	SMALL	Transportation impacts associated with construction.	SMALL	Same as at WCGS site.
Aesthetics	SMALL	Plant structures comparable in visibility to existing WCGS structures.	MODERATE to LARGE	Cooling towers, evaporative plume and transmission lines add to plant visual intrusion.
Historic and Archeological Resources	SMALL	Potential impacts can likely be effectively managed.	SMALL	Same as at WCGS site.
Environmental Justice	SMALL	Impacts on minority and low-income communities should be similar to those experienced by the population as a whole.	SMALL to MODERATE	Impacts would depend on the site chosen and the nearby population distribution.

8.2.3 Nuclear Power Generation

Since 1997, the NRC has certified four new standard designs for nuclear power plants under 10 CFR Part 52, Subpart B. These designs are the 1,300 MW(e) U.S. Advanced Boiling Water

Reactor (10 CFR 52, Appendix A), the 1,300 MW(e) System 80+ Design (10 CFR 52, Appendix B), the 600 MW(e) AP600 Design (10 CFR 52, Appendix C) and the 1,000 MW(e) AP1000 Design (10 CFR Part 52, Appendix I). All of these plants are light-water reactors. Although NRC has yet to receive a complete Combined License (COL) application, the submission of one-half of the COL application and two Early Site Permits (ESPs) indicates strong interest in the possibility of licensing new nuclear power plants. In addition, recent escalation in prices of natural gas and oil has made new nuclear power plant construction more attractive from a cost standpoint.

As a result of the increased interest in new nuclear facilities, construction of a nuclear power plant at an alternate site is considered in this section. The Staff assumed that the new nuclear plant would have a 40-year lifetime and would operate with a closed cycle cooling system.

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, sited at an alternate site. The impacts shown in Table S-3 are for a 1,000 MW(e) reactor and would need to be adjusted to reflect impacts of a new nuclear facility, to replace the output of WCGS, with a net capacity of 1,165 MW(e). The environmental impacts associated with transporting fuel and waste to and from a light-water cooled nuclear power reactor are summarized in Table S-4 of 10 CFR 51.52. The summary of NRC's findings on NEPA issues for license renewal of nuclear power plants in Table B-1 of 10 CFR 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 is presented in Section 8.2.3.1.

8.2.3.1 Land Use

Land-use impacts at an alternate site would be significant since the new nuclear plant, with its associated closed-cycle cooling system, would entail development on approximately 500-1,000 ac of land area. In addition, property would be needed to construct a transmission line form the site to the nearest tie-in with the regional transmission system. A rail spur could also be constructed to deliver materials and equipment during construction. A nuclear alternative would require approximately the same amount of land for uranium mining as currently required for WCGS. Development of a new nuclear project at an alternate site could result in MODERATE to LARGE land-use impacts.

8.2.3.2 Ecology

Ecological impacts would result from both construction and operation of the replacement nuclear facility. The terrestrial ecological impacts could include wildlife habitat loss, reduced productivity, habitat fragmentation and a local reduction in biological diversity. Construction of a transmission line would further exacerbate terrestrial impacts but would be highly dependent on the length of line and the specific habitat conditions that occur along the transmission corridor. Drawing on local surface water resources for cooling tower makeup could have some adverse aquatic resource impacts. Additional impacts could occur from the discharge of cooling tower blow-down.

Overall, ecological impacts are expected to range from MODERATE to LARGE with the principal issue being loss of habitat due to on-site and off-site construction.

8.2.3.3 Water Use and Quality

8.2.3.3.1 Surface Water

Construction and operation of a nuclear facility could potentially impact water use and quality in several ways. Construction of the plant would entail disruption to undeveloped portions of the alternate site resulting in potential soil erosion and sediment discharge to local surface waters. In addition, construction activities involve substantial use of diesel-driven equipment and lubricants and cleaning agents. While construction activities are regulated under various Federal and State stormwater management programs, some potential will exist for release of construction related contaminants to nearby surface water bodies.

During operation, the facility's cooling tower(s) would draw on local surface waters for makeup of evaporative losses. In addition, various plant systems may use surface waters for supplemental cooling and plant potable water needs could also be derived from a surface water body. Discharges to surface waters could include cooling tower blowdown and treated process and sanitary wastes.

All withdrawals from and discharges to surface waters would be regulated by Federal and State programs designed to protect water quality. While actual impacts would be site dependent, the Staff concludes that impacts to water quality resulting from construction and operation of a new nuclear facility at an alternate site would be SMALL.

8.2.3.3.2 Groundwater

It is possible that groundwater could be used as a source of service and/or potable water by a nuclear plant on an alternate site. In addition, it would be possible to discharge process water and sanitary wastes to groundwater after those waste streams receive an appropriate level of treatment. Withdrawals from and discharges to groundwater are regulated by Federal and State environmental agencies under programs intended to protect such resources. Thus, the impacts of an operating nuclear plant on groundwater resources at an alternate site are expected to be SMALL.

8.2.3.4 Air Quality

Construction of a new nuclear plant 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 and other intermittent sources. Overall, air emissions and associated impacts resulting from operation of a replacement nuclear facility at an alternate site are considered SMALL.

8.2.3.5 Waste

Siting a replacement nuclear plant at an alternate site would not alter radwaste generation rates currently occurring at WCGS. The waste impacts associated with operation of a nuclear power plant are set out in Table B-1 of 10 CFR 51, Subpart A, Appendix B. However, considerable debris would be generated during construction of the new facility, resulting in the need to dispose of the material at an appropriate off-site disposal facility. Overall, waste impacts of constructing and operating a nuclear facility are considered SMALL.

8.2.3.6 Human Health

Human health impacts for an operating nuclear power plant are set out in 10 CFR 51 Subpart A, Appendix B, Table B-1. Overall, the Staff concludes that human health impacts would be SMALL.

8.2.3.7 Socioeconomics

The construction period peak work force associated with construction of a new nuclear power plant is currently unquantified (NRC 1996). In the absence of quantitative data, the Staff assumed a construction period of 6 years and a peak work force of up to 2,500 for a 1,165 net MW(e) nuclear facility at an alternate site.

The communities around the alternate site would have to absorb the impacts of the large, temporary construction work force and a permanent and long-term contract work force of approximately 1,525 (same employment level as at WCGS). In the GEIS (NRC 1996), the Staff indicated that socioeconomic impacts of the temporary and permanent work forces would be larger at a rural site than at an urban site because more of the work force would need to move into the area. Furthermore, while employment levels would increase for communities adjacent to the alternate site, approximately 1,525 jobs would be lost over time within communities near the WCGS site. Also, property taxes would dramatically increase for communities near the alternate site and would significantly diminish for communities near WCGS. Consequently, the Staff concludes that socioeconomic impacts of constructing and operating a replacement nuclear facility at an alternate site would range from MODERATE to LARGE, with the WCGS site experiencing the larger impact due to the overall loss of permanent and long-term contract employees.

Transportation-related impacts associated with construction workers commuting to the alternate site would be site dependent but are expected to be MODERATE. Transportation impacts related to employees and contractors commuting to the operating nuclear facility would be also site dependent but typically are characterized as SMALL to MODERATE.

8.2.3.8 Aesthetics

Developing an alternate site for a 1,165 net MW(e) nuclear facility would result in aesthetic impacts at that site from the new structures associated with the plant including buildings, cooling towers, and the plume associated with the cooling towers. There would also be a potentially significant aesthetic impact from construction of a new transmission line to connect the generating station to the regional transmission system.

Noise and light related to construction and plant operations would be detectable off-site. However, under some circumstances noise and light impacts could be mitigated depending on local topography and the distances to nearby residences and other sensitive land uses. Overall, aesthetic impacts associated with locating a new nuclear facility at an alternate site can be categorized as MODERATE to LARGE. The greatest contributors to aesthetic impacts would be the cooling tower structures, the discharged vapor plume and the new transmission towers.

8.2.3.9 Historic and Archaeological Resources

A cultural resource inventory would be needed before construction of a replacement nuclear plant could begin at an alternate site if the site had 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 plant construction. Impacts to cultural resources can be effectively managed under current law, and are likely to be SMALL.

8.2.3.10 Environmental Justice

Whether or not there would be disproportionate impacts to minority and low income populations resulting from construction and operation of a nuclear facility at an alternate site would depend upon the site chosen and the nearby population distribution. Under a wide range of site circumstances, it is expected that the impacts would range from SMALL to MODERATE.

Table 8-4. Summary of Environmental Impacts of New Nuclear Power Generation at an Alternate Site Using Closed-Cycle Cooling

Impact Category	Alternate Site Impact	Comments
Land Use	MODERATE to LARGE	Approximately 500-1,000 ac required on-site.
Ecology	MODERATE to LARGE	Impacts depend on location and ecology of site; the principal issue is loss of habitat due to on-site and off-site construction.
Water Use and Quality-Surface water	SMALL	Impacts are site dependent but surface water use is a regulated activity.
Water Use and Quality-Groundwater	SMALL	Impacts are site dependent but groundwater use is a regulated activity.
Air Quality	SMALL	Emissions from new nuclear plant expected to be minor.
Waste	SMALL	Considerable debris would be generated during construction, and would be disposed at an appropriate off-site facility.
Human Health	SMALL	Human health impacts for nuclear facility considered small.
Socioeconomics	LARGE	Impacts at the alternate site due to construction and permanent work force and long-term increased tax revenues; at WCGS the impacts would be LARGE due to a reduction in tax revenues and decrease in employment levels.
Socioeconomics (Transportation)	MODERATE	Impacts due to construction workers and permanent staff commuting to the alternate site.
Aesthetics	MODERATE to LARGE	Impacts expected from cooling towers, vapor plume, and transmission lines.
Historic and Archeological Resources	SMALL	Any potential impacts can likely be effectively managed.
Environmental Justice	SMALL to MODERATE	Impacts will vary depending on population distribution near the alternate site.

8.2.4 Purchased Electrical Power

If available, purchased power could potentially obviate the need to renew the WCGS OL. If the OL were not renewed, replacing the lost 1,165 MW(e) of capacity with purchased power without building new generating facilities is not a likely scenario. It is not likely because demand in the

Southwest Power Pool Region, in which WCGS is located, is projected to continue to increase by 1.3 percent per year for the period 2006 thru 2015 (NERC 2006).

If power to replace WCGS capacity were to be purchased from sources within the United States, the generating technology would likely be one of those described in this SEIS and in the GEIS (probably coal, natural gas, nuclear and some contribution from wind projects). The description of the environmental impacts of other technologies in Chapter 8 of the GEIS is representative of the impacts of purchasing electrical power from a domestic source. Thus, the environmental impacts of purchased power would still occur, but those impacts would occur elsewhere in the region or nation.

Beyond domestic sources of purchased power, imported power from Canada or Mexico is unlikely to be available for replacement of WCGS capacity. In Canada, approximately 25 percent of the energy consumed within the country comes from renewable energy sources, principally hydropower (DOE/EIA 2005). Canada's output of electricity from nuclear power is projected to remain more or less flat between 2010 (114 billion kWh) and 2025 (112 billion kWh) (DOE/EIA 2005). EIA projects that total gross U.S. imports of electricity from Canada and Mexico will decrease from 42.3 billion kWh in 2010 to 29.4 billion kWh in year 2020 and to 26.9 billion kWh in year 2030 (DOE/EIA 2007). Over the same period there is essentially no firm power projected to be exported from the U.S. to either Canada or Mexico. Consequently, it is unlikely that electricity imported from Canada or Mexico would be able to replace the capacity lost at WCGS if the OL is not renewed.

8.2.5 Other Alternatives

Other generation technologies considered by NRC are discussed in the following paragraphs.

8.2.5.1 Oil-Fired Generation

The EIA projects that oil-fired plants will account for very little of the new generating capacity in the United States during the 2004 to 2030 time frame because of continually rising fuel costs (DOE/EIA 2007). Thus, NRC staff has not considered an oil-fired replacement for the capacity that would be lost if WCGS ceases operation.

8.2.5.2 Wind Power

Wind power, by itself, is not suitable for large base load capacity. As discussed in Section 8.3.1 of the GEIS, wind has a high degree of intermittency, and average annual capacity factors for wind plants are relatively low (on the order of 30 percent). Wind power, in conjunction with energy storage mechanisms, might serve as a means of providing base load power. However, current energy storage technologies are too expensive for wind power to serve as a large base load generator.

Most regions of the United States have been classified according to available wind power. Wind power classifications are based on typical wind speeds at 50 meters (m; approximately 164 ft) elevation above local grade. These classifications range from Class 1 (the lowest available wind power) to Class 7 (the highest). Regions classified as being in wind power Class 4 or higher can typically be useful for siting large wind power turbines. Given advances in technology, a number of locations in Class 3 areas may be suitable for utility-scale wind development. Taller wind turbines can also take advantage of some Class 3 locations with high wind shear.

The State of Kansas has wind resources consistent with utility-scale production. The state's wind resources are ranked among the top three in the nation (U.S. Public Interest Research Group 2003). Large areas with outstanding potential for siting wind energy farms can also be found throughout central portions of the State (KCC 2004). In Kansas, as of May 2007, there were five operating wind farms with a total name plate capacity of 363 MW(e) and there were 24 projects in planning with a total capacity of 3,234 MW(e) (KEIN 2007).

Construction of a wind energy farm with a name plate rating of 1,165 MW(e) would require a land area of at least 25 sq mi. (16,000 ac). Turbine footprints would require a small portion of this land, while the remaining area could be used for farming or ranchland. More significantly, though, wind generators provide output when meteorological conditions are appropriate and may operate with capacity factors of only 30 percent, or even less. As stated by the Southwest Power Pool in their regional self-assessment (NERC 2006), wind farms can only be expected to contribute between zero and 20 percent of name plate rating during summer peak load conditions. In contrast, WCGS contributed between 86 and 101 percent of nameplate capacity from 2000 to 2005. As a result, at least 5 times as much wind capacity, using approximately 125 sq mi or more, would need to be constructed to replace WCGS. This capacity would need to be distributed across different areas of the state or region to account for local wind variability. Given the extensive land requirements and uncertain capacity factors, wind energy generators are not considered a reasonable alternative to WCGS.

8.2.5.3 Solar Power

Solar power generation uses the sun's energy to produce electricity. In the GEIS, the Staff noted that by its nature, solar power is intermittent. Therefore, solar power by itself is not suitable for base load capacity and is not a feasible alternative to license renewal of WCGS. The average capacity factor of photovoltaic cells is about 25 percent, and the capacity factor for solar thermal systems is about 25 to 40 percent. Solar power, in conjunction with energy storage mechanisms, could potentially serve as a means of providing base load power. However, current energy storage technologies are too expensive to permit solar power to serve

as a large base load generator. Therefore, solar power technologies (photovoltaic and thermal) cannot currently compete with conventional fossil-fueled technologies in grid-connected applications, due to high costs per kilowatt of capacity (NRC 1996).
The State of Kansas receives, depending on location, approximately 3.5 to 5.0 kWh of solar radiation per square meter per day (KEC 2005). The ER (WCNOC 2006) states that between 13 and 19 sq. mi. (8,320 and 12,160 ac) would be needed to accommodate solar power systems that provide a capacity equivalent to that of WCGS. The Staff agrees with those estimates. As a result of such extensive land requirements, construction of a solar system of comparable capacity to WCGS could generate significant impacts to natural resources (wildlife habitat, land use, and aesthetic impacts). For that reason and because of the system's low capacity factor and high cost, solar power is not deemed a feasible baseload alternative to renewal of the WCGS OL.

8.2.5.4 Hydropower

In Section 8.3.4 of the GEIS, the Staff points out hydropower's percentage of U.S. generating capacity is expected to decline because hydroelectric facilities have become difficult to site as a result of public concern about flooding, destruction of natural habitat, and alteration of natural river courses.

The Staff estimated in the GEIS that land requirements for hydroelectric power are approximately 1 million ac per 1,000 MW(e). Due to the relatively low amount of undeveloped hydropower resource in Kansas (EG&G Idaho, Inc. 1993) and elsewhere in nearby states, and the large land use and related environmental and ecological resource impacts associated with siting hydroelectric facilities of a scale to replace WCGS, the Staff concludes that hydropower is not a feasible alternative to OL renewal.

8.2.5.5 Geothermal Energy

Geothermal energy has an average capacity factor of 90 percent and can be used for baseload power where available. However, geothermal technology is not widely used as baseload generation due to the limited geographical availability of the resource and immature status of the technology (NRC 1996). As illustrated by Figure 8.4 in the GEIS, geothermal plants are most likely to be sited in the western continental United States, Alaska, and Hawaii where hydrothermal reservoirs are prevalent. Since such resources are not available in the State of Kansas, the Staff concludes that geothermal energy is not a feasible alternative to renewal of the WCGS OL.

8.2.5.6 Wood Waste

The use of wood waste to generate electricity is largely limited to those states with significant wood resources, such as California, Maine, Georgia, Minnesota, Oregon, Washington, and Michigan. Electric power is generated in these states by the pulp, paper, and paperboard industries, which consume wood and wood waste for energy, benefiting from the use of waste materials that could otherwise represent a disposal problem.

A wood-burning facility can provide baseload power and operate with an average annual capacity factor of around 70 to 80 percent and with 20 to 25 percent efficiency (NRC 1996). However, the fuels required are variable and site-specific. A significant barrier to the use of wood waste to generate electricity is the high delivered-fuel cost and high construction cost per MW of generating capacity. The larger wood-waste power plants have electrical output capacities in the range of 40 to 50 MW(e). 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. Like coal-fired plants, wood-waste plants require large areas for fuel storage and processing and involve somewhat comparable combustion equipment.

According to researchers from Oak Ridge National Laboratory, the University of Tennessee, and Science Applications International Corporation (Walsh, et al 1999), Kansas contains relatively little wood waste at costs of up to $50 per ton. When converted to potential power output (using factors from the National Renewable Energy Laboratory [DOE/NREL 2004]), the total annual potential is approximately one-sixth the annual output of WCGS. Even if a wood-burning facility could also consume all crop residues in the state potentially available for less than $50 per ton, the total plant output would be only 25% greater than the output of WCGS. Walsh, et al, note that their analysis includes significant uncertainty and that collecting available wood residues could prove to have significant environmental consequences. As such, NRC staff believes wood and crop residue would be insufficient to support a wood-waste-fired alternative.

Due to the lack of wood and wood waste resources in Kansas, the ecological impacts of large-scale wood waste collection (for example, soil erosion and loss of wildlife habitat), high transportation costs, and low plant efficiency the Staff has determined that wood and wood waste generating facilities are not feasible alternatives to renewing the WCGS OL.

8.2.5.7 Municipal Solid Waste

Municipal waste combustors incinerate the 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. Municipal waste combustors use two basic types of technologies: mass burn and refuse-derived fuel. Mass burning technologies are most commonly used in the United States. These technologies process raw municipal solid waste "as is", with little or no sizing, shredding, or separation before combustion.

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 that may have had lower fees; and (3) increasingly stringent environmental regulations that increased the capital cost necessary to construct and maintain municipal waste combustion facilities (DOE/EIA 2007).

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. The use of landfills as a waste disposal option is likely to increase in the near term; however, it is unlikely that many landfills will begin converting waste to energy because of unfavorable economics.. For instance, DOE/EIA projects that between 2006 and 2030, the average price of electricity in constant dollars will fall in the intermediate term (thru 2015) and then rise steadily resulting in a net modest decline over the entire study period (DOE/EIA 2007).

Currently there are approximately 89 waste-to-energy plants operating in the United States. These plants generate approximately 2,700 MW(e), or an average of approximately 30 MW(e) per plant (IWSA 2006). The initial capital costs for municipal solid-waste plants are greater than for comparable steam-turbine technology at wood-waste facilities. This is due to the need for specialized waste-separation and handling equipment for municipal solid waste (NRC 1996).

The GEIS estimates that the overall level of construction impact from a waste-fired plant should be approximately the same as that for a coal-fired plant. Additionally, waste-fired plants have the same or greater operational impacts (including impacts on the aquatic environment, air, and waste disposal). Some of these impacts would be moderate, but still larger than the environmental effects of renewal of the WCGS OL. Therefore, municipal solid waste facilities, at the scale required to replace WCGS, would not be feasible alternatives to renewal of the WCGS 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 crops, converting crops to a liquid fuel such as ethanol, and gasifying crops (including wood waste). In the GEIS, the Staff points out that none of these technologies has progressed to the point of being competitive on a large scale, or of being reliable enough to replace a baseload plant such as WCGS. In developing this SEIS, staff reevaluated this assertion and determined that other biomass-derived fuels do not yet offer a feasible alternative to renewing the WCGS OL.

8.2.5.9 Fuel Cells

Fuel cells work without combustion and, consequently, avoid the environmental effects of combustion processes. Power is produced electrochemically by passing a hydrogen-rich fuel over an anode and air over a cathode and separating the two by an electrolyte. The only by-products are heat, water, and CO_2. 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 generally considered first-generation technology. These fuel cells are commercially available at a cost of approximately $4,500 per kW of installed capacity (DOE/NETL 2005). 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.

The DOE has an initiative to reduce fuel cell costs to as low as $400 per kW of installed capacity. For comparison, the installed capacity cost for a natural gas-fired combined-cycle plant is about $456 per kW (DOE/NETL 2005). As market acceptance and manufacturing capacity increase, natural gas fuel cells plants in the 50- to 100-MW(e) range are expected to become available. At the present time, however, fuel cells are not economically competitive with other alternatives for base-load electricity generation. Fuels cells are, consequently, not a feasible alternative to renewal of the WCGS OL.

8.2.5.10 Delayed Retirement

It is possible that the power being provided by WCGS could be replaced by delaying the retirement of other generating assets located throughout the State of Kansas or the Southwest Power Pool region. The applicant states that they are unaware of any plans for retiring Kansas' generating plants (WCNOC 2006). During conversations with staff of the Kansas Corporation Commission,[e] it was determined that there are no designated retirements of generating capacity within the State. The State's older coal and gas-fired units have been included in capacity projections in relationship to meeting demand. These older units operate at peak

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[e] Personal communication: Larry Holloway, Chief of Energy Operations, Kansas Corporation Commission, June 21, 2007. (Accession No. ML072420250).

demand times, are used for voltage control, and assist in balancing the load when wind generators in Western Kansas are not operating.

In addition, based on an assessment developed by the Southwest Power Pool (NERC 2006), electricity consumption throughout the region is projected to grow at 1.3 percent/yr. The Kansas Energy Council (KEC 2007) projects that electricity demand will increase by 2.5 percent annually in Kansas over the next ten years. These projections suggest that that capacity additions will be required in the region and that retirements are probably being avoided to the extent that economics and environmental regulation allow. Given that there are no plans to retire existing generating facilities and the fact that demand for electricity is projected to increase for the next ten years, the Staff considers delayed retirement not to be a feasible alternative to license renewal of WCGS.

8.2.5.11 Conservation

Kansas, as have most other states, has initiated a range of state-wide programs to reduce energy demand through conservation and efficiency (KEC 2007). Among the existing conservation and efficiency policies/programs in the State are the following:

1) State adoption of the International Energy Conservation Code in 2003 as applicable to new industrial and commercial structures;

2) State requirement for sellers of new homes to disclose, upon request, information regarding the thermal efficiency of the structure;

3) Several Kansas cities have adopted the International Residential Code which, in part, addresses energy efficiency;

4) State adoption of the International Energy Efficiency Code for new state-owned facilities;

5) Several Kansas utilities, including the owners of WCGS (WCNOC 2006) offer energy conservation services to their customers;

6) Offer the Kansas Weatherization Program to moderate income households; and

7) State launches KEEP (Kansas Energy Efficiency Program) to provide low interest loans to low and moderate income households for energy efficiency improvements.

Several additional conservation and efficiency programs that require either legislative or administrative action have been recommended including the following (KEC 2007):

1) Establish state-wide utility operated energy education and conservation programs;

2) Amend existing laws relating to energy efficiency disclosures for new homes;

3) Encourage local units of government to adopt minimum energy efficiency standards for new construction; and

4) Encourage utilities to implement PAYS (Pay as You Save) -type pilots that allows customers to fund certain efficiency improvements through their utility bills.

These conservation and efficiency programs have had an impact on demand for electricity and that impact has been factored into the projections for demand developed by the Southwest Power Pool and by the State of Kansas. These conservation and efficiency programs have had an impact on demand for electricity that State and regional planners have factored into electricity demand projections for the State of Kansas and for the Southwest Power Pool. NRC staff notes that Kansas has been recognized for some of its achievements in energy efficiency, while staff also notes that quantifiable program impacts, as well as potential conservation capacity projections, have not been forthcoming. In the absence of quantifiable potential or program achievements to date, the Staff will not evaluate conservation or efficiency programs as replacements for the full output of WCGS. Staff will, however, consider conservation as part of a combination alternative.

8.2.6 Combination of Alternatives

Even though individual alternatives might not be sufficient on their own to replace the WCGS capacity due to lack of cost-effectiveness or availability, it is conceivable that a combination of alternatives might be sufficient, as well as cost-effective. WCGS has a net generating capacity of 1,165 MW(e) and a number of combinations could potentially be considered to replace the plant. Table 8-5 contains a summary of the environmental impacts of an assumed combination of alternatives consisting of a 585 MW(e) natural gas combined-cycle complex (50 percent of the WCGS net output), 290 MW(e) of purchase power (25 percent of the WCGS net output) and 290 MW(e) of conservation. The summary in Table 8-5 assumes that the gas-fired facility operates at either the WCGS site (once through cooling) or an alternate site (closed cycle cooling).

Environmental impacts of the natural gas combined-cycle unit are based on the analysis presented in Section 8.2.2, adjusted for the reduced capacity. The analysis shows that the principal impacts of the natural gas combined cycle unit are related to construction activity, use of additional undeveloped land, increased air emissions, loss of permanent jobs in the WCGS vicinity, and aesthetics (due to cooling tower). Table 8-5 shows no particular impacts ascribed to the conservation measures that would need to be implemented to replace 25 percent of WCGS capacity, as the GEIS notes that impacts from a conservation alternative would be mostly SMALL, and, in some cases, negligible. The environmental impacts associated with purchased power (25 percent of WCGS output) are not shown on Table 8-5. Impacts of purchased power would still occur but would be located elsewhere in the region (see Section 8.2.4).

Table 8-5. Summary of Environmental Impacts of 585 MW(e) of Natural Gas-Fired Generation, 290 MW(e) Purchase Power, and 290 MW(e) Conservation

Impact Category	WCGS - Open Cycle		Alternate Site - Closed Cycle	
	Impact	**Comments**	**Impact**	**Comments**
Land Use	MODERATE	40 ac for powerblock, offices, roads, parking areas. Additional temporary impact of approximately 60 ac for construction of underground gas pipeline.	MODERATE	50 ac for plant and additional area for gas and electric transmission lines.
Ecology	SMALL to MODERATE	Reduced water withdrawals from Coffey County Lake.	MODERATE	Construction and long term impacts of plant and transmission lines.
Water Use and Quality-Surface Water	SMALL to MODERATE	Considerably less water use than WCGS, but could still result in some water use conflicts.	SMALL	Cooling tower significantly reduces water withdrawals.
Water Use and Quality-Groundwater	SMALL	Does not use groundwater. Impacts to aquifers controlled by State.	SMALL	Impacts depend on volume withdrawn.
Air Quality	MODERATE	• Sulfur oxides (46 tons/yr) • Nitrogen oxides (146 tons/yr) • Carbon monoxide (31 tons/yr) • PM_{10} particulates (26 tons/yr) Some hazardous air pollutants.	MODERATE	Same emissions as for WCGS site.

Table 8.5. (cont'd)

Impact Category	WCGS - Open Cycle		Alternate - Closed Cycle	
	Impact	**Comments**	**Impact**	**Comments**
Waste	SMALL	Small amount of ash produced.	SMALL to MODERATE	Impacts would depend on the site chosen and the nearby population distribution.
Human Health	SMALL	Impacts considered to be minor.	SMALL	Same as at WCGS site.
Socioeconomics	MODERATE to LARGE	Impacts due to 300 construction workers during peak construction period; reduction in permanent work force by 1,425; tax base partially preserved.	MODERATE to LARGE	Impacts due to 300 construction worker; 100 new permanent jobs; enhanced tax base. However, all 1,525 employees at WCGS would loose their jobs and the majority of Coffey County tax base would be lost.
Socioeconomics (Transportation)	SMALL	Transportation impacts associated with construction.	SMALL	Same as at WCGS site.
Aesthetics	SMALL	Plant structures comparable in visibility to existing WCGS structures.	MODERATE to LARGE	Cooling towers, evaporative plume and transmission lines add to plant visibility.
Historic and Archeological Resources	SMALL	Potential impacts can likely be effectively managed.	SMALL	Same as at WCGS site.
Environmental Justice	SMALL	Impacts on minority and low-income communities should be similar to those experienced by the population as a whole.	SMALL	Same as at WCGS site.

8.3 Summary of Alternatives Considered

The environmental impacts of the proposed action, renewal of the WCGS OL are either SMALL or SMALL to MODERATE for all impact categories, except for collective off-site radiological impacts from the fuel cycle and from high-level waste (HLW) and spent fuel disposal. Collective off-site radiological impacts from the fuel cycle and from HLW and spent fuel disposal were not assigned a single significance level but were determined by the Commission to be Category 1 issues nonetheless.

In comparison, impacts from alternatives to license renewal 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 WCGS. The impacts of electrical power purchased outside of Kansas would still occur, but would occur elsewhere. In addition, Staff finds it very 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 WCGS OL. In conducting this analysis, NRC staff considered impacts from the no-action alternative (discussed in 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 (discussed in Section 8.2.4), alternative technologies unable to individually replace WCGS (discussed in Section 8.2.5), and a combination of alternatives (discussed in Section 8.2.6).

If NRC renews the WCGS license, NRC leaves the decision of whether to continuing operating WCGS or to rely on an energy alternative to the appropriate state- and utility-level decisionmakers. If NRC takes no action, i.e., NRC does not renew the license, then appropriate decisionmakers would have to replace existing WCGS capacity by using one of the alternatives staff considered in Section 8.2.

Based on analysis in the preceding chapter, the Staff concludes that the environmentally preferred alternative for meeting future electrical system needs is renewal of the WCGS OL, thereby allowing decisionmakers the option of operating WCGS for an additional 20 years beyond expiration of its existing OL.

8.4 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 52. Code of Federal Regulations, Title 10, *Energy,* Part 52, "Early Site Permits; Standard Design Certifications; and Combined Licenses for Nuclear Power Plants."

40 CFR Part 50. Code of Federal Regulations, Title 40, *Protection of Environment*, Part 50, "National Primary and Secondary Ambient Air Quality Standards."

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 of Performance for New Stationary Sources."

Clean Air Act of 1970, as amended (CAA). 42 USC 7401, *et seq.*

C & A Carbone, Inc. v. Town of Clarkstown, New York, 511 U.S. 383, (U.S. Supreme Court 1994).

Department of Energy (DOE). 2006. "National Electric Transmission Study". August 2006.

Department of Energy, Energy Information Administration (DOE/EIA). 2005. International Energy Outlook 2005. USDOE/EIA-0484(2005). Washington, DC. Accessed at: http://www.eia.doe.gov/oiaf/ieo/index.html on April 21, 2006.

Department of Energy, Energy Information Administration (DOE/EIA). 2007. *Annual Energy Outlook 2007 with Projections to 2030.* February 2007.

Department of Energy, National Energy Technology Laboratory (DOE/NETL). 2005. *2005 Office of Fossil Energy Fuel Cell Program Annual Report*. September.

EG&G Idaho, Inc. 1993. U.S. Hydropower Resource Assessment for Kansas. Accessed at: http://hydropower.id.doe.gov/resourceassessment/pdfs/states/ks.pdf.

Environmental Protection Agency (EPA). 1998. "Revision of Standards of Performance for Nitrogen Oxide Emissions From New Fossil-Fuel Fired Steam Generating Units; Revisions to Reporting Requirements for Standards of Performance for New Fossil-Fuel Fired Steam Generating Units, Final Rule." *Federal Register* Volume 63, Number 179, pp. 49442-49455. Washington, DC, September 16, 1998.

Environmental Protection Agency (EPA). 1999. "Regional Haze Regulations, Final Rule" *Federal Register* Volume 64, Number 126, pp. 35714-3577. Washington, DC, July 1, 1999.

Environmental Protection Agency (EPA). 2000a. "Regulatory Finding on the Emissions of Hazardous Air Pollutants from Electric Utility Steam Generating Units." *Federal Register*. Volume 65, Number 245, pp. 79825-79831. Washington, DC, December 20, 2000.

Environmental Protection Agency (EPA). 2000b. "Notice of Regulatory Determination on Wastes from the Combustion of Fossil Fuels." Federal Register, Volume 65, pp. 32214-32237. Washington, DC, May 22, 2000.

Environmental Protection Agency (EPA). 2007. Clean Air Mercury Rule." Accessed at: http://www.epa.gov/mercury /oar/mercuryrule/. July 9, 2007.

Gabbard, Alex. 1993. "Coal Combustion: Nuclear Resource or Danger," *Oak Ridge National Laboratory Review*. Oak Ridge National Laboratory: Oak Ridge, Tennessee. Summer/Fall 1993. Accessed at: http://www.ornl.gov/ORNLReview/rev26-34/text/colmain.html on September 29, 2006.

Integrated Waste Services Association. (IWSA). *Energy Overview*. Accessed at: http://www.wte.org/energy on September 19, 2006.

Kansas Corporation Commission (KCC). 2004. Kansas Wind Resource Map, 2004. Accessed at: http://www.kcc.state.us/energy/wind.htm. on June 18, 2007.

Kansas Energy Council (KEC). 2005. *Kansas Energy Report 2005*, Compiled by Liz Brosius, Scott White, and M. Lee Allison, Kansas Geological Survey, Published by the Kansas Geological Survey, in cooperation with the Kansas Corporation Commission. Kansas Geological Survey, Open-file Report 2004-59.

Kansas Energy Council (KEC). 2007. *Kansas Energy Plan 2007*, Kansas Energy Chart Book. January 2007.

Kansas Energy Information Network (KEIN). 2007. Proposed and Existing Wind Power Projects in Kansas. May 2007. Accessed at: www.KansasEnergy.org/wind_projects.htm on June 18, 2007.

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

North American Electric Reliability Council (NERC). 2006. *Long-Term Reliability Assessment-The Reliability of the Bulk Power Systems in North America*. October 2006.

Nuclear Regulatory Commission (NRC). 1996. *NUREG-1437, Generic Environmental Impact Statement for License Renewal of Nuclear Power Plants (GEIS)*, Volumes 1 and 2. Washington, DC, May, 1996.

Nuclear Regulatory Commission (NRC). 2001. "NRC Organizes Future Licensing Project Organization." Press Release Number 01-035, March 30, 2001.

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

Nuclear Regulatory Commission (NRC). 2006. "NRC Establishing Office of Near Reactors, Additional Region II Deputy Regional Administrator". Press Release Number 06-096, July 24, 2006.

U.S. Geological Survey (USGS). 1997. "Radioactive Elements in Coal and Fly Ash: Abundance, Forms, and Environmental Significance; USGS Fact Sheet FS-163-97." Available URL: http://greenwood.cr.usgs.gov/enerfy/factshts/163-97/FS-163-97.pdf.

U.S. Public Interest Research Group. 2003. *Generating Solutions: How Clean, Renewable Energy is Boosting Local Economies and Saving Consumers Money.*

Wolf Creek Nuclear Operating Corporation (WCNOC). 2006. *Applicant's Environmental Report – Operating License Renewal Stage, Wolf Creek Generating Station.* Docket Number 50-482. Burlington, Kansas.

9.0 Summary and Conclusions

By letter dated September 27, 2006, Wolf Creek Nuclear Operating Corporation (WCNOC) submitted an application to the U.S. Nuclear Regulatory Commission (NRC) to renew the operating license (OL) for Wolf Creek Generating Station (WCGS) for an additional 20-year period (WCNOC 2006a). If the OL is renewed, State and Federal (other than NRC) regulatory agencies and WCNOC would ultimately decide whether the plant will continue to operate based on factors such as the need for power, power availability from other sources, regulatory mandates, or other matters within the agencies' jurisdictions 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 March 11, 2025.

Section 102 of the National Environmental Policy Act of 1969, as amended (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. 10 CFR Part 51 identifies licensing and regulatory actions that require an EIS. In 10 CFR 51.20(b)(2), NRC requires preparation of an EIS or a supplement to an EIS 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 WCGS 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 (*Federal Register*, Volume 71, page 70997-70999 [NRC 2006]) on December 7, 2006. The Staff visited the WCGS site in September 2006, held two public scoping meetings on December 19, 2006, and conducted a site audit in March 2007. The Staff reviewed the WCGS Environmental Report (ER) (WCNOC 2006b) 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, the *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 this Supplemental Environmental Impact Statement (SEIS) for WCGS. 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 Staff held public meetings in Burlington, Kansas, in November 2007 to describe the preliminary 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 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. All comments received on the draft SEIS were considered by the Staff in developing this final SEIS. These comments are presented in Appendix A, Part 2, of SEIS.

This SEIS includes the NRC staff's analysis that considers and weighs the environmental effects of the proposed action (including cumulative impacts), the environmental impacts of alternatives to the proposed action, and mitigation measures available for reducing or avoiding adverse effects. This SEIS 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 evaluation criterion for 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 would contribute to NRC's ultimate determination of 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).[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 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 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.

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.

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[b] 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."

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 WCGS), alternative methods of power generation, and conservation. These alternatives were evaluated assuming that the replacement power generation plant is located at either the WCGS site or some other unspecified location.

9.1 Environmental Impacts of the Proposed Action - License Renewal

WCNOC 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 WCNOC 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, WCNOC, nor the Staff has identified any new issue applicable to WCGS 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 WCGS.

WCNOC's license renewal application presents an analysis of the Category 2 issues that are applicable to WCGS, plus environmental justice and chronic effects from electromagnetic fields. The Staff has reviewed the WCNOC analysis for each issue and has conducted an independent review of each issue plus environmental justice and chronic effects from electromagnetic fields. Two Category 2 issues are not applicable because they are related to plant design features or site characteristics not found at WCGS. Four Category 2 issues are not discussed in this SEIS because they are specifically related to refurbishment. WCNOC (WCNOC 2006a) has 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 as necessary to support the continued operation of WCGS for the license renewal period. 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 Wolf Creek Generating Station, Unit 1* (NRC 1982).

Fifteen Category 2 issues (including fourteen Category 2 issues plus the severe accident mitigation alternatives [SAMAs] issue from Chapter 5) 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 both to refurbishment and to operation during the renewal term and are only discussed in this SEIS in relation to operation during the renewal term. For the fifteen Category 2 issues and environmental justice, the Staff concludes that the potential environmental effects are of SMALL and SMALL to MODERATE significance in the context of the standards set forth in the GEIS. A SMALL to MODERATE impact was determined based on groundwater quality and water-use conflicts (plants with cooling ponds or cooling towers using makeup water from a small river with low flow). If water use conflicts occur, associated impacts in the Neosho River due to impingement and habitat reduction on aquatic organisms, including threatened and endangered species, would be SMALL to MODERATE. Research is continuing in the area of chronic effects on electromagnetic fields, and a scientific consensus has not been reached. Therefore, no further evaluation of this issue is required. For SAMAs, the Staff concludes that a reasonable, comprehensive effort was made to identify and evaluate SAMAs. Based on its review of the SAMAs for WCGS, and the plant improvements already made, the Staff concludes that WCNOC identified seven potentially cost-beneficial SAMAs. 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.

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. The Staff concludes that cumulative impacts of WCGS license renewal would be SMALL for most potentially affected resources, with the exception of some aquatic resources. The Staff concluded that groundwater quality and water use conflicts (plants with cooling ponds or cooling towers using makeup water from a small river with a low flow), would experience SMALL to MODERATE cumulative impacts. In addition, due to the increased potential for impingement and habitat reduction during periods with water use conflicts, cumulative impacts on aquatic organisms, including threatened and endangered species, would also be SMALL to MODERATE.

Mitigation measures were considered for each Category 2 issue. For all issues, current measures to mitigate the environmental impacts of plant operation were found to be adequate.

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 renewal term.

All unavoidable adverse impacts of continued operation identified are considered to be of SMALL significance. The unavoidable adverse impacts of likely alternatives if WCGS 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 WCGS during the current license period 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 off-site storage space for the spent fuel assemblies.

The most significant resource commitments related to operation during the renewal term are the fuel and the permanent storage space. WCGS replaces a portion of its fuel assemblies during every refueling outage, which occurs on an 18-month cycle (WCNOC 2006b).

The likely power generation alternatives if WCGS ceases operation on or before the expiration of the current OLs would 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 WCGS was set when the plant was approved and construction began. That balance is now well established. Renewal of the OL for WCGS and continued operation of the plant would not alter the existing balance, but may postpone the availability of the site for other uses. Denial of the application to renew the OL would lead to shutdown of the plant and will alter the balance in a manner that depends on subsequent uses of the site.

9.2 Relative Significance of the Environmental Impacts of License Renewal and Alternatives

The proposed action is renewal of the OL for WCGS. 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 WCGS. 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 coal, gas, or nuclear-fired generating capacity at an unspecified greenfield site, gas-fired generation of power at WCGS, and a combination of alternatives are compared in Table 9-1. Continued use of open-cycle cooling is assumed for WCGS. All fossil fueled alternatives presented in Table 9-1 are assumed to use closed-cycle cooling systems. Substitution of once-through cooling for the recirculating cooling system in the evaluation of the nuclear and gas and coal-fired generation alternatives would result in greater environmental impact to categories related to water use and aquatic ecology. Alternatively, land use and aesthetic impacts are somewhat reduced with open-cycle cooling.

Table 9-1 shows that the significance of the plant specific environmental effects of the proposed action would be SMALL for all impact categories except for the following:

- Groundwater quality), for which a SMALL to MODERATE level of significance was assigned;
- Water use conflicts (plants with cooling ponds and cooling towers using makeup water from a small river with low flow), for which a SMALL to MODERATE level of significance was assigned;
- If water use conflicts occur, associated impacts in the Neosho River due to impingement and habitat reduction on aquatic organisms, including threatened and endangered species, for which a SMALL to MODERATE level of significance was assigned;
- Collective offsite radiological impacts from the fuel cycle and from high-level radioactive waste, for which a single significance level was not assigned (see Chapter 6); and
- Spent fuel disposal, for which a single significance level was not assigned (see Chapter 6).

Cumulative impacts on the proposed action would be SMALL, with the exception of some aquatic resources. The Staff concluded that groundwater quality and water use conflicts (plants with cooling ponds or cooling towers using makeup water from a small river with a low flow), would experience SMALL to MODERATE cumulative impacts. In addition, due to the increased potential for impingement and habitat reduction during periods with water use conflicts, cumulative impacts on aquatic organisms, including threatened and endangered species, would also be SMALL to MODERATE.

The alternative actions, excluding 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, (2) the ER submitted by WCNOC, (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, the recommendation of the Staff is that the Commission determine that the adverse environmental impacts of license renewal for WCGS 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 License Renewal, the No Action Alternative, and Alternative Methods of Generation Using Once-Through Cooling[(a)]

	Proposed Action	No Action Alternative	Coal-Fired Generation		Natural-Gas-Fired Generation [(b)]		New Nuclear Generation [(b)]	Combination of Alternatives	
								Gas Fired with Purchased Power and Conservation	
Impact Category	License Renewal	Denial of Renewal	WCGS Site	Alternate Site[(b)]	WCGS Site	Alternate Site	Alternate Site	WCGS Site	Alternate Site
Land Use	SMALL	SMALL	MODERATE to LARGE	MODERATE to LARGE	MODERATE	MODERATE to LARGE	MODERATE to LARGE	MODERATE	MODERATE
Ecology	SMALL to MODERATE	SMALL	MODERATE to LARGE	MODERATE to LARGE	SMALL to MODERATE	MODERATE	MODERATE to LARGE	SMALL to MODERATE	MODERATE
Water Use and Quality – Surface Water	SMALL to MODERATE	SMALL	SMALL to MODERATE	SMALL to MODERATE	SMALL to MODERATE	SMALL	SMALL	SMALL to MODERATE	SMALL
Water Use and Quality - Groundwater	SMALL to MODERATE	SMALL	SMALL to MODERATE	SMALL to MODERATE	SMALL	SMALL	SMALL	SMALL	SMALL
Air Quality	SMALL	SMALL	MODERATE	MODERATE	MODERATE	MODERATE	SMALL	MODERATE	MODERATE
Waste	SMALL	SMALL	MODERATE	MODERATE	SMALL	SMALL	SMALL	SMALL	SMALL
Human Health	SMALL[(c)]	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL
Socio-economics	SMALL	LARGE	MODERATE to LARGE	MODERATE to LARGE	MODERATE - LARGE	SMALL to MODERATE	LARGE	MODERATE to LARGE	MODERATE to LARGE
Transportation	SMALL	SMALL	MODERATE to LARGE	MODERATE to LARGE	SMALL	SMALL	MODERATE	SMALL	SMALL
Aesthetics	SMALL	SMALL	MODERATE	MODERATE to LARGE	SMALL	MODERATE to LARGE	MODERATE to LARGE	SMALL	MODERATE to LARGE
Historical and Archeological Resources	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL
Environmental Justice	SMALL	SMALL	SMALL	SMALL to LARGE	SMALL	SMALL to MODERATE	SMALL to MODERATE	SMALL	SMALL to MODERATE

(a) The majority of impacts shown are negative; however, several impacts are positive. See Chapters 4 and 8 for details.
(b) Analysis based on use of a closed-cycle cooling system.
(c) Except for the 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."

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

Nuclear Regulatory Commission (NRC). 1982. *Final Environmental Statement Related to Operation of Wolf Creek Generating Station, Unit 1.* NUREG-0878. Office of Nuclear Regulation. Washington, DC.

Nuclear Regulatory Commission (NRC). 1996. NUREG-1437, Generic Environmental Impact Statement for License Renewal of Nuclear Power Plants (GEIS), Volumes 1 and 2. Washington, DC.

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.

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, DC.

Nuclear Regulatory Commission (NRC). 2006. "Notice of Acceptance for Docketing of the Application, Notice of Opportunity for Hearing, and Notice of Intent to Prepare an Environmental Impact Statement and Conduct the Scoping Process for Facility Operating License Number NPF-42 for an Additional Twenty-Year Period; Wolf Creek Nuclear Operating Corporation; Wolf Creek Generating Station, Unit 1." *Federal Register.* Volume 71, Number 235, pp. 70997-70999. December 7, 2006.

Wolf Creek Nuclear Operating Corporation (WCNOC). 2006a. *License Renewal Application, Wolf Creek Generating Station*, Docket Number 50-482, Facility Operating License Number NPF-42, Burlington, Kansas.

Wolf Creek Nuclear Operating Corporation (WCNOC). 2006b. *Applicant's Environmental Report – Operating License Renewal Stage, Wolf Creek Generating Station.* Docket Number 50-482, Burlington, Kansas.

Appendix A

Comments Received on the Environmental Review

Appendix A

Comments Received on the Environmental Review

Part I - Comments Received During Scoping

On December 7, 2006, the NRC published a Notice of Intent in the *Federal Register* (71 FR 70997), to notify the public of the Staff's intent to prepare a plant-specific supplement to the GEIS regarding the renewal application for the WCGS operating license. The plant-specific supplement to the GEIS will be prepared in accordance with NEPA, Council on Environmental Quality (CEQ) guidelines, and 10 CFR Part 51. As outlined by NEPA, the NRC initiated the scoping process with the issuance of a *Federal Register* Notice (71 FR 70997). The NRC invited the applicant, Federal, State, local, and tribal 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 January 29, 2007.

The scoping process included two public scoping meetings, which were held on December 19, 2006, at the Coffey County Library, Burlington Branch, 410 Juniatta Street, Burlington, Kansas. The NRC issued press releases, placed newspaper ads, and distributed flyers locally. Approximately 40 people attended the meetings. Both sessions began with NRC staff members providing a brief overview of the license renewal process and the NEPA process. Following the NRC's prepared statements, the meetings were open for public comments. There were no public comments or questions at the meetings. The meeting summary, which was issued on January 19, 2007, and the associated transcripts are available for public inspection in the NRC Public Document Room (PDR), located at One White Flint North, 11555 Rockville Pike, Rockville, Maryland 20852, or from the NRC's Agencywide Documents Access and Management System (ADAMS). The ADAMS Public Electronic Reading Room is accessible at http://www.nrc.gov/reading-rm/adams/web-based.html. The meeting summary can be found in ADAMS at Accession No. ML070170473. The transcripts of the meeting can be found in ADAMS at Accession Nos. ML070120121 and ML070120114. Persons who do not have access to ADAMS, or who encounter problems in accessing the documents located in ADAMS, should contact the NRC's PDR reference staff by telephone at 1-800-397-4209, or 301-415-4737, or by e-mail at pdr@nrc.gov.

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. Two (2) letters and one (1) e-mail containing comments were received during the scoping period. No comments were received orally or in writing at the scoping meetings. 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 transcript, letter, or e-mail in which the comments were submitted.

Comments were consolidated and categorized according to the topic within the proposed supplement to the GEIS or according to the general topic if outside the scope of the GEIS. Comments with similar specific objectives were combined to capture the common essential issues that had been raised in the source comments. Once comments were grouped according to subject area, the Staff and contractor determined the appropriate action for each comment.

Table A-1 identifies the individuals providing comments and the Commenter ID letter associated with each person's set(s) of comments. The Commenter ID letter is preceded by WCGS.

Table A-1. Individuals Providing Comments During Scoping Comment Period

Commenters ID	Commenter	Affiliation (If Stated)	Comment Source
WCGS-A	Mike Seymour	Local Resident	Written comments
WCGS-B	Michael J. LeValley	US Department of the Interior, Fish and Wildlife Services	Written comments
WCGS-C	Kimberly O. Johnson	US Environmental Protection Agency, NEPA	Written comments

Comments are grouped in the following categories:

A.1.1 Comments Concerning Aquatic Ecology
A.1.2 Comments Concerning Threatened and Endangered Species
A.1.3 Comments Concerning Transmission Lines
A.1.4 Comments Concerning General Environmental Impacts
A.1.5 Comments Concerning Decommissioning
A.1.6 Comments Concerning License Renewal and Its Processes

A.1 Comments and Responses

A.1.1 Comments Concerning Aquatic Ecology

Comment: Impingement and entrainment at the intakes for the cooling system should also be addressed in the EIS. As you are probably aware, on January 26, 2007, the United States Court of Appeals for the Second Circuit issued a decision remanding to EPA the 2004 Clean Water Act Section 316(b) Phase II rule, which regulates cooling water intake structures at existing power producing facilities, (Riverkeeper, Inc. v EPA, 2d Cir. Jan. 25, 2007). Although this decision may modify the regulations, 316(b) will still apply to the Wolf Creek facility. (WCGS-C)

Response: *The comment is related to operation of the plants cooling system, specifically the effects of impingement and entrainment. A discussion of the potential impacts associated with the plants cooling system will be presented in Chapter 4 of the SEIS. Additionally a brief discussion of potential mitigation measures to limit impingement and entrainment impacts will be presented in Chapter 4 of the SEIS.*

A.1.2 Comments Concerning Threatened and Endangered Species

Comment: In accordance with section 7(c) of the Endangered Species Act, we have determined that the Federally-listed threatened bald eagle (*Haliaeetus leucocephalus*), the threatened Mead's milkweed (*Asclepias meadii*) and the threatened Neosho madtom (*Norturus placidus*) may occur in the project area. If the project may adversely affect listed species, the Nuclear Regulatory Commission (NRC) should initiate informal or formal section 7 consultation with this office. (WCGS-B)

Response: *The comment is noted. The impacts on any Federally-threatened or endangered species will be evaluated and discussed in Chapter 4 of the SEIS and the Biological Assessment. Informal or formal consultations with the Fish and Wildlife Service will be initiated as appropriate.*

Comment: There has been an active bald eagle nest at WCGS since 1994; however, the pair has not successfully fledged any young since 1999. Because of the uncertain reproductive status of this nesting pair and it's proximity to potential source contaminants from WCGS, we recommend further evaluation of the potential affects of WCGS on the bald eagle and other piscivorous bird and mammal species that may occur in the project area. (WCGS-B)

Response: *The comment is noted. An evaluation of the current status and potential impacts of WCGS on the bald eagle (Haliaeetus leucocephalus) pair at the site will be evaluated and discussed in Chapters 2 and 4 of the SEIS and also in the Biological Assessment.*

Comment: The many acres of native prairie and rangeland found on WCGS may provide suitable habitat for Mead's milkweed. If these habitats have not been previously surveyed for Mead's milkweed, we recommend a field survey by the Kansas Biological Survey or other qualified botanists. The Kansas Biological Survey may be contacted by writing at 2041 Constant Avenue, Lawrence, Kansas 66047-2906, or by telephone at (785) 864-1538. In addition, if suitable Mead's milkweed habitat is found on-site or could be made suitable through management, we would like to discuss with the applicant the potential for transplant and management of this plant on the WCGS site. (WCGS-B)

Response: *The comment is noted. As part of the environmental review process, the Staff will evaluate the existing conditions, including any existing survey data, at the site as well as the potential impacts likely to result from operation of the WCGS for an additional 20 years. This evaluation will be documented in the Biological Assessment that will be submitted to the U.S. Fish and Wildlife Service. However, requiring the applicant to conduct additional biological surveys or requiring a Mead's milkweed transplant and monitoring program is not within the purview of the NRC.*

Comment: The Neosho madtom occurs in the Neosho River both upstream and downstream of John Redmond Reservoir. Your National Environmental Policy Act (NEPA) analyses should evaluate the potential direct and indirect effects of water withdrawal from the Neosho River on this species, especially during drought years. (WCGS-B)

Response: *The comment is noted. The potential direct and indirect effects of water withdrawal from the Neosho River on the Neosho madtom will be evaluated and discussed in Chapter 4 of the SEIS and also in the Biological Assessment.*

Comment: Also, due to the aging of the facility and corrosion within the cooling tower structure, trace elements such as nickel, iron, and chromium may be accumulating in Coffey County Lake at higher than background levels. The potential exposure of Neosho madtom, bald eagle and the Neosho mucket to these trace elements should be addressed in the NEPA documents. (WCGS-B)

Response: *The comment is noted. The WCGS utilizes a once through cooling system, not a cooling tower structure for heat dissipation. Regardless of the cooling system, the discharge of other metals in cooling system waste water is considered a Category 1 issue. 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 (i.e., once through cooling water systems) and are not expected to be a problem during the license renewal term. As part of the environmental review, the Staff will conduct an independent review of existing information to determine if there is any new and significant information that would alter the conclusions of the GEIS and the findings will be presented in Chapter 4 of the SEIS.*

Comment: The candidate species Neosho mucket (*Lampsilis rafinesqueana*), which is a freshwater unionid mussel, occurs in the Neosho River within the project area. Candidates are those species for which the USFWS has on file substantial information on biological vulnerability and threats to support proposals to list them as endangered or threatened species. Development and publication of proposed rules to list candidate species as threatened or endangered are anticipated at some point in the future. Candidate species have no legal protection under the Endangered Species Act; however, the USFWS is concerned for their conservation due to their uncertain status. (WCGS-B)

Response: *The comment is noted. An evaluation of the current status and potential impacts of WCGS on the Neosho mucket will be evaluated and discussed in Chapters 2 and 4 of the SEIS and also in the Biological Assessment.*

A.1.3 Comments Concerning General Environmental Impacts

Comment: Transmission lines have been documented as constituting a significant collision hazard to migratory birds including waterfowl, wading birds, shorebirds, and raptors. Project lines occurring within one mile of streams, wetlands, and other water bodies such as the Neosho River, Coffey County Lake, John Redmond Reservoir, and Flint Hills National Wildlife Refuge, should be evaluated for their potential to impact migratory birds. If project lines meet these criteria, and there is little existing field data documenting the presence or absence of a collision hazard, we recommend that line segments be monitored during the renewal process to determine whether a collision hazard exists. If a hazard is identified, line segments should be marked for enhanced visibility following established guidelines. (WCGS-B)

Response: *The comment is noted. Bird collisions with power lines is a Category 1 issue, determined to be of small significance at all sites and not required to be reevaluated in the site-specific SEIS, unless new and significant information is identified that would lead the NRC staff to reevaluate the GEIS's conclusions. As part of the environmental review, the Staff will evaluate existing data to determine if there is any new and significant information that would change the GEIS conclusions. This review would include all available data, including the wildlife monitoring program that included avian collision surveys of the transmission lines that was conducted by the applicant from 1982 through 1986. However, requiring the applicant to conduct additional monitoring for collision hazards is outside NRC regulatory purview.*

Comment: Our main environmental and human health concerns with nuclear generating stations include safety, water quality, and spent fuel storage. The unintended release of tritium and strontium from plant operations and the impacts on groundwater is an emerging issue at some power plants, as well as the local impacts of transporting high-level waste (spent fuel) once a long-term repository is finalized. We recommend that these issues be analyzed and discussed in the EIS. (WCGS-C)

Response: *The comment is noted. Safety will be addressed as a separate part of the license review process. The NRC staff performs a safety review, on-site inspections, and audits to determine if the applicant has adequately demonstrated that the effects of aging will not have adverse impacts during the extended period operation. In addition, a safety evaluation report (SER) documents the results of the NRC's staff's review of aging-management and the applicant's programs to address these matters during the period of extended operation. Water and groundwater issues, as well as potential mitigation measures, if applicable, will be addressed in Chapters 2 and 4 of the SEIS. Currently, the transportation of high-level waste (spent fuel) is considered a Category 1 issue, determined to be of small significance at all sites* *and not required to be reevaluated in the site-specific SEIS, unless new and significant information is identified that would lead the NRC staff to reevaluate the GEIS's conclusions. As part of the environmental review, the Staff will evaluate existing data to determine if there is any new and significant information that would change the GEIS conclusions.*

A.1.4 Comments Concerning Decommissioning

Comment: Wolf Creek is probably half way to the time of decommission. Approximate costs for decommission will be around $1.5 Billion. Half of that sum is $750 million. Is there enough money in that fund or will other environmental issues be left begging when our children are forced to use scarce tax dollars for this inevitable cleanup? No one likes to talk about this major issue. It is my belief that the present stockholders intend to take a profit and then bail out leaving a huge cleanup cost for my grandchildren to pay for. Please ask two direct questions. 1) How much money is in the cleanup fund? 2) Who controls it? The answers should be: 1) No less than $750 million. 2) Some unbiased third party. Any other answer means we have a serious problem here. (WCGS-A)

Response: *NRC regulations that establish the requirements for how a licensee will provide reasonable assurance that funds will be available for the decommissioning process are provided in 10 CFR 50.75. The Commission's final rule on "Financial Assurance Requirements," published in the Federal Register on September 22, 1998 (63 FR 50465), required, among other things, that power reactor licensees submit decommissioning funding status reports to the NRC by March 31, 1999, and every 2 years thereafter. In response to the site specific questions, the most recent (March 2005) 10 CFR 50.75 Report on Status of Decommission Funding provided by WCGS (ADAMS Accession No. ML0509603661) details the amount collected to date for decommissioning, and the amounts yet to be collected. As of the March 2005 report, the NRC has projected that the WCGS will have sufficient funds for decommissioning in the year 2025. This money has been placed in an external sinking fund. An external sinking fund is a fund established and maintained by setting funds aside periodically into an account segregated from licensee assets and outside the licensee's administrative control. The total amount of these funds would be sufficient to pay decommissioning costs at the time that it is anticipated that the licensee will cease operations. An external sinking fund may be in the form of a trust, escrow account, government fund, certificate of deposit, or deposit of government securities. If the NRC issues a new license to WCGS, then NRC regulations would require the licensee to provide sufficient funds to the trust to support decommissioning by the new license expiration date. Although this comment is noted, the cost of renewal versus decommissioning is a business decision that NRC does not control. The Commission has determined these issues are outside the scope of the environmental analysis for license renewal.*

A.1.5 Comments Concerning License Renewal and Its Processes

Comment: We are also interested in how the Nuclear Regulatory Commission will address issues and actions that may arise between the license renewal date in 2009 and 2025 when the renewed license becomes effective. The useful "life" of an EIS is considered to be 5 years; after that time period, additional analysis and documentation may be required. (WCGS-C)

Response: *If the license is renewed, the licensee will be issued a new license that incorporates and supersedes the existing license. The new license will have a new expiration date, which is up to twenty years past the expiration date of the original operating license. Therefore, issues and actions that may arise between 2009 and 2025 and through the remaining term of the new license would be addressed as current operating issues.*

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 Wolf Creek Generating Station, Draft Report for Comment* (NUREG-1437, Supplement 32, 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 DSEIS, the Staff:

- placed a copy of the DSEIS in the NRC's electronic Public Document Room, its license renewal website, and the Coffey County Library;

- sent copies of the DSEIS to the applicant, members of the public who requested copies, and certain Federal, Sate, Native America Tribal, and local agencies;

- published a notice of availability of the DSEIS in the *Federal Register* on September 25, 2007 (72 FR 54469-54470);

- issued press releases and public announcements such as advertisements in local newspapers and postings in public places announcing the issuance of the DSEIS, the public meetings, and instructions on how to comment on the DSEIS;

- held public meetings in Burlington, Kansas on November 8, 2007, to describe the results of the environmental review and answer related questions; and

- established an e-mail address to receive comments on the DSEIS through the Internet.

During the DSEIS comment period, the staff received a total of 5 written sets of comments. One commenter spoke during the public meetings. The Staff 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 Agencywide Documents Access Management System (ADAMS). ADAMS is accessible at http://www.nrc.gov/reading-rm/adams.html. The ADAMS accession numbers for the afternoon and evening public meeting transcripts are ML073240311 and ML073240288, respectively. A summary of the comments and the Staff's responses are provided in Section A.2.

Each comment identified by the Staff was assigned a specific commenter identifier (marker). That identifier is provided with the comment discussion.

Table A-2. Individuals Providing Comments During the Public Meetings and Comment Period

Commenters ID	Commenter	Affiliation (If Stated)	Comment Source
WCGS-D	Ronald Fraass	Local Resident	Written Comments
WCGS-E	Dorothy Shoup	Local Resident	Afternoon Public Meeting
WCGS-F	Terry J. Garrett	Wolf Creek Nuclear Operating Company	Written Comments
WCGS-G	Cheryl Crisler	Acting Director, Environmental Services Division, EPA Region VII	Written Comments
WCGS-H	Robert F. Stewart	Regional Environmental Officer, United States Department of the Interior, Office of the Secretary	Written Comments
WCGS-I	Michael J. LeValley	Field Supervisor, United States Department of the Interior, Fish and Wildlife Service	Written Comments

Comments are grouped in the following categories:

A.2.1 Comments Concerning Aquatic Ecology
A.2.2 Comments Concerning Threatened and Endangered Species
A.2.3 Comments Concerning Water Use and Quality
A.2.4 Comments Concerning Groundwater Use and Quality

A.2.5 Comments Concerning Radiological Impacts
A.2.6 Comments Concerning Uranium Fuel Cycle and Waste Management
A.2.7 Comments Concerning Decommissioning Issues
A.2.8 Comments Concerning Alternative Energy Sources
A.2.9 Comments Concerning License Renewal and its Process
A.2.10 Comments Concerning Support for License Renewal at Wolf Creek Generating Station
A.2.11 Comments Outside the Scope of the Environmental Review for License Renewal
A.2.12 Comments Concerning Editorial Issues

A.2 Comments and Responses

A.2.1 Comments Concerning Aquatic Ecology

Comment: Section 2.2.5, Aquatic Resources, pages 2-42 -- 2-48; and Section 4.1.2, Entrainment of Fish and Shellfish in Early Life Stages, and Section 4.1.3, Impingement of Fish and Other Aquatic Organisms, pages 4-20 -- 4-37. The DEIS contains several statements of fact and species observations without the benefit of supporting references. The final EIS would be enhanced if the document included supporting references for such statements of fact and field surveys. Examples include, but are not limited to, the following:

- "Aquatic vegetation indicator samples for KDHE were collected...between July and September 2005 and April and June 2006." (page 2-51, 2nd paragraph)
- "Limited data on larval fish...have been collected by WCNOC...These samples were collected monthly from...to determine approximate peak occurrence of larvae." (page 4-21, 1st and 2nd full paragraphs)
- "Although sample sizes were small, the results indicated that larval fish densities were much lower upstream of the cooling water intake in Coffey County Lake than in the Neosho River." (page 4-21, 3rd full paragraph)
- "Least terns were recorded...but nesting has not been observed there." (page 4-73, 2nd full paragraph)
- "The bird collision survey...and the area of the Lime Sludge Pond" and "The dead bird surveys began in February 1983 and continued through February 1988." (page 4-73, 4th full paragraph and top of page 4-74, respectively). (WCGS-H)

Response: *The Staff partially agrees with the comment. The Staff has added references as appropriate to support these statements. In some cases, the reference was cited later in the paragraph; however, the reference was added as suggested to aid in clarification.*

Comment: Section 2.2.5.2.2, Radionuclide Concentrations in Tissue Samples - The draft stated that the fish tissue analysis was conducted on the edible portions of the fish. To evaluate potential ecological risk to fish and piscivores due to radionuclide exposure, whole fish tissue samples should be processed. (WCGS-G)

Response: *The NRC requirements for performing a radiological environmental monitoring program require only sampling and analysis of the edible portions of fish. This is because the focus of NRC radiation protection standards is the protection of humans, not biota. The dose modeling used to calculate the dose to humans assumes that only the edible portion of the fish is consumed and can contribute to radioactive exposure of the person. Nevertheless, the NRC staff has performed an ecological assessment of radiological risk to aquatic and terrestrial biota, including piscivores. The assessment utilized the available fish tissue data based on samples of muscle tissue. The only radionuclide related to WCGS operations that was detected in fish tissue was tritium. Given that tritium is present in organisms as tritiated water, it is unlikely to occur in bone, fat, or other tissues at concentrations higher than in muscle. Therefore, muscle concentrations are considered a reasonably conservative basis for assessing internal dose and risk to fish from tritium. Risk to terrestrial piscivores (the bald eagle) was assessed based on dose calculated from concentrations in eagle muscle and was not dependent on modeling from fish concentrations.*

A.2.2 Comments Concerning Threatened and Endangered Species

Comment: A Biological Assessment was provided in Appendix E to the Draft GEIS, Supplement 32 (Docket Number 50-482) and addresses potential effects on endangered or threatened species. In this assessment, potential effects to the Neosho madtom were reviewed and assessed. It was concluded that when water use conflicts exist during low-flow or drought condition in the Neosho River, continued operation of WCGS may adversely affect the Neosho madtom. WCNOC contends when considering the comments and clarifications presented above, that the potential for adverse effects on the Neosho madtom due to WCGS would be less likely. (WCGS-F)

Response: *The Staff conducted additional analysis of the relationship between WCGS water withdrawals and flow rates within the Neosho River. Based on the conclusions of the additional analysis and the existing analysis in the BA, no changes have been made to the text of the BA in response to this comment.*

Comment: On October 16, 2007, the Service received a letter dated September 20, 2007, from the U.S. Nuclear Regulatory Commission requesting comments on a Biological Assessment (BA) of the Potential Impacts to Threatened and Endangered Species Resulting from an Additional 20 Years of Operation of the Wolf Creek Generating Station, Unit 1, Nuclear Power Plant, located in Coffey County, Kansas. The BA determined that the proposed action would not likely adversely affect Mead's milkweed. Likewise, during periods with no water use conflicts, the proposed action would not likely adversely affect the Neosho madtom. However, when water use conflicts exist during low-flow or drought condition in the Neosho River, continued operation of Wolf Creek may adversely affect the Neosho madtom. The September 20 letter requested Service concurrence with these conclusions.

After reviewing the BA, the Service concurs with your conclusion that the project is not likely to adversely affect Mead's milkweed. We also concur that the project may adversely affect the Neosho madtom during low-flow or drought conditions. However, we believe it would be beneficial for the Service and the Nuclear Regulatory Commission to remain in informal consultation regarding the madtom, so that additional information and data can be developed to: 1) determine if formal consultation is needed, and 2) provide the best scientific and commercial data available for development of a Biological Opinion by the Service if formal consultation is warranted.

We believe measures may be employed to offset some of the impacts this project could have on Neosho madtom habitats during low-flow and drought conditions, and would like to discuss these further with you and Wolf Creek personnel. If it is later determined that formal consultation is necessary, there will be sufficient time to complete the consultation within your required timeframe. (WCGS-I)

Response: *The comments about concurrence with the conclusions of the BA regarding Mead's milkweed and the Neosho madtom are noted. The comments about continued informal consultation with regard to the madtom and the need for additional discussion of measures that may be employed to offset impacts on the madtom resulted in discussions between the NRC staff and FWS. As a result, additional analysis of the relationship between WCGS water withdrawals and flow rates within the Neosho River was performed. The analysis indicated that water use conflicts and reduced flow impacts on Neosho madtom habitat are legitimate concerns in this WCGS area. However, these conflicts and impacts are almost entirely due to naturally low levels of precipitation. While low flow conditions that affect Neosho madtom habitat have occurred during the WCGS operational period, none of these conditions have been nearly as extensive or severe as the low flow conditions that occurred naturally during the 1952 to 1954 drought. In addition, restrictions on future water availability in the basin are primarily driven by the rapid sedimentation rate in John Redmond Reservoir rather than water use by WCGS. Based on these conclusions, no changes have been made to the text of the BA in response to this comment.*

Comment: To aid our discussions and evaluation of potential measures to avoid or minimize adverse effects to Neosho madtom, we request further analyses of how make-up water withdrawal affects seasonal stream flows and habitat in the Neosho River. We are unaware of any recently collected data which characterizes the relationship between instream flows and habitat conditions such as depth and velocity at gravel bars used by Neosho madtoms. For that reason, we believe an evaluation of how seasonal withdrawals affect flows and stage at stream gages downstream of the make-up water withdrawal point is likely the best information we can rely on at this point to determine adverse effects, if any. There are five existing United States Geological Survey stream gages within the reach of the Neosho River occupied by Neosho madtoms. These gages occur at Burlington, Iola, and Parsons, Kansas, and at Commerce and Miami, Oklahoma. Use of stage data at gages unaffected by low-head dam backwater effects is preferred, if possible.

Flow and stage changes at these gages with project withdrawals should be compared to a hydrological baseline that captures all present and likely future water depletions within the Neosho River Basin through the 20-year term of the license. Demand for water in the Neosho Basin is projected to exceed supply by 2012. The Kansas Water Office, U.S. Army Corps of Engineers, or other entities may have relevant data regarding present and likely future depletions in the basin. In addition to an evaluation of how existing makeup water withdrawal operations affect downstream flows and stages during drought or low flow conditions, it would be helpful to examine stage-change effects that would occur if withdrawals were scheduled during high-flow events or periods of normal flows rather than being based on the elevation of the cooling water lake. (WCGS-I)

Response: *The comments are noted and are in regard to the impacts of continued operation of WCGS on threatened and endangered species.*

In response to comments regarding the impact of water withdrawal on Neosho madtom habitat, Staff conducted additional analysis of the relationship between WCGS water withdrawals and flow rates within the Neosho River.

The additional analysis included a detailed comparison of precipitation, Redmond Dam discharge, WCGS water withdrawals, and Neosho River flow rates at Burlington and Iola, Kansas for the period from 2000 to 2007. Although USFWS requested inclusion of additional gauging stations, Staff determined that the three locations closest to WCGS (Redmond Dam, Burlington, and Iola) were likely to be the most direct indicators of WCGS impacts, and evaluation of withdrawal impacts at the more distal gauging stations would only be of use if impacts were detected at the more proximal gauging stations. The time period from 2000 to 2007 included six identified periods in which low flow conditions occurred in the Neosho River, so was thought to have included a representative range of flow conditions.

Also, USFWS requested that the analysis include evaluation of stage data, as well as an indication of how the flow rate correlate to Neosho madtom habitat. Unfortunately, historical stage data for the Neosho River were not readily available. In addition, the correlation of flow to habitat has already been performed by several entities and was incorporated into the development of Minimum Desirable Streamflow (MDS) levels for the Neosho River. In the Draft

SEIS (Page 4-13) and in Section 4.1.2 of the Biological Assessment (BA), the Staff conducted an evaluation of the 40 cfs MDS at Iola to verify that it is protective of Neosho madtom habitat and concluded that it was protective. Therefore, this MDS value was used as the standard to define low flow conditions in this analysis.

The conclusions of the analysis are as follows:

- *Low flow conditions in the Neosho River are caused by low levels of precipitation and the resulting low volumes of releases from John Redmond Dam. WCGS withdrawals, by themselves, do not cause low flow conditions.*

- *WCGS water withdrawal from the Make-Up ScreenHouse (MUSH), which occurs at a rate of 120 cubic feet per second (cfs) during normal and high flow periods, results in an identifiable reduction in the flow rate in the Neosho River. During these periods, the flow rate at Burlington is an average of approximately 100 to 150 cfs lower than the flow rate released from Redmond Dam. Although the withdrawals reduce the flow volume, they only occur during times of normal or high flow conditions (above the 40 cfs MDS), and therefore have no impact on low flow conditions.*

- *WCGS water withdrawals have also occurred during low flow conditions. This water is withdrawn through the conservation pool by-pass pipe at a rate of 70 cfs. This withdrawal does not directly result in any identifiable reduction in the flow volume at Burlington. This is because no water is withdrawn directly from the river under these conditions. The withdrawals do, however, contribute to a reduction in the volume of water within the reservoir.*

- *Because WCGS withdrawals during low flow periods reduce the volume of water within the reservoir, these withdrawals may extend the duration of the time period in which releases from the dam are not sufficient to maintain the MDS flow volume in the Neosho River. Because the relationship between WCGS withdrawals and Redmond Dam release volumes is indirect, the magnitude of this effect cannot be quantified. However, it is likely to be small compared to the effect of rainfall on Redmond Dam release volumes.*

In the Draft SEIS (page 4-14, Line 29) and in Section 4.1.2 of the BA, the Staff concluded that WCGS water withdrawals may extend the duration and severity of low flow conditions in the Neosho River. In addition, the Staff concluded that increased future demand on water resources and sedimentation rates in John Redmond Reservoir were likely to increase the magnitude of this impact in the future. Therefore, the Draft SEIS concluded that water use impacts due to availability of water for other users, and impacts on Neosho madtom habitat, may be SMALL to MODERATE. This conclusion is confirmed by this more detailed analysis. Therefore, no changes were made in the text of the Draft SEIS or BA regarding these impacts.

The Staff have also reviewed the recent "Surface Water Supply and Demand Projections for Selected Basins in Eastern Kansas" document that was the source of the information regarding water demand outstripping supply by 2012. The document shows that, although demand is increasing, the conflict is almost entirely due to the reduction in supply from John Redmond Reservoir. This future reduction, and the need for future actions to address it, have already been discussed in the Draft SEIS and were a large part of the reason that NRC concluded that future water use conflicts could be SMALL to MODERATE. Therefore, no further text changes related to this issue have been made.

The USFWS comments also requested an evaluation to determine if mitigation measures, specifically phasing of withdrawals only in normal and high flow periods, were appropriate. Comparison of the water withdrawal dates with the Neosho River flow rate at Iola shows that almost all withdrawals (92.8%) occurred on days when the flow rate at Iola exceeded the 40 cfs MDS. Only 7.2% of the withdrawals occurred on days when the flow rate at Iola was below 40 cfs. Overall, there were 346 days during the study period in which the flow rate at Iola was below 40 cfs, and withdrawals only occurred on 48 of these days. Therefore, while NRC agrees that efforts should be made to avoid withdrawal during low flow periods, the data show that these efforts are already being made.

The Staff also evaluated Coffey County Lake elevations to determine if the withdrawals that occurred on low flow days could have been shifted to high flow days. This review showed that WCGS clearly manages their water withdrawals in an attempt to avoid withdrawing on low flow days. During normal and high flow periods, WCGS has to balance the potential for future dry periods with the potential for future wet periods, so the decision to perform withdrawal is based not only on the lake level, but also the time of year and expected rainfall levels in the coming weeks. During low flow periods, it is clear the facility ceases withdrawals as soon as the low flow condition begins, tries to avoid withdrawal as long as the low flow condition persists (even though the Coffey County Lake level is low), and then immediately starts pumping again to raise the lake level as soon as a normal/high flow period starts again. Based on this review, the staff concludes that withdrawals are already maximized, and no changes in operational procedures that could achieve greater efficiency are possible. Therefore, this proposed mitigation measure has not been added to the SEIS.

Overall, the analysis performed by the Staff during the development of the Draft SEIS and the BA, and in response to USFWS comments, indicates that water use conflicts and reduced flow impacts on Neosho madtom habitat are legitimate concerns in this area. However, these conflicts and impacts are almost entirely due to naturally low levels of precipitation. While low flow conditions that affect Neosho madtom habitat have occurred during the WCGS operational period, none of these conditions have been nearly as extensive or severe as the low flow conditions that occurred naturally during the 1952 to 1954 drought. In addition, restrictions on future water availability in the basin are primarily driven by the rapid sedimentation rate in John

Redmond Reservoir rather than water use by WCGS. Based on these conclusions, no changes have been made to the text of the Draft SEIS or the BA in response to this comment.

A.2.3 Comments Concerning Water Use and Quality

Comment: For nearly a decade, I had responsibility for environmental monitoring of the area around Wolf Creek Generating Station. Recent results from KDHE monitoring around the station were quoted in the Draft GEIS. Tritium is the only significant isotope found in the environment from the plant and it is present in the cooling lake at levels below the drinking water standard.

While the Draft GEIS was extensive, perhaps an additional issue of merit in considering the Denial of Renewal Option might be considered: If the station closes, Coffee County Lake would likely cease to exist and that entire aquatic and shoreline population would be lost. Although evaporative loss would be reduced without the station in operation, the normal input to the lake is probably not sufficient to maintain it. If so, that would increase the negative impacts of denial of renewal. (WCGS-D)

Response: *The NRC's regulations implementing the National Environmental Policy Act of 1969, as amended (NEPA), specify that the no-action alternative be discussed in an NRC environmental impact statement (EIS) (see 10 CFR Part 51, Subpart A, Appendix A[4]). For license renewal, the no-action alternative refers to a scenario in which the NRC would not renew the OL for WCGS and Wolf Creek Nuclear Operating Corporation (WCNOC) would then cease plant operations by the end of the current license and initiate decommissioning of the plant. The environmental impacts associated with decommissioning would be bounded by the discussion of impacts in Chapter 7 of the GEIS, Chapter 7 of this draft supplemental EIS (SEIS), and the Final Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities, NUREG 0586, Supplement 1 (NRC 2002).*

Impacts from the decision to permanently cease operations are not considered in NUREG-0586, Supplement 1. Therefore, immediate impacts that occur between plant shutdown and the beginning of decommissioning are discussed in Chapter 8 of the draft SEIS (see Table 8-1 presented at the end of Section 8.1). Impacts of the no-action alternative specific to surface water use and quality are discussed in Section 8.1.1. Therefore, no changes were made to the Draft SEIS.

Comment: The Draft GEIS, Supplement 32, states in the paragraph starting on line 32, page 4-35, that during times of water use conflicts when the MUSH is withdrawing water from the Neosho River, and water levels are low, impingement impacts to fish populations may increase. Supporting this statement was that reduced volume and habitat in the river would cause fish densities to be higher, cause fish to seek new habitat and refuges, and reduced flow would make their upstream migration to the MUSH area easier. Together these changes could increase impingement impact.

WCNOC questions this assessment due to existing structures and habitats in the MUSH vicinity; primarily influences of the Burlington City dam approximately two miles downstream. This structure impounds river water nearly to the MUSH, and creates lentic habitats likely to be kept full due to efforts to maintain MDS. In addition, the dam makes upstream migration unlikely during low flow conditions. Consequently, similar habitats and physical restrictions to upstream fish migration during low flow conditions should not increase fish concentrations or decrease fish habitat in the vicinity of the MUSH, thus increased impingement should not occur. (WCGS-F)

Response: *The Staff partially agrees with the comment. The Staff has edited the text of this paragraph to remove the statement that reduced flow would make upstream migration easier. However, the concept that fish in the reach below the dam could seek refuge and congregate in deeper water in the area of the MUSH was retained as a possibility that could increase impingement.*

Comment: "may be approaching the pre-construction estimate of 23,000 pCi/L". The 2005 annual mean for detected tritium in Spillway (SP) surface water was 12,855 pCi/L and 2006 was 11,286 pCi/L (Reference WCNOC Annual Radiological Environmental Operation Reports). It does not appear that surface water tritium is approaching the 23,000 pCi/L level. Suggest deleting the verbiage in question. (WCGS-F).

Response: *Due to the effect of precipitation and evaporation rates on tritium concentrations in Coffey County Lake, the Staff do not believe that a one-year reduction in concentration from 2005 to 2006 is indicative of a leveling off of tritium concentrations. The tritium concentration plot developed by WCNOC (and used as Figure 2-7 in the Draft SEIS) shows a long-term increase in tritium concentrations, even though there are many short-term decreases from year-to-year. A concentration plot developed by KDHE also shows some year-to-year reductions, but also a long-term trend that appears to show that an ultimate tritium concentration of 23,000 pCi/L is possible. Based on a review of the previous modeling and the WCNOC and KDHE historical datasets, the Staff believe that the text in the Draft SEIS is accurate. Therefore, no change has been made to the Draft SEIS in response to this comment.*

Comment: Attachment I, comment 4. The Draft GEIS, Supplement 32, states in the paragraph starting on line 39, page 4-14 that a comparison of water withdrawal dates with Neosho River streamflows indicates that withdrawals have occurred in the past on days when the Neosho River flow rate was below the 40 cfs MDS. WCNOS assumes that the Neosho River flow rate reviewed was downstream at Iola, where the MDS applies. With this being the case, it is true that withdrawals have occurred when MDS were not being achieved, however, the withdrawal was from the stored contract water, and not taken from the natural flows of the Neosho River intended to maintain MDS. (WCGS-F)

Response: *Further analysis by the Staff have verified that stored contract water withdrawal does not directly reduce the flow rate in the river, so the correlation between withdrawal dates and low flow dates is not directly meaningful. However, the withdrawal of stored contract water during low flow periods does reduce the volume of water in the conservation pool of the reservoir, which must be made up from natural flows at a later time. This may indirectly result in extending the period of time during which Redmond Dam releases are not sufficient to maintain the MDS in the river. The Draft SEIS has been revised to clarify the relationship.*

Comment: Table 2-3 and 2-4, Surface Water Quality Monitoring - A list of the analytes included as Gamma Isotopes should be included in the SEIS along with their detection limits. Further, text should be included in the SEIS that explains the rationale behind monitoring these particular analytes. (WCGS-G)

Response: *The Staff partially agrees with the comment. The Staff has added a brief discussion on the typical gamma-emitting radionulcides released and the detection level used to measure low levels of radionuclides in the environment. The SEIS provides references to the 2002 Annual Radioactive Effluent Release Report and Wolf Creek's Offsite Dose Calculation Manual. These two references provide a detailed information and discussion of the radionuclides measured and the detection level used in the analysis.*

Comment: Section 2.2.5.1.2, Neosho River and John Redmond Reservoir, page 2-47, lines 29-39. The paragraph provides a discussion of annual streamflow statistics for three USGS gaging stations on the Neosho River. Annual streamflow statistics at two of the gaging sites are for the period 1964 to 2004; however, a period of 1994 to 2004 was selected for the third site (Neosho River near Iota, Kansas; USGS number 07183000). It is suggested that the same period of record be used in the analysis. Further, the annual statistics reported for this site during the abbreviated period of 1994-2004 are not correct. Annual streamflow statistics for the Neosho River near Iota are available on the Internet at: http://waterdata.usgs.gov/ks/nwis/annual/?referred module=sw&site no=07183000&por 07183 000 1=92933,00060,1,1896,2006&year type=W&format=html table&date format=YYYYMM-DD&rdb compression=file&submitted form=parameter selection list. (WCGS-H)

Response: *The Staff agrees with the comment. Annual streamflow statistics for the three USGS stations were retrieved from the Internet link provided in the comment and the text of this paragraph was revised. Because data through 2007 are available on the website, the datasets for all three gaging stations were expanded to include data from 1964 to 2007.*

A.2.4 Comments Concerning Groundwater Use and Quality

Comment: "If additional groundwater users install wells in the area in the future, the facility would be required to evaluate the potential for impact and possible inclusion of these wells in the REMP sampling program." Groundwater users are not required to inform WCNOC of any new wells being installed. Therefore recommend delete this statement or clarify as follows; "If additional wells are installed by SCNOC in the area ...." (WCGS-F)

Response: *The comment is correct that WCNOC would not be required to identify and evaluate newly installed residential groundwater wells. Although WCNOC could install and sample wells as stated in the comment, there is no guarantee that this will happen. This raises the possibility that tritium-impacted water in Coffey County Lake could potentially seep into groundwater, migrate off of WCNOC property, and be used by local residents without their knowledge. Based on this possible scenario, the Draft SEIS has been revised to indicate that Groundwater Quality Impacts during the license renewal term could be SMALL to MODERATE.*

Comment: Recent events at several nuclear power plants have highlighted a concern with tritium contamination of groundwater as a result of unplanned releases, such as those due to equipment degradation. Since the concentrations of tritium in the Coffey County Lake are expected to increase marginally and infiltration through seepage from the lake to groundwater is not well known, we request that further characterization be conducted as discussed in Section 2.2.3.2 Groundwater, page 2-39, line 17. The results of the study should be included in the Final SEIS. (WCGS-G)

Response: *In response to other comments, the Final SEIS conclusions have been revised to indicate that Groundwater Quality Degradation impacts may be SMALL to MODERATE. This conclusion is based on the existing information, which is that groundwater degradation and seepage may be occurring, but that it does not currently exceed drinking water standards, and there are few or no groundwater users who could be affected by degraded groundwater. Detailed investigation of the current extent of groundwater impacts would not change this conclusion. The Staff agree that evaluation of this issue by the appropriate regulatory agencies may be warranted, but such investigation is outside of the scope of this SEIS.*

A.2.5 Comments Concerning Radiological Impacts

Comment: In general, the EIS fails to evaluate potential risk to both terrestrial and aquatic receptors that are exposed to radionuclides from operation of the plant. Of primary concern is tritium, which has been found to be increasing steadily in surface water and fish tissue in Coffey County Lake. The SEIS should include a conceptual model of tritium behavior in the environment, along with ecological toxicity reference values describing potential effects to both aquatic and terrestrial receptors. In summary, although tritium is monitored, the draft has not identified a threshold where tritium concentrations would exert a negative impact upon the aquatic life in Coffey County Lake. (WCGS-G)

Comment: Section 2.2.7, Radiological Impacts - Activation, corrosion, or fission products attributable to plant operation have been detected in surface water, fish tissue, and bottom sediments of Coffey County Lake. However, ecological benchmarks for those materials have not been presented as part of the SEIS, making it impossible to determine the impacts of these plant related contaminants on the aquatic life of Coffey County Lake or the piscivorous organisms that may be consuming organisms from the lake. Further, given the accumulation of tritium in surface water and fish tissue over time, an ecological risk assessment that is specific for tritium should be included as part of the SEIS to predict levels that may become harmful to fish and their predators. (WCGS-G)

Response: *The NRC has provided an assessment of potential ecological risks to aquatic and terrestrial receptors from exposures to tritium and other radionuclides in Coffey County Lake and environs in a new section, Section 2.2.5.2.3, Ecological Risk from Radionuclides. However, the NRC does not have a regulatory framework for assessing radiological impacts on biota. The focus of NRC regulatory framework is the protection of humans. To perform the radiological assessment of biota, the Staff utilized a Department of Energy (DOE) Standard (DOE-STD-1153-2002), "A Graded Approach for Evaluating Radiation Doses to Aquatic and Terrestrial Biota" (DOE 2002). Radiation doses from tritium to fish and the bald eagle were calculated based on tissue concentrations and compared to ecological dose benchmarks, which were identified by the International Atomic Energy Agency (IAEA) and the National Council on Radiation Protection and Measurements (NCRP) and are a basis of the DOE guidelines. Concentrations of tritium and other radionuclides (^{137}Cs and ^{60}Co) in surface water, sediment, and soil also were screened against conservatively derived, nuclide-specific benchmarks expressed as media concentrations (Biota Concentration Guides) from DOE (2002) in order to assess risk to a range of aquatic, riparian, and terrestrial receptors. A conceptual model describing the characteristics and behavior of tritium in the environment was included, and potential future risk from increasing tritium concentrations in the lake was evaluated.*

Comment: The Service is also concerned with potential exposure of migratory birds found at Wolf Creek to tritium, and its effects on reproduction/survival in these species. A pair of bald eagles have nested at Wolf Creek for many years, and successfully fledged offspring from 1994-99. However nesting attempts since then have failed to produce young. Recently, the female eagle was killed by a car and was sent for lab analysis. This analysis found tritium in the bird's muscle tissue.

If sufficient data exists in the literature to conduct an ecological risk assessment of tritium's effects on reproduction/survival of piscivorous birds, waterfowl and other water birds that use the cooling lake and other power plant habitats, the results of this assessment should be presented in the DSEIS. If results show that there is a risk of exposure to tritium at levels that have effects on reproduction/survival, a discussion of how those effects may be avoided or mitigated should be included in the DSEIS as well. (WCGS-I)

Response: *See previous response. The ecological risk screenings included a specific evaluation of the tritium concentration detected in the bald eagle and were sufficiently conservative to be protective of other wildlife.*

A.2.6 Comments Concerning Uranium Fuel Cycle and Waste Management

Comment: I was here 20 years ago, or a little over, when they had the hearing before they first licensed Wolf Creek, and at that time I had two questions. One of them was how would we deal with the hazardous waste, and I am not here pro or con, I'll just read what I wrote. Today I do not take a pro or con stand but I do seek information. So what I'm going to tell you is not pro or con of the plant. I think they've done a pretty good job of running the plant. But these questions I still have because the government -- we have not re-addressed this hazardous waste problem, the toxic waste. We're storing it, it seems to be all right now. Kansas didn't want the dump site, Nebraska didn't want the dump site, nobody wants the dump site, and I understand. So we have that to face, and as citizens, these people are not able to address directly, ... (WCGS-E)

Comment: Number one, care and disposal of the hazardous waste, including current status of waste storage here in Coffey County, Kansas. France was and is a big user of nuclear power, and I was told at that original hearing that hazardous waste, spent fuel and so forth, was being shipped to France, from France to Japan. What now and here? I'm just asking for information; somebody may know this, I do not know. (WCGS-E)

Comment: ... we recognize that no "new and significant information" was identified during the review process for the license renewal related to the uranium fuel cycle and transportation of nuclear fuel and wastes and that these issues are documented in the *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (GEIS), NUREG-1437, Volumes 1 and 2. However, we recommend including a discussion of environmental effects related to potential onsite spent fuel storage if onsite storage would be foreseeable during the license renewal time frame. (WCGS-G)

Response: *Onsite storage of spent nuclear fuel is a Category 1 issue. The safety and environmental effects of long-term storage of spent fuel onsite has been evaluated by the NRC, and, as set forth in the Waste Confidence Rule. The NRC's Waste Confidence Rule, found in 10 CFR 51.23, states: The Commission 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. Further, the Commission believes there is* *reasonable assurance that at least one mined geologic repository will be available within the first quarter of the twenty-first century, and sufficient repository capacity will be available within 30 years beyond the licensed life for operation of any reactor to dispose of the commercial high-level waste and spent fuel originating in such reactor and generated up to that time. In its Statement of Considerations for the 1990 update of the Waste Confidence Rule (55 FR 38472), the Commission addressed the impacts of the disposal of spent fuel discharged from the current fleet of reactors operating under existing and renewed licenses and from a new generation of operating reactors. The rule was last reviewed by the Commission in 1999 when it reaffirmed the findings in the rule (64 FR 68005, dated December 6, 1999) and the rule was updated in 2007 (72 FR 49509, dated August 28, 2007).*

The comments provide no new and significant information. Therefore, no changes were made to the Draft SEIS.

A.2.7 Comments Concerning Decommissioning Issues

Comment: Two, de-commissioning plan, and that is mentioned in here. After 20-plus years, is that feasibly sufficient and enforceable? Please briefly outline it for us. Now, I'm not asking for these people to give me answers but I'm hoping that we can get some answers. Maybe a newspaper article or something eventually can address some of these things. (WCGS-E)

Response: *The comments are related to decommissioning. Decommissioning was evaluated in Chapter 7.0 of the GEIS and was determined to be a Category 1 issue. The Staff did not identify any new and significant information during its independent review of the WCGS ER, the site visit, the scoping process, or the evaluation of other available information. Therefore, the Staff concludes that there would be no impacts regarding decommissioning beyond those discussed in the GEIS. The comments provide no new and significant information; therefore, no changes were made to the Draft SEIS.*

A.2.8 Comments Concerning Alternative Energy Sources

Comment: France, I think, has as much as 40 percent of their energy coming from nuclear and you know what problems we have. Ethanol costs about as much to make as it does and it's a good temporary thing but it's not the answer. Coal is dirty. We try to scrub it, that takes energy. And the sun doesn't store very well, we've got to get better batteries. So I think there are people who can address these things but we need on it. (WCGS-E)

Response: *The comments are related to the environmental impacts of alternatives to license renewal at WCGS. The GEIS included an extensive discussion of alternative energy sources. Environmental impacts associated with various reasonable alternatives to renewal of the operating licenses for WCGS were evaluated in Chapter 8 of the SEIS. The comments provide no new and significant information. Therefore, no changes were made to the Draft SEIS.*

A.2.9 Comments Concerning License Renewal and its Process

Comments: Number three -- now, these came to me as I was calling about this meeting -- expansion or additions, and I got a little bit of misinformation. Somebody said it's already a done deal, someone else said it is not. An Osage County acquaintance told me that this is being requested. Specifically, briefly what is being requested? Has it been granted? And apparently it has not. [During the public hearing at which this comment was presented, Mr. Jacob's of the NRC responded: "There's been no request, ma'am, for expansion of Wolf Creek beyond the current nuclear plan. And one other thing, Dorothy, the reason that they come in when they do, they have an opportunity 5 to 20 years before the current license expires. So that's part of the regulations, and if they were not to get a license renewal, they'd need some time to figure out what else they were going to be doing, so that's why they come in when they do."] I think that should be brought out in a newspaper article so people can review it, because I think people are interested but they're very, very busy. (WCGS-E)

Comment: ... but I notice they handed out this wonderful book here, and while I was scanning right now, in Section 4 it talks about the fish and the rivers -- I'll depend on you hunters and fishermen to look at that -- and then Section 5 environmental impacts of postulated accidents. I'll address that in just a second. And then one more, 7 environmental impacts of alternatives to license renewal. One of my questions was, when I got this, apparently they're applying now for 2025 is the expiration date now. That's quite a ways away, isn't it? And I don't know what the reason is for applying so soon but there must be a good reason. Application requests authorization to operate Wolf Creek Generating Station for an additional 20 years. Now, if that wouldn't take place until 2025, then it would be in 40-some, I'll be dead and gone long since. But I'm just interested in that; that was something that came up today. (WCGS-E)

Response: *The regulations for license renewal were developed through a rulemaking process. The rulemaking process for license renewal started in the early 1980s when the Staff recognized that they needed to identify the information required and the process to be used to determine whether or not to grant renewed licenses for nuclear power reactors. The staff recognized this need because the Atomic Energy Act of 1954 specified that licenses for commercial nuclear reactor facilities would be for 40 years and could be renewed for an additional period of time at the end of the 40 years.*

In 1982, the NRC established a comprehensive program for Nuclear Plant Aging Research as the result of a widely attended workshop on nuclear power plant aging. Based on the results of that research, a technical review group concluded that many aging phenomena were readily manageable and did not pose technical issues that would preclude life extension for nuclear power plants.

The NRC also concluded that the existing regulatory requirements governing a nuclear reactor facility would offer reasonable assurance of adequate protection if the license were renewed, provided that the current licensing basis was modified to account for age-related safety issues. In 1991, the Commission approved a rule on the technical requirements for license renewal and published the rule in the Code of Federal Regulations, 10 CFR Part 54. The NRC then undertook a demonstration program to apply the rule to pilot plants and to develop experience to establish implementation guidance. The rule defined the scope as age-related degradation unique to license renewal. However, during the demonstration program, the NRC found that many aging effects are managed adequately during the initial license period. In addition, the NRC found that the review did not allow sufficient credit for existing programs, particularly the maintenance rule, which also helps manage plant-aging phenomena.

As a result, in 1995, following the rulemaking process, the NRC amended the license renewal rule. The amended rule in 10 CFR Part 54 established a regulatory process that is more effective, stable and predictable than the previous license renewal rule. In particular, Part 54 was clarified to focus on managing the adverse effects of aging. The rule changes were intended to ensure that important systems, structures, and components would continue to perform their intended function during the 20-year period of extended operation.

A.2.10 Comments Concerning Support for License Renewal at Wolf Creek Generating Station

Comment: I support the NRC staff's preliminary recommendation that "the Commission determine that the adverse environmental impacts of license renewal for WCGS are not so great that preserving the option of license renewal for energy planning decision makers would be unreasonable." (WCGS-D)

Response: *The comments are noted. The comments are supportive of license renewal at WCGS, and are general in nature. The comments provide no new information. Therefore, no changes were made to the Draft SEIS.*

A.2.11 Comments Outside the Scope of the Environmental Review for License Renewal

Comments: And the last one -- this probably doesn't apply to very many of you - - we in Osage County, we usually have winds from the southwest. Therefore, we are in the normal path of a toxic plume, if there ever were one at the Wolf Creek Power Plant. Yet when I ask our county FEMA representative -- everybody has one now, you know - - about this aspect of a nuclear plant operations, I was told, A, she does not recall information received or on hand. Apparently, she's not being notified and it probably wouldn't hurt to get along with our neighbors to do this for the plant. And Mr. Guevel, G-U-E-V-E-L, is he here somewhere? I'm probably saying it wrong. Anyway, he is with the plant. Now maybe they could do something about that. And letter B, permission to attend emergency preparedness exercises has been requested by this person in Osage County but refused. One was just concluded, I understand. Comments, please, on this. Why would it not be a good thing to have that FEMA representative, because as we know, when 9/11 came, all these aviation places were teaching these guys how to fly and they told people but the locals were not heard. (WCGS-E)

Response: *Emergency preparedness is an ongoing process at all plants, including Wolf Creek. 10 CFR 50 requires to each nuclear plant to have an approved emergency plan that is revised and updated periodically. Licensees are required to frequently test the effectiveness of the plans by conducting emergency response exercises. During these exercises, which often include the participation of various federal, state, and local government agencies, the NRC assesses each licensee's ability to protect the public. Emergency planning is addressed under the current operating license and is outside the scope of the environmental analysis for license renewal.*

A.2.12 Comments Concerning Editorial Issues and Text Clarification

Comment: Section 2.2.5.1.2, Neosho River and John Redmond Reservoir, page 2-47, line 18. The reference Osterkamp and Hedman (1981) is not listed in the references section at the end of the chapter. (WCGS-H)

Comment: Attachment I, comment 1. In the Draft GEIS, Supplement 32, Section 4.1.1.1.2 (Instream and Riparian Impacts in the Neosho River), benefits of established Minimum Desirable Streamflows (MDS) legislated under the Kansas Water Appropriation Act are discussed. Normal withdrawals of the natural flows of the Neosho River for WCGS are allowed under two water appropriations from the State of Kansas, both of which require 250 cubic feet per second (cfs) or greater to remain in the river downstream of the Makeup Water Screen House (MUSH), the point of diversion. With such river flows, the MDS which is set at a minimum of 40 cfs downstream at Iola, Kansas will clearly not be impacted. As stated in the GEIS, Supplement 32 (paragraph starting on line 5, page 4-14), it is true that WCNOC can request a variance from the 250 cfs limitation from the Chief Engineer of the Division of Water Resources (DWR), and that the current water appropriations are not subject to the MDS restriction. By granting the variance, the Chief Engineer may permit withdrawal of such flows to the extent it is found to be in the public interest. WCNOC does not expect to request diversion of the Neosho River's natural flows at such times that less than 250 cfs would remain downstream, however, if such a request is made, then WCNOC fully expects the Chief Engineer to consider the public interests at that time before allowing such withdrawals. (WCGS-F)

Comment: Attachment I, comment 2. The Draft GEIS, Supplement 32, states in the paragraph starting on line 14, page 4-14, that resources that could be affected by the purchase of water from the conservation pool are the same as those that could be affected by the WCGS appropriations form the natural flows of the Neosho River. WCNOC disagrees with this statement because the referenced conservation pool water is stored water contracted for industrial use between the owners of WCGS and the State of Kansas. Since this water is stored in the John Redmond Reservoir, it is not considered natural flows of the Neosho River during low flow conditions. (WCGS-F)

Comment: Attachment I, comment 3. The Draft FEIS, Supplement 32, states in the paragraph starting on line 32, page 4-14, that the 70 cfs withdrawal rate exceeds the 41 cfs estimate established by NRC as the volume of withdrawal that could cause reduced flows within the river. WCNOC recommends that this statement be clarified. The referenced 41 cfs was a volume representing a portion of the conservation pool of John Redmond Reservoir that he State or Kansas determined could be contracted for beneficial use. It was derived from the estimated yield of the pool after 50 years of sedimentation, and during a 1 in 50 year drought. The 70 cfs refers to a pump diversion rate, and not a total volume. The water purchase contract allows a total water allotment of 9,672 million gallons per year (41 cfs). When accessing the stored contract water, only as much can be pumped to Coffey County Lake as can be obtained through a valved bypass pipe installed in the John Redmond Dam for such purposes. Natural flows of the Neosho river are passed through the John Redmond Dam spillway, and this includes MDS. Based on actual flows measured through the bypass pipe, and pump capacities, the makeup flow is effectively limited to 70 cfs, which is one pump's capacity. Contrary to initial design expectations, they bypass pipe does not provide sufficient flow to operate two pumps rated at 120 cfs combined. The water purchase contract allows a maximum ump rate of 120 cfs, with a quarterly running average not to exceed 41 cfs. Once the total allotment is pumped, makeup activities would be discontinued. Since the cited 70 cfs is based on rate, and not volume, and it is bound by the total allotment, including the quarterly running average, such withdrawal will not increase impacts over those previously evaluated. The same total volume would be removed from the conservation pool. (WCGS-F)

Comment: Attachment II, comment 1. Page 2-12, Line 34. Spent fuel pool is in the Fuel Building, rather than the Reactor Building. (WCGS-F)

Comment: Attachment II, comment 2. Page 2-22, Line 30. Coffey County Lake water may be released to Wolf Creek through four mechanisms. These are the service spillway, the auxiliary spillway, the blow down structure and seepage. (WCGS-F)

Comment: Attachment II, comment 3. Page 2-22, Line 31. To clarify, surface waters above elevation 1088' msl are discharged over the dam spillway. This can also occur by wave action from north winds when lake level is below 1088' msl. (WCGS-F)

Comment: Attachment II, comment 4. Page 2-22, Lines 12-14. KDHE has data available for iron, chromium, and copper in the cooling lake during 2006. (WCGS-F)

Comment: Attachment II, comment 5. Page 2-36, Line 6. The 5 wells referenced in the Environmental Education Area were abandoned domestic wells that were plugged. Possibly line 6 is a duplicate of line 12. (WCGS-F)

Comment: Attachment II, comment 6. Page 2-38, Line 2. Change number of samples for C-10 for "5" to "4". (WCGS-F)

Comment: Attachment II, comment 7. Page 2-38, Line 2. Change "No" to "Yes" for Required by ODCM? for locations F-1, G-2 & J-2. (WCGS-F)

Comment: Attachment II, comment 8. Page 2-39, Line 9. Wells were not installed in 2006, nor were they installed for groundwater monitoring. WCNOC is monitoring wells that were already in place. Suggest changing sentence to: "In 2006, three wells were monitored on the WCGS site: one well located near the auxiliary building and two dewatering wells located near the Essential Service Water line." (WCGS-F)

Comment: Attachment II, comment 9. Page 2-39, Line 10. Reference to CTR-1, CTR-2 & CTR-3 should be deleted. Neither the KDHE nor WCNOC REMPs use these designators for these locations. (WCGS-F)

Comment: Attachment II, comment 10. Page 2-39, Line 11. "These wells were installed to evaluate the potential for leakage from the buried effluent line." should be removed. (See comment #8). (WCGS-F)

Comment: Attachment II, comment 11. Page 2-39, Lines 16 and18. The reference cited (Earth Tech 2007c) is not included in the Reference Section 2.3. (WCGS-F)

Comment: Attachment II, comment 12. Page 2-44, Lines 1-4. Recommend deleting the second sentence, as it seems to repeat information in the first sentence. Also, page 2-22 line 35, page 4-12 line 22 and page E-24 line 10 discuss the distance from Wolf Creek to its confluence with the Neosho River and cite different distances. (Note: NUREG 0878 cites 5.5. miles). (WCGS-F)

Comment: Attachment II, comment 13. Page 2-44, Lines 23-24. To clarify, 70 cfs is the rate of one makeup pump, which in practice limits the amount that can be diverted from the bypass pipe to 70 cfs. The bypass is rated for higher flows, with experienced maximum approximately 110 cfs. During makeup pumping, the bypass valve is throttled to match one pump's transfer rate (70 cfs). (WCGS-F)

Comment: Attachment II, comment 14. Page 2-45, Line 14. "The auxiliary (emergency) spillway" should be changed to "The blow down structure". (WCGS-F)

Comment: Attachment II, comment 16. Page 2-45, Line 27. To clarify, dam inspection by a professional engineer is required as a result of the implementation of the systems, rather than prior to it. (WCGS-F)

Comment: Attachment II, comment 17. Page 2-50, Line 11. Remove "discharge cove". Fish are not always collected at the discharge cove. (WCGS-F)

Comment: Attachment II, comment 18. Page 2-50, Line 27. Remove "discharge cove". Fish are not always collected at the discharge cove. (WCGS-F)

Comment: Attachment II, comment 19. Page 2-62, Line 21. References to differing ages of the Neosho River and Wolf Creek is unclear, as both are of similar age. (WCGS-F)

Comment: Attachment II, comment 20. Page 2-83, Line 34. Change "2,280" to "1,823". The "2,280" was from a sample obtained at the Oily Waste Outfall 002, not from a well. (WCGS-F)

Comment: Attachment II, comment 21. Page 4-13, Line 17. Remove "Neosho Falls" since the water treatment facility at Neosho Falls has closed. (WCGS-F)

Comment: Attachment II, comment 22. Page 4-36, Line 8. To clarify, impingement data for the MUSH were collected over 20 years ago, however, data for the Coffey County Lake has been collected since 2004. (WCGS-F)

Comment: Attachment II, comment 23. Page 4-64, Lines 32-35. To clarify, for WCGS to use the appropriations water, 250 cfs must remain in the river, thus a withdrawal rate of 120 cfs would require a minimum river flow of 370 cfs. Consequently, the maximum that can be diverted would be less than one-third of the river flow.
Comment: Attachment II, comment 25. Page 4-77, Line 12. Remove "via a permit system" since a permit system is no longer being used at lake access. (WCGS-F)

Comment: Page 2-12, Lines 29 and 36. Is ML0712000055 correct Accession No.? (WCGS-F)

Comment: Page 2-27, Figure 2-6. "Pooling Impoundment" should be "Cooling Impoundment". (WCGS-F)

Comment: Page 2-27, Figure 2-6. The source for the figure "WCNOC 2007h) appears to be incorrect. (WCGS-F)

Comment: Page 2-28, Footnote (c). "KDEH" should be "KDHE". (WCGS-F)

Comment: Page 2-29, Line 1. "OCDM" should be "ODCM". (WCGS-F)

Comment: Page 2-30, Line 1. "2005" should be changed to "2006" since data was derived from the 2006 Annual Radiological Environmental Operating Report. (WCGS-F)

Comment: Page 2-36, Line 32. Change to read "Operating Report. The most recent report was". (WCGS-F)

Comment: Page 2-58, Line 3. Plafkin et. al. may need to be Platkin et. al. (WCGS-F)

Comment: Page 2-59, Lines 27-28. Reference WCNOC 2007 may need to be EA 1988. (WCGS-F)

Comment: Page 2-62, Line 11. "Neosho River these /Wolf Creek" should be "Neosho River/Wolf Creek". (WCGS-F)

Comment: Page 2-62, Lines 13 & 18. Reference WCNOC 2007 may need to be EA 1988. (WCGS-F)

Comment: Page 2-102, Lines 28-30. This reference may be the same as USACE 2002 cited on page 2-111, lines 11-13. (WCGS-F)

Comment: Page 2-110, Line 6. "right" may need to be D. Wright. (WCGS-F)

Comment: Page 4-37, Line 8. "Coffee" should be Coffey. (WCGS-F)

Comment: Page 4-37, Line 39. "recalculating" may need to be recirculating. (WCGS-F)

Comment: Page 4-38, Line 20. "northeast" should be "northwest". (WCGS-F)

Comment: Page 4-54, Line 19. "79 an 85" should be "79 and 85". (WCGS-F)

Comment: Page 8-9, Line 35. "site and, as well as," should be "site, as well as,". (WCGS-F)

Comment: Page 8-14, Line 16. "time" should be "times". (WCGS-F)

Comment: Page 8-14, Line 30. "environmental" should be "environment". (WCGS-F)

Comment: Page 8-31, Line 40. "long" should be "along". (WCGS-F)

Comment: Page A-1, Line 20. "Coffee" should be "Coffey". (WCGS-F)

Response: *These comments are editorial in nature. The comments have been incorporated into the SEIS as appropriate.*

Appendix B

Contributors to the Supplement

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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 (NRC). The statement was prepared by members of the Office of Nuclear Reactor Regulation with assistance from other NRC organizations, Earth Tech, Inc. and Information Systems Laboratories, Inc.

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Appendix C

Chronology of NRC Staff Environmental Review Correspondence Related to Wolf Creek Nuclear Operating Corporation's Application for License Renewal of Wolf Creek Generating Station

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Chronology of NRC Staff Environmental Review Correspondence Related to Wolf Creek Nuclear Operating Corporation's Application for License Renewal of Wolf Creek Generating Station

This appendix contains a chronological listing of correspondence between the U.S. Nuclear Regulatory Commission (NRC) and Wolf Creek Nuclear Operating Corporation (WCNOC) and other correspondence related to the NRC staff's environmental review, under 10 CFR Part 51, of WCNOC's application for renewal of the Wolf Creek Generating Station (WCGS) 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 Documents Access and Management System (ADAMS), which provides text and image files of NRC's public documents in the publicly available records component of ADAMS. The ADAMS accession number for each document is included below.

September 27, 2006	Letter from Mr. Terry J. Garrett, Wolf Creek Nuclear Operating Corporation, to NRC submitting the application for the renewal of the operating license for Wolf Creek Generating Station. (Accession No. ML062770301).
October 12, 2006	Letter from NRC to Mr. Terry J. Garrett, Wolf Creek Nuclear Operating Corporation, regarding receipt and availability of the License Renewal Application for Wolf Creek Generating Station, Unit 1. (Accession No. ML062840512).
October 18, 2006	Federal Register Notice of receipt of application for renewal of Facility Operating License No. NPF-42 for an additional 20-year period. (71FR61512).
November 3, 2006	Letter from Ms. V.M. Rodriguez, NRC, Washington, DC, to Mr. T.J. Garrett, WCNOC regarding License Renewal Application for Wolf Creek Generating Station, Unit 1. (Accession No. ML063260283).

November 17, 2006	Letter from Mr. M.W. Sunseri, Wolf Creek Nuclear Operation Corporation to NRC Document Control Desk, Docket No. 50-482: Supplemental Environmental Information to Support the Application for Renewed Operating License for Wolf Creek Generating Station. (Accession No. ML063070581).
November 22, 2006	Letter from NRC to Mr. Don L. Klima, Advisory Council on Historic Preservation regarding Wolf Creek Generating Station License Renewal Application Review. (Accession No. ML063210199).
November 29, 2006	Letter from NRC to Mr. Rey Kitchkumme, Prairie Band of Potawatomi Tribal Council regarding request for comments on the Wolf Creek Generating Station License Renewal Application Review. (Accession No. ML063280160).
November 29, 2006	Letter from NRC to Ms. Fredia Perkins, Sac and Fox Nation of Missouri regarding request for comments on the Wolf Creek Generating Station License Renewal Application Review. (Accession No. ML063280164).
November 29, 2006	Letter from NRC to Mr. Steve Cadu, Kickapoo Tribe in Kansas regarding request for comments on the Wolf Creek Generating Station License Renewal Application Review. (Accession No. ML063280165).
November 29, 2006	Letter from NRC to Mr. Paul Spicer, Seneca-Cayuga Tribe of Oklahoma regarding request for comments on the Wolf Creek Generating Station License Renewal Application Review. (Accession No. ML063280168).
November 29, 2006	Letter from NRC to Mr. Jim Gray, Osage Tribe of Oklahoma regarding request for comments on the Wolf Creek Generating Station License Renewal Application Review. (Accession No. ML063280169).
November 29, 2006	Letter from NRC to Mr. Eugene Little Coyote, Northern Cheyenne Tribal Council regarding request for comments on the Wolf Creek Generating Station License Renewal Application Review. (Accession No. ML063280170).
November 29, 2006	Letter from NRC to Mr. Darrell Flyingman, Cheyenne-Arapaho Tribe regarding request for comments on the Wolf Creek Generating Station License Renewal Application Review. (Accession No. ML063310013).

January 11, 2007	Letter from NRC to Mr. Terry J. Garrett, Wolf Creek Nuclear Operating Corporation, regarding Response to Request for Additional Information Regarding the Review of the License Renewal Application. (Accession No. ML070180367).
January 19, 2007	Summary of Public Scoping Meetings Conducted Related to the Review of the Wolf Creek Generating Station, License Renewal Application. (Accession No. ML070220041).
January 29, 2007	Letter from U.S. Fish and Wildlife Service, providing a response to the December 7, 2006 NRC staff letter requesting a list of protected species within the area under evaluation for license renewal of Wolf Creek Generation Station. (Accession No. ML070330025).
January 31, 2007	Letter from U.S. Environmental Protection Agency, Wolf Creek Generating Station, License Renewal, Coffey County, Kansas. (Accession No. ML070430252).
February 7, 2007	Letter from NRC to Mr. Terry J. Garrett, Wolf Creek Nuclear Operation Corporation, regarding Request for Additional Information pertaining to Severe Accident Mitigation Alternatives for Wolf Creek Generating Station (TAC No. MD3182) (Accession No. ML070240554).
February 21, 2007	Letter from NRC to Mr. Terry J. Garrett, Wolf Creek Nuclear Operating Corporation, regarding Environmental Site Audit Regarding Wolf Creek Generating Station License Renewal Application. (TAC No. MD3182) (Accession No. ML070230546).
May 1, 2007	Issuance of Environmental Scoping Summary Report Associated with the Staff's Review of the Application by Entergy Nuclear Operations, Inc., for Renewal of the Operating License for Wolf Creek Generating Station. (TAC NO. MD3182) (Accession No. ML070850538).
April 4, 2007	Email from NRC to Mr. Charlie M. Medenciy, Wolf Creek Nuclear Operation Corporation, regarding Extension Request for SAMA RAIs. (Accession No. ML070960083).
April 7, 2007	Letter from NRC to Wolf Creek Nuclear Operating Corporation Regarding Summary of Telephone Conference Call held on March 20, 2007, between the U.S. Nuclear Regulatory commission and Wolf Creek Nuclear Operating Corporation, concerning the analysis of severe

November 29, 2006	Letter from NRC to Mr. Leon Campbell, Iowa Tribe of Kansas and Nebraska regarding request for comments on the Wolf Creek Generating Station License Renewal Application Review. (Accession No. ML063310014).
November 29, 2006	Letter from NRC to Mr. Ivan Posey, Shoshone and Arapaho Joint Tribal Business Council regarding request for comments on the Wolf Creek Generating Station License Renewal Application Review. (Accession No. ML063310016).
November 29, 2006	Letter from NRC to Ms. Jennie Chinn, State Historical Preservation Officer, Kansas State Historical Society regarding Wolf Creek Generating Station License Renewal Application. (Accession No. ML063210171).
November 30, 2006	Letter from NRC to Mr. Mike LeValley, U.S. Fish and Wildlife Service, regarding request for a list of the protected species within the area under evaluation for the Wolf Creek Generating Station License Renewal Application Review. (Accession No. ML063340137).
November 30, 2006	Letter from NRC to Mr. Terry J. Garrett, Wolf Creek Nuclear Operating Corporation, regarding Determination of Acceptability and Sufficiency for Docketing, Proposed Review Schedule, and Opportunity for a Hearing regarding the Application from Entergy for Renewal of the Operating License for the Wolf Creek Generating Station, Unit 1. (Accession No. ML063240216).
December 5, 2006	NRC press release announcing the opportunity to request a hearing on license application for Wolf Creek Nuclear Power Plant. (Accession No. ML063390067).
December 7, 2006	Federal Register Notice of acceptance for docketing of the application and notice of opportunity for a hearing regarding the application for license renewal of Wolf Creek Generating Station. (71 FR 70997).
December 12, 2006	Letter from NRC to Mr. Terry J. Garrett, Wolf Creek Nuclear Operating Corporation, regarding Request for Additional Information for the Review of the Wolf Creek Generating Station, Unit 1, License Renewal Application. (Accession No. ML063420403).
December 13, 2006	NRC press release announcing two public meetings to discuss license renewal process for Wolf Creek Nuclear Power Plant. (Accession No. ML063470208).

	accident mitigation alternatives pertaining to the Wolf Creek Generating Station, Unit 1, License Renewal Application. (Accession No. ML070930584).
April 9, 2007	Letter from NRC to Mr. Terry J. Garrett, Wolf Creek Nuclear Operation Corporation, Request for Additional Information Regarding the Environmental Review for Wolf Creek Generating Station License. (Accession No. ML070851188).
April 18, 2007	E-mail from Ms. Lorrie Bell, Wolf Creek Nuclear Operating Corporation to Mr. Christian Jacobs, NRC regarding Response to questions posed by NRC during March 20, 2007 telecon. (Accession No. ML071080261).
April 20, 2007	Letter from Mr. Terry J. Garrett, Wolf Creek Nuclear Operation Corporation to NRC Document Control Desk. Subject: Docket No. 50-482: Response to Request for Additional Information Regarding Severe Accident Mitigation Alternatives for Wolf Creek Generating Station. (Accession No. ML071160203).
April 27, 2007	Letter from NRC to Wolf Creek Nuclear Operating Corporation Regarding Summary of Environmental Site Audit Related to the Review of the License Renewal Application for Wolf Creek Generating Station, Unit 1. (Accession No. ML071030077).
May 23, 2007	Email from Mr. Christian Jacobs, NRC to Mr. Charlie Medenciy, Wolf Creek Nuclear Operating Corporation regarding SAMA questions on Wolf Creek LRA. (Accession No. ML071590342).
June 1, 2007	Email from Mr. Charlie Medenciy, Wolf Creek Nuclear Operating Corporation to Mr. Christian Jacobs, NRC Regarding SAMA Follow-up Response. (Wolf Creek Generating Station) (Accession No. ML071590339).
June 20, 2007	Fax from Mr. Charlie Medenciy, Wolf Creek Nuclear Operating Corporation to Mr. Christian Jacobs, NRC Regarding an error in the output of the SECPOP2000 program. (Accession No. ML071720273).
June 26, 2007	Letter from Mr. Terry J. Garrett, Wolf Creek Nuclear Operating Corporation, to NRC, ET 07-0023, Docket No. 50-482: Response to NRC Requests for Follow-up Information Regarding Severe Accident Mitigation Alternatives for Wolf Creek Generating Station License Renewal Application. (Accession No. ML071840190).

June 26, 2007	Letter from Mr. Terry J. Garrett, Wolf Creek Nuclear Operating Corporation, to NRC, ET 07-0026, Docket No. 50-482: Response to NRC Requests for Follow-up Information Regarding Severe Accident Mitigation Alternatives for Wolf Creek Generating Station License Renewal Application. (Accession No. ML071840188).
July 6, 2007	Letter from Mr. Christian Jacobs, NRC, to Wolf Creek Nuclear Operating Corporation, Summary of Telephone Conference Call Held on May 24, 2007, Between the U.S. Nuclear Regulatory Commission and Wolf Creek Nuclear Operating Corporation, Concerning the Analysis of Severe Accident Mitigation Alternatives Pertaining to the Wolf Creek Generating Station, Unit 1, License Renewal Application. (Accession No. ML071602012).
July 11, 2007	Emails between Mr. Christian Jacobs, NRC, and Mr. Charlie Medenciy, Wolf Creek Nuclear Operating Corporation Regarding CR Fire CDF Issue Clarification. (Accession No. ML071940442).
July 13, 2007	Letter from the Mr. Christian Jacobs, NRC to Wolf Creek Nuclear Operating Corporation, Summary of Telephone Conference Call held on June 21, 2007, Between the U.S. Nuclear Regulatory Commission and Wolf Creek Nuclear Operating Corporation, Concerning Water Use of John Redmond Reservoir by the Wolf Creek Generating Station. (Accession No. ML071840181).
July 13, 2007	Letter from Mr. Terry J. Garrett, Wolf Creek Nuclear Operating Corporation, to NRC, ET 07-0029, Docket No. 50-482: Summary of the Impact to Wolf Creek Generating Station License Renewal Application Severe Accident Mitigation Alternatives Analysis due to Computer Program Error. (Accession No. ML072000312).
August 15, 2007	Letter from Mr. Terry J. Garrett, Wolf Creek Nuclear Operating Corporation, to NRC, ET 07-0035, Docket No. 50-482: Summary of the Impact to Wolf Creek Generating Station License Renewal Application Severe Accident Mitigation Alternatives Analysis due to Computer Program Error. (Accession No. ML072340443).
September 18, 2007	Letter from Ms. Rani Franovich, NRC to Wolf Creek Nuclear Operating Corporation: Notice of Availability of the Draft Plant-Specific Supplement 32 to the Generic Environmental Impact Statement for License Renewal of Nuclear Plants Regarding Wolf Creek Generating Station, Unit 1. (Accession No. ML072220449).

September 19, 2007	Letter from Ms. Rani Franovich, NRC to Ms. Jennie Chinn, State Historical Preservation Officer, Kansas State Historical Society, Regarding Wolf Creek Generating Station License Renewal Application Review. (Accession No. ML072280571).
September 19, 2007	NRC press release announcing the opportunity to comment on a Draft Environmental Impact Statement for Wolf Creek License Renewal Application. (Accession No. ML072620531).
September 20, 2007	Letter from Ms. Rani Franovich, NRC to Mr. Mike LeValley, United States Fish and Wildlife Service, Kansas Field Office, Regarding Biological Assessment for License Renewal of Wolf Creek Generating Station (TAC No. MD3182). (Accession No. ML072420147).
September 24, 2007	Letter from Ms. Terressa Barnes, NRC to the United States Environmental Protection Agency, Office of Federal Activities, NEPA Compliance Division, EIS Filing Section, Regarding Notice of Availability of the Draft Plant-Specific Supplement 32 to the Generic Environmental Impact Statement for License Renewal of Nuclear Plants Regarding Wolf Creek Generation Station, Unit 1. (Accession No. ML072280526).
September 24, 2007	Letter from Mr. Jim Hays, Kansas Department of Wildlife & Parks to Ms. Rani L. Franovich, NRC, Regarding U.S. Nuclear Regulatory Commission for Supplement 32 to the Generic Environmental Impact Statement for License Renewal of Nuclear Plants Regarding Wolf Creek Generation Station, Unit 1. (Accession No. ML072820287).
September 25, 2007	Federal Register notice of availability of the Draft Supplement 32 to the Generic Environmental Impact Statement for License Renewal of Nuclear Plants, and Public Meeting for the License Renewal of Wolf Creek Generating Station, Unit 1 (72 FR 54469-54470)
October 8, 2007	Letter from Mr. Patrick Zollner, Kansas State Historical Society to Ms. Rani Franovich, NRC, Regarding License Renewal Application Review, Wolf Creek Generating Station, Coffey County Kansas. (ADAMS Accession No. ML072960312).
December 7, 2007	Letter from Mr. Terry J. Garrett, Wolf Creek Nuclear Operating Corporation to NRC, Regarding Docket No. 50-482: Comments on NUREG-1437 Supplement 32, Draft Generic Environmental Impact Statement for License Renewal of Nuclear Plants, Regarding Wolf Creek Generation Station, Unit 1 (ADAMS Accession No. ML073600846).

December 18, 2007	Letter from NRC to Wolf Creek Nuclear Operating Corporation, Summary of Public Meetings on the Draft Supplemental Environmental Impact Statement Regarding the Wolf Creek Generating Station License Renewal Review, TAC No. MD3181. (ADAMS Accession No. ML 073320343).
December 18, 2007	Letter from Mr. Robert F. Stewart, U.S. Geological Survey to NRC Regarding the US. Department of the Interior review of the DEIS Wolf Creek Generating Station. (ADAMS Accession No. ML073650056).
December 19, 2007	Letter from Ms. Cheryl Crisler, U.S. Environmental Protection Agency, Region VII, to NRC Regarding Wolf Creek Generation Station License Renewal, Coffey County, Kansas NUREG-1437, Supplement 32, Draft Report for Comment. (ADAMS Accession No. ML073650068).
December 21, 2007	Letter from Mr. Michael J. LeValley, U.S. Fish and Wildlife Service to NRC Regarding the DSEIS Wolf Creek. (ADAMS Accession No. ML073650064).
January 8, 2008	Letter from Mr. Terry J. Garrett, Wolf Creek Nuclear Operating Corporation, to NRC Document Control Desk Regarding Docket No. 50-482: Summary of the Impact to Wolf Creek Generating Station License Renewal Application Severe Accident Mitigation Alternative Analysis due to computer Program Errors. (Accession No. ML080160124).

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:

City of Burlington, Kansas

City of Emporia, Kansas

Coffey County, Kansas

Corporation Commission, Topeka, Kansas

Kansas Department of Agriculture, Division of Water Resources

Kansas Department of Health and Environment (KDHE), Division of Environment, Bureau of Air and Radiation

Kansas Department of Health and Environment (KDHE), Division of Environment, Bureau of Water, Watershed Management Section

Kansas Department of Health and Environment (KDHE), Division of Environment, Bureau of Water, Public Water Supply Section

Kansas Department of Health and Environment (KDHE), Division of Environment, Bureau of Water, Industrial Programs Section

Kansas Department of Transportation

Kansas Department of Wildlife and Parks

Kansas State Historical Society, State Historic Preservation Office

Kansas Water Office

Lyon County, Kansas

Organizations Contacted

U.S. Army Corps of Engineers

U.S. Environmental Protection Agency, Region 7

U.S. Fish and Wildlife

U.S. Geological Survey

Appendix E

Wolf Creek Generating Station
Compliance Status and Consultation Correspondence

Appendix E

Wolf Creek Generating Station Compliance Status and Consultation Correspondence

Correspondence received during the process of evaluation of the application for renewal of the license for Wolf Creek Generating Station (WCGS) 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 WCGS are listed in Table E-2.

Table E-1. Consultation Correspondence

Source	Recipient	Date of Letter
U.S. Geological Survey (R. F. Stewart)	U.S. Nuclear Regulatory Commission	December 18, 2007
U.S. Fish and Wildlife Service (M. J. LeValley)	U.S. Nuclear Regulatory Commission	January 29, 2007
U.S. Environmental Protection Agency (K.O. Johnson)	U.S. Nuclear Regulatory Commission	January 31, 2007

Table E-2. Federal, State, Local, and Regional Licenses, Permits, Consultations, and Other Approvals for Wolf Creek Generating Station

Agency	Authority	Requirement	Number	Issue or Expiration Date	Activity Covered
Kansas Department of Health and Environment	Nuclear Development and Radiation Control Act (L. 1963, Ch. 290); Kansas Annotated Regulations 28-35-133 through 28-35-363	Radioactive Materials License	21-B690-01	Issued on 09/30/2005 Expires on 06/30/2006	Authorizes the transfer, receipt, possession, and use of radioactive material.
Kansas Department of Health and Environment		Aboveground Storage Tank Permits	Facility ID 23762	Issued on 08/01/2005 Expires on 7/31/2006	Authorizes operation of aboveground storage tanks.
Kansas Department of Health and Environment		Underground Storage Tank Permits	Facility ID 23762	Issued on 08/01/2005 Expires on 7/31/2006	Authorizes operation of underground storage tanks.
Kansas Department of Health and Environment, Bureau of Air and Radiation	K.S.A. 65-3008; K.A.R. 28-19-540	Air Emission Source Class II Operating Permit	0310021	Issued on 09/08/2005 No expiration date	Established emissions limits.

Table E-2. (cont'd)

Agency	Authority	Requirement	Number	Issue or Expiration Date	Activity Covered
Kansas Department of Health and Environment, Bureau of Epidemiology and Disease Prevention		Consultation	Requires the applicant to consult with the State agency as to whether there is a concern about the potential *existence and concentration of Naegleria* fowleri in the receiving waters for plant cooling water discharge.	Kansas Department of Health and Environment, Bureau of Epidemiology and Disease Prevention	
Kansas State Historical Society		Consultation	Requires Federal agency issuing license to consider cultural impacts and consult with State Historic Preservation Officer (SHPO).	Kansas State Historical Society	
Kansas Water Resources Board		Use of State water	76-2	Issued on 01/01/1978 Expires on 12/31/2017	Authorizes withdrawal of water from John Redmond Reservoir.
South Carolina Department of Health and Environmental Control, Division of Waste Management	Act No. 429 of 1980, South Carolina Radioactive Waste Transportation and Disposal Act	South Carolina Waste Transport Permit	0223-15-06-X	Issued on 11/18/2005 Expires on 12/31/2006	Authorizes transportation of waste into or within the State of South Carolina.

Table E-2. (cont'd)

Agency	Authority	Requirement	Number	Issue or Expiration Date	Activity Covered
Tennessee Department of Environment and Conservation – Division of Radiological Health	Tennessee Code Annotated 68-202-206	License to Ship Radioactive Material	T-KS001-L06	Issued on 11/17/2005 Expires on 12/31/2006	Authorizes shipment of radioactive material to a licensed disposal/processing facility within the State of Tennessee.
U.S. Department of Transportation	79 CFR Part 107, Subpart G; 49 USC 5108	Hazardous Materials Certificate of Registration	052703 001 005LN	Issued 05/28/2003 Expires 06/30/2006	
U.S. Environmental Protection Agency (EPA); Kansas Department of Health and Environment – Bureau of Water	Clean Water Act (33 USC Section 1251 et seq.); Kansas Statutes Annotated 65-164 and 65-165	Kansas Water Pollution Control Permit	Kansas: I-NE07-PO02 Federal: KS0079057	Issued on 02/01/2005 Expires on 12/31/2008	Contains effluent limits for WCGS discharges to the Neosho River via Wolf Creek via Wolf Creek Cooling Impoundment, Neosho River Basin.
U.S. Fish and Wildlife Service (USFWS)	Endangered Species Act Section 7 (16 USC 1536)	Consultation	Requires Federal agency issuing a license to consult with USFWS.	U.S. Fish and Wildlife Service (USFWS)	Endangered Species Act Section 7 (16 USC 1536)
U.S. Nuclear Regulatory Commission	Atomic Energy Act (42 USC 2011, et seq.), 10 CFR 50.10	License to Operate	NPF-42	Issued on 06/04/1985 Expires on 03/11/2025	Operation of Unit 1

Table E-2. (cont'd)

Agency	Authority	Requirement	Number	Issue or Expiration Date	Activity Covered
U.S. Nuclear Regulatory Commission	Atomic Energy Act (42 USC 2011 et seq.)	License Renewal	Environmental Report submitted in support of license renewal application	U.S. Nuclear Regulatory Commission	Atomic Energy Act (42 USC 2011 et seq.)
Utah Department of Environmental Quality – Division of Radiation Control	R313-26 of the Utah Radiation Control Rules	Generator Site Access Permit	0309 002 468	Issued on 11/23/2005 Expires on 11/23/2006	Authorizes delivery of radioactive material to a land disposal facility within Utah.

United States Department of the Interior

OFFICE OF THE SECRETARY
Office of Environmental Policy and Compliance
Denver Federal Center, Building 56, Room 1003
Post Office Box 25007 (D-108)
Denver, Colorado 80225-0007

TAKE PRIDE IN AMERICA

December 18, 2007

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RULES AND DIRECTIVES BRANCH USNRC

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ER 07/784

Chief, Rulemaking, Directives and Editing Branch
U.S. Nuclear Regulatory Commission
Mail Stop T6-D59
Washington, DC 20555-0001

Dear Sir/Madam:

The U.S. Department of the Interior has reviewed the subject Draft Generic Environmental Impact Statement (DEIS) for License Renewal of Nuclear Plants, Supplement 32 to NUREG-1437, Wolf Creek Generating Station, Burlington, Coffey County, Kansas, and offers the following comments.

SPECIFIC COMMENTS

Section 2.2.5.1.2, Neosho River and John Redmond Reservoir, page 2-47, line 18

The reference Osterkamp and Hedman (1981) is not listed in the references section at the end of the chapter.

Section 2.2.5.1.2, Neosho River and John Redmond Reservoir, page 2-47, lines 29-39

The paragraph provides a discussion of annual streamflow statistics for three USGS gaging stations on the Neosho River. Annual streamflow statistics at two of the gaging sites are for the period 1964 to 2004; however, a period of 1994 to 2004 was selected for the third site (Neosho River near Iota, Kansas; USGS number 07183000). It is suggested that the same period of record be used in the analysis. Further, the annual statistics reported for this site during the abbreviated period of 1994-2004 are not correct. Annual streamflow statistics for the Neosho River near Iota are available on the Internet at:
http://waterdata.usgs.gov/ks/nwis/annual/?referred_module=sw&site_no=07183000&por_07183000_1=92933,00060,1,1896,2006&year_type=W&format=html_table&date_format=YYYY-MM-DD&rdb_compression=file&submitted_form=parameter_selection_list

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Add - C. Jacobs (CJJ)

Section 2.2.5, Aquatic Resources, pages 2-42 – 2-48; and Section 4.1.2, Entrainment of Fish and Shellfish in Early Life Stages, and Section 4.1.3, Impingement of Fish and Other Aquatic Organisms, pages 4-20 – 4-37

The DEIS contains several statements of fact and species observations without the benefit of supporting references. The final EIS would be enhanced if the document included supporting references for such statements of fact and field surveys. Examples include, but are not limited to, the following:

- "Aquatic vegetation indicator samples for KDHE were collected...between July and September 2005 and April and June 2006." (page 2-51, 2nd paragraph)
- "Limited data on larval fish...have been collected by WCNOC...These samples were collected monthly from...to determine approximate peak occurrence of larvae." (page 4-21, 1st and 2nd full paragraphs)
- "Although sample sizes were small, the results indicated that larval fish densities were much lower upstream of the cooling water intake in Coffey County Lake than in the Neosho River." (page 4-21, 3rd full paragraph)
- "Least terns were recorded...but nesting has not been observed there." (page 4-73, 2nd full paragraph)
- "The bird collision survey...and the area of the Lime Sludge Pond." and "The dead bird surveys began in February 1983 and continued through February 1988." (page 4-73, 4th full paragraph and top of page 4-74, respectively)

Thank you for the opportunity to review and comment on this DEIS. If you have any questions concerning our comments, please contact Lloyd Woosley, Chief of the USGS Environmental Affairs Program, at (703) 648-5028 or at lwoosley@usgs.gov.

Sincerely,

Robert F. Stewart

Robert F. Stewart
Regional Environmental Officer

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Kansas Ecological Services Field Office
2609 Anderson Avenue
Manhattan, Kansas 66502-6172

January 29, 2007

Chief, Rules and Directives Branch
Division of Administrative Services
Office of Administration, Mail Stop T-6D59
US Nuclear Regulatory Commission
Washington, D.C. 20555-0001

12/07/06
71FR 70997
2

RE: ER06/1173 NOI Wolf Creek, dated 12/7/2006, page 70997 FWS Tracking # 2007-P-0204

Dear Sirs:

This is in response to your December 7, 2006 notice requesting comment on the proposed renewal of operating license NPF-42, which authorizes the Wolf Creek Generating Station (WCGS), to operate WCGS, Unit 1, for an additional 20 years beyond the period specified in the current license.

The proposed action would include the use and continued maintenance of existing plant facilities and transmission lines. The WCGS site covers approximately 9,818 aces, of which only approximately 135 acres is industrial. Coffey County Lake, the station's cooling reservoir, occupies approximately 5,090 acres. Most of the remaining land is made up of rangeland, cropland, native prairie and forested areas.

In accordance with section 7(c) of the Endangered Species Act, we have determined that the federally-listed threatened bald eagle (*Haliaeetus leucocephalus*), the threatened Mead's milkweed (*Asclepias meadii*) and the threatened Neosho madtom (*Noturus placidus*) may occur in the project area. If the project may adversely affect listed species, the Nuclear Regulatory Commission (NRC) should initiate informal or formal section 7 consultation with this office.

There has been an active bald eagle nest at WCGS since 1994; however, the pair has not successfully fledged any young since 1999. Because of the uncertain reproductive status of this nesting pair and it's proximity to potential source contaminants from WCGS, we recommend further evaluation of the potential affects of WCGS on the bald eagle and other piscivorous bird and mammal species that may occur in the project area.

The many acres of native prairie and rangeland found on WCGS may provide suitable habitat for Mead's milkweed. If these habitats have not been previously surveyed for Mead's milkweed, we recommend a field survey by the Kansas Biological Survey or other qualified botanists. The Kansas Biological Survey may be contacted by writing at 2041 Constant Avenue, Lawrence, Kansas 66047-2906, or by telephone at (785) 864-1538. In addition, if suitable Mead's milkweed habitat is found on site or could be made suitable through management, we would like to discuss with the applicant the potential for transplant and management of this plant on the WCGS site.

The candidate species Neosho mucket (*Lampsilis rafinesqueana*), which is a freshwater unionid mussel,

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Call = V. Rodriguez (VMR1)
C. Jacobs (CJJ)

occurs in the Neosho River within the project area. Candidates are those species for which the USFWS has on file substantial information on biological vulnerability and threats to support proposals to list them as endangered or threatened species. Development and publication of proposed rules to list candidate species as threatened or endangered are anticipated at some point in the future. Candidate species have no legal protection under the Endangered Species Act; however, the USFWS is concerned for their conservation due to their uncertain status.

The Neosho madtom occurs in the Neosho River both upstream and downstream of John Redmond Reservoir. Your National Environmental Policy Act (NEPA) analyses should evaluate the potential direct and indirect effects of water withdrawal from the Neosho River on this species, especially during drought years. Also, due to the aging of the facility and corrosion within the cooling tower structure, trace elements such as nickel, iron and chromium may be accumulating in Coffey County Lake at higher than background levels. The potential exposure of Neosho madtom, bald eagle and the Neosho mucket to these trace elements should be addressed in the NEPA documents.

Transmission lines have been documented as constituting a significant collision hazard to migratory birds including waterfowl, wading birds, shorebirds, and raptors. Project lines occurring within one mile of streams, wetlands, and other water bodies such as the Neosho River, Coffey County Lake, John Redmond Reservoir, and Flint Hills National Wildlife Refuge, should be evaluated for their potential to impact migratory birds. If project lines meet these criteria, and there is little existing field data documenting the presence or absence of a collision hazard, we recommend that line segments be monitored during the renewal process to determine whether a collision hazard exists. If a hazard is identified, line segments should be marked for enhanced visibility following established guidelines.

Thank you for this opportunity to comment. If we can be of further assistance or you need clarification of our comments, please call Ms. Michele McNulty of my staff at 785-539-3474 ext. 106.

Sincerely,

Michael J. LeValley

Michael J. LeValley
Field Supervisor

cc: KDWP, Pratt, KS (Environmental Services)
OEPC – Staff Contact: Vijai Rai, DOI, Denver
Connie Young-Dubovsky, R6, RO, (ES)
Pat Gonzales, Refuge Manager, Flint Hills NWR
FWS—BAP and HC (Nash)

- 2 -

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION VII
901 NORTH 5TH STREET
KANSAS CITY, KANSAS 66101

RECEIVED

2007 FEB -6 PM 3:48

RULES AND DIRECTIVES BRANCH

JAN 3 1 2007

Chief, Rules and Directives Branch
Division of Administrative Services
Office of Administration
U.S. Nuclear Regulatory Commission
Mailstop T-6D 59
Washington, D.C. 20555-0001

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71FR 70997
3

To Whom It May Concern:

RE: Wolf Creek Generation Station License Renewal, Coffey County, Kansas

This letter responds to your November 30, 2006, correspondence regarding National Environmental Policy Act (NEPA) compliance for the proposed Wolf Creek Generation Station License Renewal Project in Coffey County, Kansas. Thank you for including the EPA in your communications to identify the scope of the environmental review for this project.

Our main environmental and human health concerns with nuclear generating stations include safety, water quality, and spent fuel storage. The unintended release of tritium and strontium from plant operations and the impacts on groundwater is an emerging issue at some power plants, as well as the local impacts of transporting high-level waste (spent fuel) once a long-term repository is finalized. We recommend that these issues be analyzed and discussed in the EIS.

Impingement and entrainment at the intakes for the cooling system should also be addressed in the EIS. As you are probably aware, on January 26, 2007, the United States Court of Appeals for the Second Circuit issued a decision remanding to EPA the 2004 Clean Water Act Section 316(b) Phase II rule, which regulates cooling water intake structures at existing power producing facilities, (Riverkeeper, Inc. v EPA , 2d Cir. Jan. 25, 2007). Although this decision may modify the regulation, 316(b) will still apply to the Wolf Creek facility.

We are also interested in how the Nuclear Regulatory Commission will address issues and actions that may arise between the license renewal date in 2009 and 2025 when the renewed license becomes effective. The useful 'life' of an EIS is considered to be 5 years; after that time period, additional analysis and documentation may be required.

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E-RIDS = ADM-03
Add = V. Rodriguez (VMR1)
C. Jacobs (CSS)

RECYCLE

For more information, see the Council of Environmental Quality's (CEQ) website http://ceq.eh.doe.gov/nepa/nepanet.htm and the "Forty Most Asked Questions Concerning CEQ's National Environmental Policy Act Regulations" (http://ceq.eh.doe.gov/nepa/regs/40/30-40.HTM#32).

Thank you again for including us in your scoping efforts for this project. We look forward to meeting with you in the future and reviewing the environmental impact statement. If you have any questions regarding this letter or need any additional information, please call me at 913-551-7975.

Sincerely,

Kimberly O. Johnson, P.E.
NEPA Reviewer

Biological Assessment

Wolf Creek Generating Station
License Renewal

March 2008

Docket Number 50-482

U.S. Nuclear Regulatory Commission
Rockville, Maryland

Biological Assessment of the Potential Effects on Federally Listed Endangered or Threatened Species from the Proposed License Renewal for the Wolf Creek Generating Station

1.0 Introduction

The U.S. Nuclear Regulatory Commission (NRC) issues operating licenses (OLs) for domestic nuclear power plants in accordance with the provisions of the Atomic Energy Act of 1954, as amended, and NRC implementing regulations. The purpose and need for this proposed action, the renewal of the OL for Wolf Creek Generating Station (WCGS), is to provide an option that permits electric power generation to continue beyond the term of the current nuclear power plant OL. This would allow future electric generating needs to be met, if the operator and State regulatory agencies pursue that option.

The NRC is reviewing an application submitted by the Wolf Creek Nuclear Operating Corporation (WCNOC) for the renewal of OL NPF-42 for WCGS for 20 years beyond the current OL expiration date of March 11, 2025. The WCNOC, which operates WCGS, prepared an Environmental Report (ER; WCNOC 2006a) as part of its application for the renewal of the WCGS OL. In the ER, WCNOC 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. The NRC is using the ER and additional information as the basis for this Biological Assessment (BA) and a Supplemental Environmental Impact Statement (SEIS), a plant-specific supplement to the *Generic Environmental Impact Statement for License Renewal of Nuclear Power Plants, NUREG-1437* (NRC 1996). Unless stated otherwise, much of the information in this BA is taken from the ER.

Pursuant to Section 7 of the Endangered Species Act of 1973, as amended, NRC staff requested in a letter dated December 7, 2006 (NRC 2006), that the U.S. Fish and Wildlife Service (FWS) provide information on Federally listed endangered or threatened species, as well as proposed or candidate species, and any designated critical habitats that may occur in the vicinity of WCGS. In a letter to the NRC dated January 29, 2007 (FWS 2007a), the FWS provided information about three Federally listed species and one candidate species with the potential to occur in the project area. One of the three species, the bald eagle (*Haliaeetus leucocephalus*), has been delisted (FWS 2007b) since receipt of the FWS letter. Because Section 7 consultations do not address candidate species, this BA does not include information on the candidate species Neosho mucket (*Lampsilis rafinesqueana*) that may occur in the area. Therefore, this BA examines the potential effects of the continued operation of WCGS on two Federally threatened species: the threatened Neosho madtom *(Noturus placidus)* and the threatened Mead's milkweed *(Asclepias meadii)*.

2.0 The Proposed Federal Action

The proposed Federal action is renewal of the OL for WCGS. The WCGS facility is located in Coffey County in eastern Kansas approximately 75 miles southwest of Kansas City. The location of the facility and the areas within 50-miles (mi) and 6-mi radii of the facility are shown in Figures 2-1 and 2-2, respectively. The plant has one Westinghouse pressurized water reactor with a reactor core power of 3,565 megawatts thermal, and a design net electrical capacity of 1,165 megawatts electric. Plant cooling is provided by a once-through heat dissipation system that withdraws cooling water from, and discharges it to, a cooling pond, Coffey County Lake. The current OL for WCGS expires on March 11, 2025. By letter dated September 27, 2006, WCNOC submitted an application (WCNOC 2006b) to the NRC to renew this OL for an additional 20 years of operation, that is, until March 11, 2045.

There would be no major construction, refurbishment, or replacement activities associated with the license renewal. If the NRC approves the license renewal application, the reactor and support facilities, including the cooling system, would be expected to continue to be operated and maintained until the renewed license expires in 2045. Maintenance activities would also continue to be performed on the transmission lines that connect WCGS to the electric grid, including inspection, surveillance, and vegetation management within the right-of-ways (ROWs).

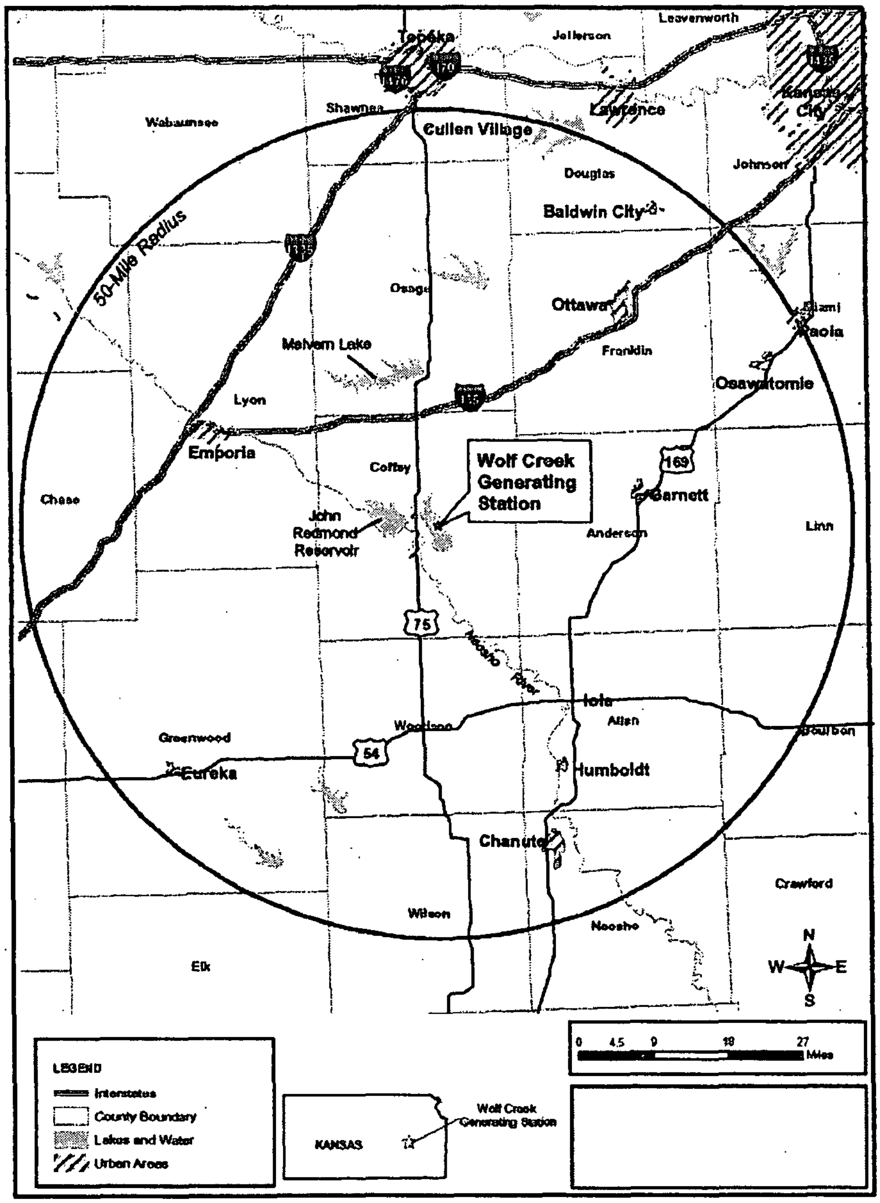
3.0 The Plant and Associated Transmission Line System

3.1 Cooling and Auxiliary Water Systems

WCGS operates as a once-through cooling facility, with Coffey County Lake being the water source for the circulating water condenser cooling system as well as the Service Water System (SWS) and Essential Service Water System (ESWS). Coffey County Lake (formerly known as the Wolf Creek Cooling Lake) also serves as the receiving water body, or cooling pond, for the discharges from the condenser cooling system as well as the other two systems. The source of makeup water for Coffey County Lake is the Neosho River immediately downstream of the John Redmond Reservoir dam. Figure 3-1 shows the locations of WCGS facilities in relation to these water bodies.

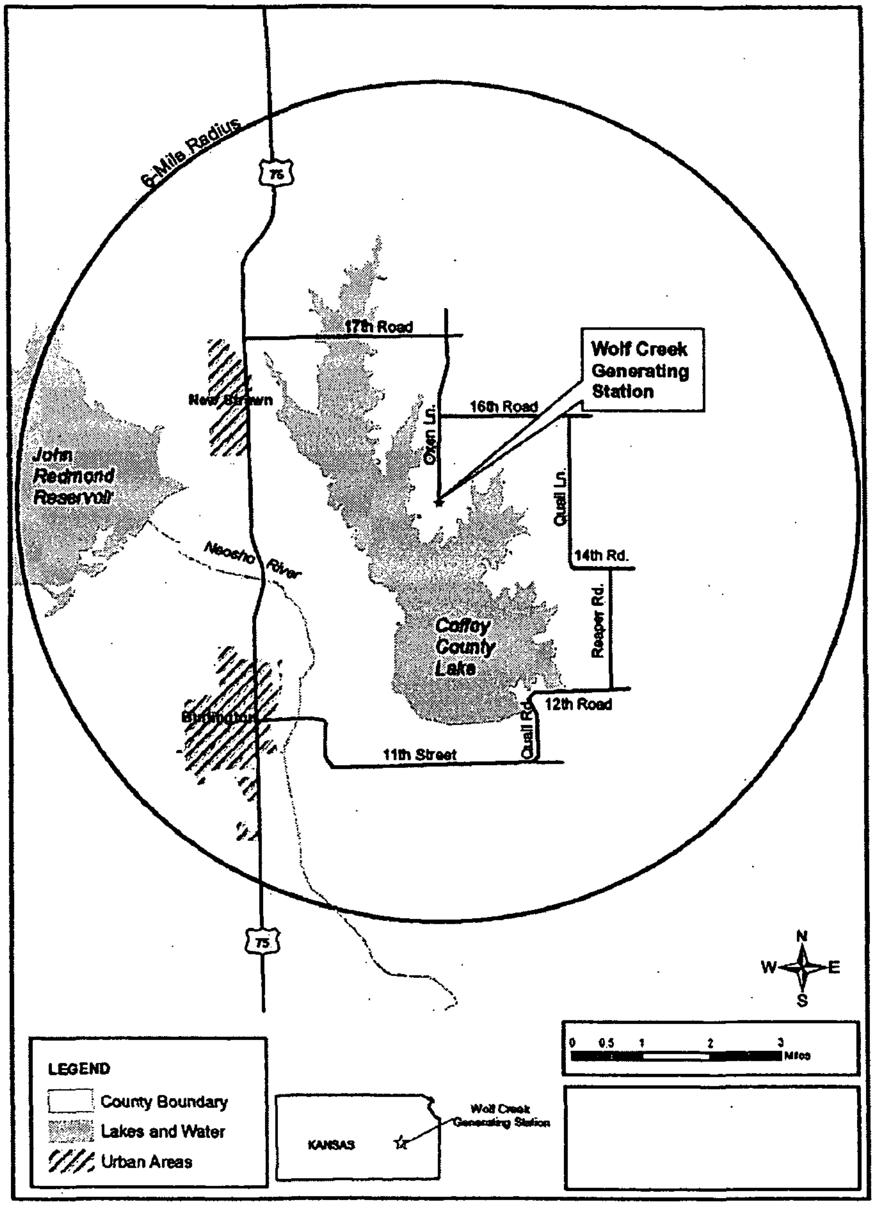
3.1.1 Cooling Water Intake

Condenser cooling water is withdrawn from Coffey County Lake through the circulating water intake structure (CWIS). The CWIS is within the Circulating Water Screenhouse, which is located in the southeast corner of the main facility area on the shore of Coffey County Lake. The screenhouse contains the major equipment associated with the circulating water system and the SWS. The ESWS, described below, is located in a separate building to the northeast of the CWIS.



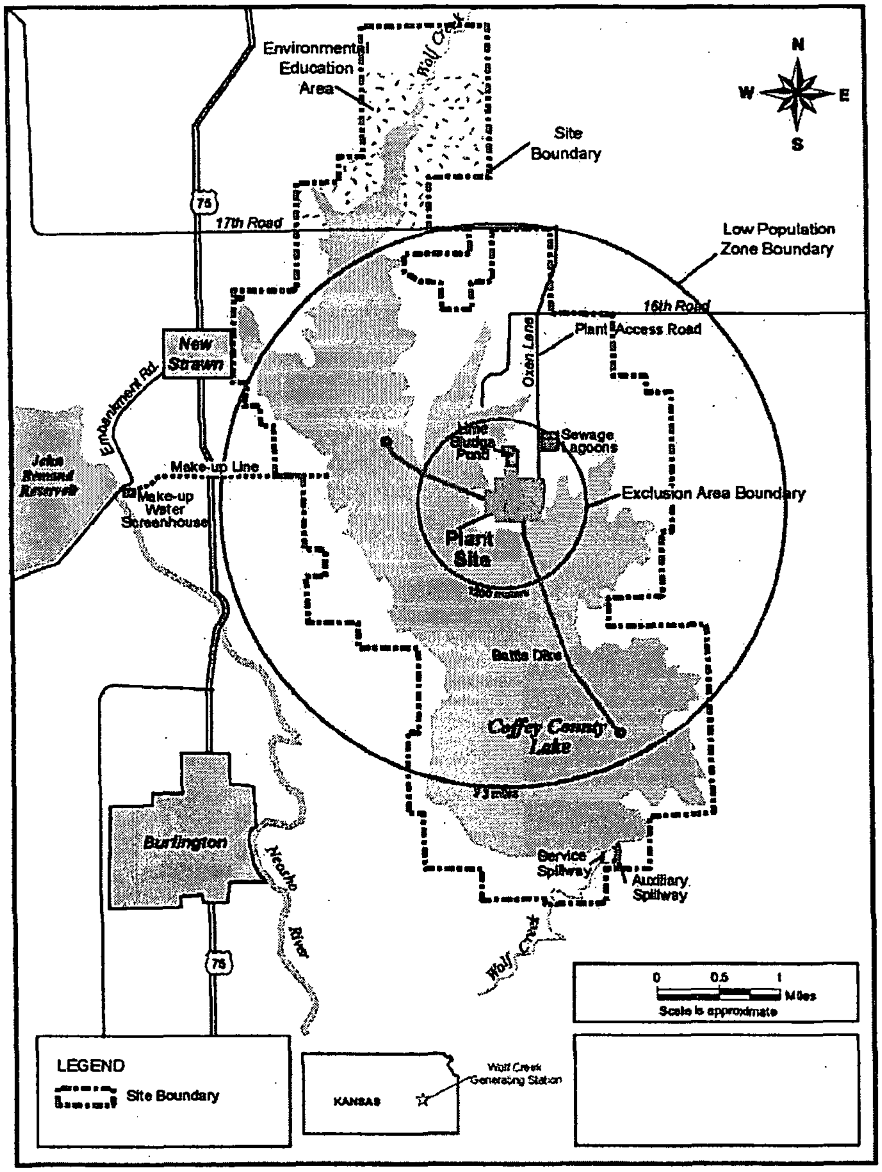
Source: WCNOC 2006a

Figure 2-1. Location of WCGS, 50-mile radius



Source: WCNOC 2006a

Figure 2-2. WCGS, 6-mile radius



Source: WCNOC 2006a

Figure 3-1. WCGS Property Boundaries and Environs

The circulating water and service water flow from the lake past a vertical steel plate used to keep ice from entering the circulating water intake structure (CWIS) and then through bar grills (trash racks) into three separate bays where the traveling screens are located. The bar grills are used for removing the larger debris while the traveling screens are designed to remove smaller debris. The bar grill, located at the inlet of the intake bays, is constructed of 1-inch (in.) vertical bars spaced at 3-in. intervals. These bars have not been cleaned throughout the history of the plant. Behind the bar grill, there are six traveling screens with two traveling screens per bay. The traveling screens are of a vertical single entry/exit type with standard 0.375-in. mesh. The traveling water screens are operated intermittently either by a timer or automatically due to a high-differential-pressure sensor.

There are low- and high-pressure screen washes to rinse debris and organisms off the screens. Typically, the low-pressure wash is used to remove debris and organisms on the screens, but a high-pressure wash can be activated for cleaning or heavy fouling. Debris and organisms washed from the screens are directed to a concrete sluiceway, then to a basket on the outside of the building. From the sluiceway to the basket, there is an approximate 2-foot (ft) drop to the grated basket. Larger debris and organisms remain in the basket until they are manually removed. Cleaning of the basket occurs every 8 hours when there is heavy loading; at other times it may be a few days until the basket is emptied. Smaller debris and organisms pass through the grates and fall approximately 3 to 4 ft to the water surface. Some service water is also discharged into the grated area. The traveling screens are continuously turned if there are winds greater than 25 miles per hour (mph) from the south in October or November or if there is a fish kill. Records are not kept regarding the operation of the screens at Coffey County Lake, but generally they are turned for 30 minutes every eight hours.

The CWIS operates continuously during power generation, including startup and shutdown. Three one-third capacity, motor-driven, vertical, wet-pit circulating water pumps pump the circulating water from the cooling lake to the main condenser. They are designed to operate through the expected range of cooling lake levels. When lake water temperatures are greater than 50 degrees Fahrenheit (°F), three pumps provide the design flow rate of approximately 500,000 gallons per minute (gpm). Under normal conditions all three pumps would be operating at a total capacity of 1,178 cubic feet per second (cfs). Because condenser cooling is more efficient with colder intake water, only two pumps are operated with a design flow of 365,000 gpm when lake temperatures are below 50°F. At these pumping rates, through screen velocity is less than 1.0 foot per second (fps). Based on a total flow rate of 1,256 cfs (circulating water and service water combined), the average intake water velocities are 0.87 fps (approach velocity to the CWIS); 1.06 fps (velocity through the bar grills), 1.06 fps (approach velocity to the traveling screens), and 1.95 fps (velocity through the traveling screens). WCNOC injects anti-scalants and dispersants, biocides, and corrosion inhibitors into the CWIS to maintain the system and prevent fouling by corrosion and biological organisms. Additions of these constituents to the CWIS is limited by the facility's National Pollutant Discharge Elimination System (NPDES) permit.

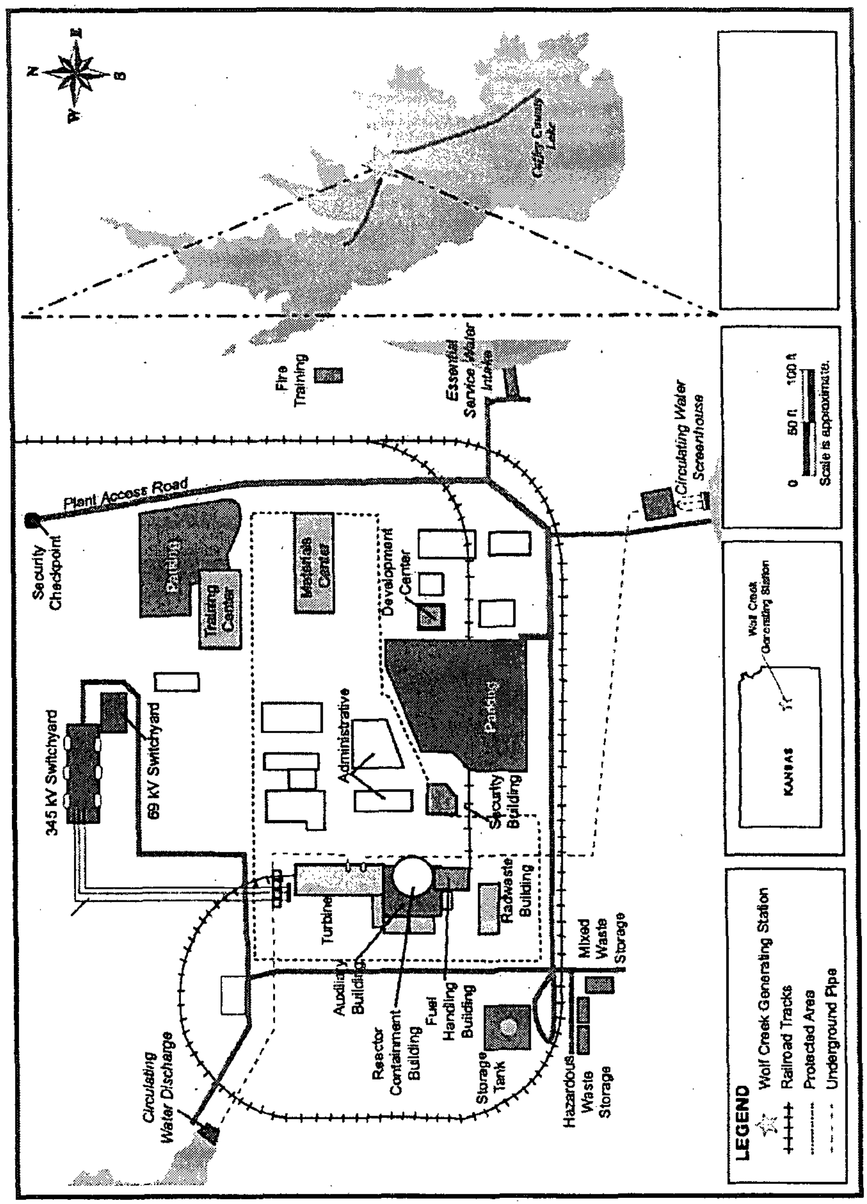
3.1.2 Cooling Water Discharge

After passing through the condenser, the heated water is returned to Coffey County Lake through the circulating water discharge structure located at the northeast corner of the facility (Figure 3-2). This structure has a discharge well that overflows into a 40-ft wide apron and then onto the surface of the lake. The heated effluent is discharged from the circulating water discharge structure into an approximately 290-acre (ac) cove in Coffey County Lake. A baffle dike directs the effluent along a northwesterly path as it leaves the discharge cove to allow greater heat dissipation before warm water mixes with water in the main body of the lake (WCNOC 2006a). Baffle dikes prevent short-circuiting of the discharge water back to the intake (Figure 3-1). The discharged water takes approximately 38 days to travel from the discharge to the intake structure (WCNOC 2007). The maximum increase in discharged water temperature relative to the ambient water temperature of the lake is 30°F, but the normal temperature increase ranges from 0.8°F to 7.6°F.

3.1.3 Service Water Systems

There are two service water systems at WCGS, the main SWS and ESWS. The SWS takes water from the circulating water intake structure and returns the warmed water to the circulating water discharge pipe. The flow rate is variable, but flow rates can be as high as 50,000 gpm. Three service water pumps are housed in the CWIS. Typically, two service water pumps are operating at a total capacity of 90 cfs with one pump serving as a standby. During normal plant operation, the SWS supplies water to the turbine plant auxiliary equipment and the steam generator blowdown nonregenerative heat exchanger. The SWS is the normal water supply for the demineralized water makeup system, the fire protection diesel and electric fire pumps, and the ESWS. Both the SWS and ESWS incorporate the use of oxidants such as chlorine for control of biofouling. Per the facility's NPDES permit, a maximum of 1.0 milligram per liter (mg/L) total residual oxidants is allowed, with up to 22 hours of continuous chlorination (Hammond 2006).

The ESWS cools several safety-class systems and provides cooling for safe shutdown in an accident. During accident conditions, the ESWS intake structure takes water from the Ultimate Heat Sink, a specially designed impoundment within Coffey County Lake in the cove southeast of the facility. An underwater dam prevents draining of the Ultimate Heat Sink in the event of the failure of the Coffey County Lake dam. The ESWS intake structure consists of two totally independent intake systems. Each has a forebay with the same type of trash racks as found in the CWIS; however, there are no vertical steel plates, used for ice protection, as seen in the CWIS. Each system also has a traveling screen similar to the CWIS. Debris and organisms trapped on the traveling screens are diverted to a shared sluiceway that discharges to the



Source: WCNOC 2006a

Figure 3-2. WCGS Facility Layout

outside of the building. Similar to the CWIS, the ESWS screens can be operated automatically or manually. Some service water is diverted to the ESWS consistently to keep the system clean. Heated effluent can also be directed to the intake for ice control. The ESWS is operated infrequently. The discharge goes to a separate discharge structure on the Ultimate Heat Sink.

3.1.4 Makeup Water System

Makeup water for Coffey County Lake is drawn from the Neosho River through the Makeup Water Screen House (MUSH) located approximately 300 ft downstream of the John Redmond Reservoir dam. Water for WCGS leaves John Redmond Reservoir through a 30-in. supply pipe that empties into the Neosho River, where the flow is diverted into a channel on the east side of the river at the MUSH. The MUSH contains three makeup water pumps, each with a dedicated bar grill and 3/8-in. traveling screens. Only two pumps can be used at a time. Each pump is designed to provide 60 cfs through a 54-in.-diameter supply line to Coffey County Lake. This supply line is designed for 130 cfs, with an optimum flow rate of 120 cfs (WCNOC 2006c).

The design and operation of the bar grill and traveling screens are similar to the CWIS. There are no provisions for returning fish that survive impingement to the Neosho River. However, according to WCGS, the design intake velocity of less then 0.5 fps at the normal water level in the river at the MUSH (1,007.5 feet above mean sea level [MSL]) should minimize fish impingement (WCNOC 2006c). From the MUSH, water flows through the supply line to Coffey County Lake and discharges at the makeup water discharge structure on the western shore of the lake, immediately adjacent to the Coffey County Lake boat ramp. The structure consists of a stilling basin/sump wherein the makeup water pipeline discharges. From this sump, the makeup water flows over a weir and down a spillway to the lake.

3.2 Power Transmission System

The applicant identified three 345-kilovolt (kV) transmission lines that were constructed in conjunction with the construction of WCGS in order to connect the facility to the electric power grid:

- Wolf Creek to pre-existing Benton line
- Wolf Creek to pre-existing La Cygne line
- Wolf Creek to Rose Hill substation

Prior to construction of WCGS, a 345-kV transmission line ROW extended from La Cygne (located approximately 60 miles east of WCGS) to Benton (located northwest of Wichita) and traversed the site. This line was rerouted around Coffey County Lake and connected to the WCGS switchyard by constructing a 7-mi segment around the lake on the east end of what became the Wolf Creek – Benton line and a 0.7-mi segment on the west end of what became the Wolf Creek – La Cygne line (Figure 3-3). Both of these lines have 150-ft-wide ROWs that are almost entirely on WCGS property. In addition, a new 345-kV transmission line was built in conjunction with the construction of WCGS, the Wolf Creek – Rose Hill line. This line extends southwest from WCGS for 98 miles within a 150-foot-wide ROW to the Rose Hill Substation located southeast of Wichita (WCNOC 2006a).

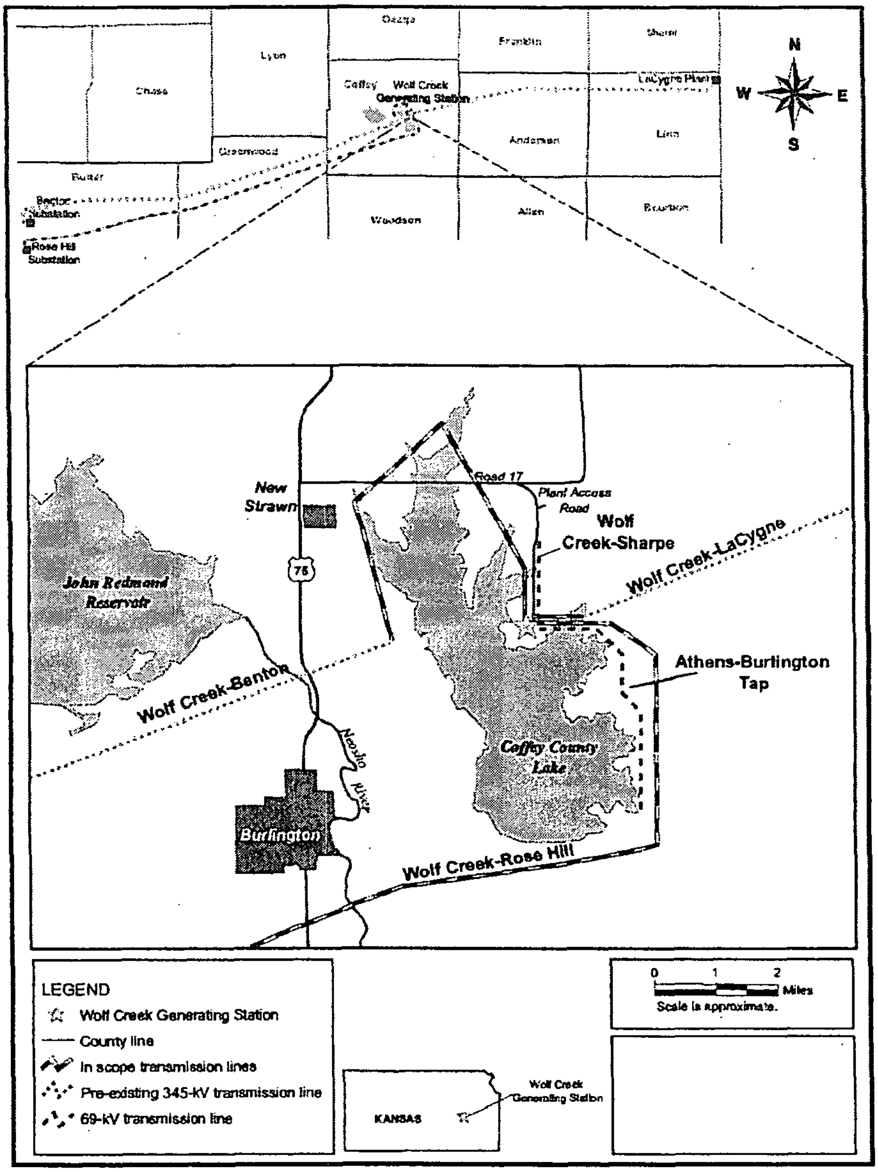
These lines are contained within approximately 106 miles of 150-ft-wide ROWs that include a total area of over 1920 ac in Coffey, Greenwood, and Butler Counties. The transmission line ROWs primarily occur within agricultural and open range lands and cross numerous county, State, and Federal highways. They do not cross any national or State parks, wildlife refuges, or wildlife management areas. The Wolf Creek – Benton line crosses over several inlets and tributaries of Coffey County Lake, and the Wolf Creek – La Cygne and Wolf Creek – Rose Hill lines cross over one inlet of the lake east of the WCGS facility. The Wolf Creek – Rose Hill line also crosses the Neosho, Verdigris, Fall, Little Walnut, and Walnut Rivers, as well as many smaller creeks. It does not cross any major lakes or ponds outside of the WCGS property.

4.0 Environmental Setting

WCGS is located on Coffey County Lake, a man-made lake constructed on Wolf Creek specifically to act as a cooling water reservoir for the facility (WCNOC 2006a). The major features of the WCGS site are the reactor containment building, turbine building, auxiliary building, control building, fuel handling facility, switchyard, radioactive waste building, training center, visitor's center (with associated Emergency Operations Facility and simulator), outdoor firing range, and other supporting buildings (WCNOC 2006a). The area within the site boundaries (Figure 3-1) owned by WCGS includes the 500-ac Wolf Creek Environmental Education Area at the northern end of Coffey County Lake (WCNOC 2006a). The general facility layout is depicted on Figure 3-2.

4.1 Aquatic Resources

The aquatic resources relevant to the operation of WCGS are those associated with Coffey County Lake; Wolf Creek, on which the lake was constructed; and the Neosho River and John Redmond Reservoir, which are affected by the transfer of makeup water to Coffey County Lake. This section provides a description of the aquatic resources potentially affected by the operations of the WCGS.



Source: WCNOC 2006a

Figure 3-3. WCGS Transmission Lines

4.1.1 Wolf Creek and Coffey County Lake

Wolf Creek is a small, intermittent tributary of the Neosho River that begins to the north of Coffey County Lake. The total annual flow for Wolf Creek is approximately 12,985 ac-ft or 18 cfs (WCNOC 2006a). Wolf Creek contributes approximately one percent of the 1,865 cfs average Neosho River water flow measured at Iola (Putnam and Schneider 2005), which is downstream of the confluence of Wolf Creek with the Neosho River.

Coffey County Lake was created by erecting an earthen dam across Wolf Creek that, along with five perimeter saddle dams, serves to impound the creek approximately 5 miles above its confluence with the Neosho River (KG&E 1984). Filling of Coffey County Lake using water from John Redmond Reservoir released into the Neosho River began in October 1989 and was completed in June 1982 (EA 1988). The tops of the dams are at an elevation of 1,100 ft above MSL to allow for sufficient freeboard. Service and auxiliary spillways with ogee crests of 1,088 ft above MSL and 1,090.5 ft above MSL, respectively, were constructed on the east abutment of the main dam to prevent overtopping of the dams by the probable maximum flood and wind and wave action. The normal operating elevation of Coffey County Lake is 1,087 ft above MSL; at this elevation the lake has a capacity of 111,280 ac-ft and covers 5,090 ac (EA 1988), with a maximum depth of 60 ft (KDWP 2007), and an average depth of 21.5 ft (KG&E 1986). At this pool level, the lake is designed to provide adequate cooling water to the plant during a 1 in 50 year drought.

The water level in Coffey County Lake is normally maintained by the watershed; however, during dry months, it is sometimes necessary to pump water to the lake from the Neosho River through the MUSH below the John Redmond Dam. If the flow rate within the Neosho River is below 250 cfs downstream of the intake, then water may be purchased from the conservation pool within John Redmond Reservoir and delivered to the MUSH via a bypass pipe (WCNOC 2006a).

During times of flooding, service and auxiliary spillways provide for controlled release of lake water to prevent overtopping of the Coffey County Lake dam. Although the dam has provisions for releasing water to Wolf Creek (blowdown for chemistry control), such release is infrequently performed. A strong north wind would cause waves to break over the spillways thus causing a release of water to Wolf Creek. Per the facility's NPDES permit, sampling must be conducted whenever a discharge occurs. Discharge occurs relatively infrequently. In 1997, there were 6 separate discharge events; in 1998, 34; 1999, 19; 2000, 3; 2001, 1 event; no events in 2002 to 2004; 7 events in 2005; and 2 events in 2006.

4.1.2 Neosho River and John Redmond Reservoir

The John Redmond Reservoir was created by the construction of John Redmond Dam across the Neosho River approximately 3 miles north and 1 mile west of Burlington, Kansas. The dam and reservoir were completed for full flood control in September 1964. John Redmond Reservoir has a surface area of 9,400 ac with an average depth of 6 ft and a maximum depth of 12 ft. The current water supply, the conservation pool of John Redmond Reservoir, is now at 1,039 ft above MSL (USACE 2007). The amount of water-supply storage in the conservation pool has been reduced by unforeseen sedimentation (Engineering-Environmental Management, Inc. 2002). The reservoir bottom is shallow and flat, which allows for a rapid vegetative response when water is lowered (Jirak 2005). The slope of the Neosho River is very flat as it enters John Redmond Reservoir, contributing to the creation of a mudflat near the entrance to the reservoir and the collection upstream of a large logjam of woody debris approximately 1.5 miles long (USACE 2005).

The Neosho River below the John Redmond Dam to the Kansas-Oklahoma State line is characterized by a meandering channel with a bed that typically consists of a combination of bedrock, cobble, gravel, sand, and silt. The channel slope of the Neosho River below John Redmond Reservoir averages about 1.2 ft/mi (Juracek and Perry 2005). The riverbank height varies from about 15 to 30 ft (Juracek and Perry 2005) with a channel bank that consists of mostly cohesive silt and clay (Osterkamp and Hedman 1981 as cited in Juracek and Perry 2005) and is typically covered by partial to complete mature trees (Juracek and Perry 2005). Changes in the downstream flow as a result of the John Redmond Dam have included a decrease in the magnitudes of peak flows and increase in the magnitude of low flows (Studley 1996). A study conducted by M. Wildhaber, *et al.* (2000) on the Neosho River, found that the water temperature was cooler, turbidity was higher, and the fredle index (a measure of sediment particle size) was marginally lower above the dam than below the dam. Dissolved oxygen increased downriver of the dam, but conductivity, alkalinity, and hardness were all higher above the dam.

The minimum desirable streamflow (MDS) in the Neosho River, downstream of John Redmond Reservoir, is 40 cfs during all times of the year (USGS 2007). As required by the Kansas Water Appropriation Act (KWAA 2004), a minimum flow of 40 cfs in the Neosho River at Iola (approximately 55 river mi south of the John Redmond Dam) is required during the months of July to March, 60 cfs is required in April, and 200 cfs is required in May and June. These flow rates were established as the minimum flows allowable to avoid adverse impacts to the Neosho River instream and riparian communities (WCNOC 2006a). WCGS, however, is not subject to withdrawal restrictions to maintain these minimum flows.

The withdrawal of water from the natural flows within the Neosho River is regulated by the conditions of the two appropriation mechanisms used by WCGS to acquire the water. These conditions require that withdrawals of natural flows can only be made when the flow rate remaining within the Neosho River downstream of the MUSH intake structure is 250 cfs or greater (WCNOC 2006c). However, the appropriation mechanism allows WCNOC to request a variance from the 250 cfs limitation from the Chief Engineer of the Division of Water Resources

(DWR). The appropriation mechanisms are not subject to the MDS restriction of 40 to 200 cfs for the Neosho River.

The resources that could be affected by the purchase of water from the conservation pool are the same as those that could be affected by the WCGS appropriations from the natural flows of the Neosho River. The purchase of the conservation pool water would only occur when the water elevation within John Redmond Reservoir is below 1,039 ft above MSL, and under these conditions, the flow rate within the Neosho River would already be below the 250 cfs required to acquire water through the appropriations (WCNOC 2006c). Therefore, the Neosho River would already be in a low-flow or drought condition (WCNOC 2006c).

Prior to the beginning of facility operations, the NRC conducted an analysis of the impact of water withdrawal from the Neosho River during severe and prolonged drought conditions (NRC 1975). This analysis evaluated the expected water withdrawal rates from WCGS during what was considered to be a 1 in 50 year drought. The precipitation and water volume data to support the study were taken from actual measurements on the Neosho River during the period from January 1951 to December 1959, which corresponded with a 1 in 50 year drought. The results of this analysis were that withdrawal of stored contract water by WCGS at 41 cfs would cause reduced flows within the river, would extend the duration and severity of low-flow conditions, and could cause stress to aquatic communities and fish populations (NRC 1982).

Similar to the Neosho River appropriations, the withdrawal of water from the conservation pool through the purchase contracts is regulated by the conditions of the purchase contract and also is restricted by the physical limitations of the MUSH withdrawal system (WCNOC 2006c). These restrictions result in a maximum withdrawal rate of 70 cfs for stored water from the conservation pool (WCNOC 2006c). This volume of water exceeds the 41 cfs estimate established by NRC as the volume of withdrawal that could cause reduced flows within the river.

Although MDS levels have been established to protect aquatic resources in the Neosho River, the appropriations and water purchase contract mechanisms under which WCGS obtains makeup water are not subject to these restrictions. The MDS restrictions apply only to junior water rights obtained after April 12, 1984, and Kansas Statutes Annotated (KSA) 82a-703b(b) states that "all vested rights, water appropriation rights and applications for permits to appropriate water having a priority date on or before April 12, 1984, shall not be subject to any minimum desirable streamflow requirements." As the WCGS appropriations were established prior to April 12, 1984, they are not subject to the restrictions. The water purchase contract is also not subject to MDS restrictions. A comparison of water withdrawal dates with Neosho River streamflows indicates that withdrawals have occurred in the past on days when the Neosho River flow rate was below the 40 cfs MDS.

The proposed action described in the WCGS ER (WCNOC 2006a) assumes that John Redmond Reservoir would continue to be the primary source of makeup water, but does not address the likelihood that the availability of this source is being reduced through sedimentation. The documentation of the sedimentation issue in the *Environmental Impact Statement Prepared for the: Reallocation of Water Supply Storage Project: John Redmond Lake* (USACE 2002) and the Kansas Water Office Fact Sheet for John Redmond Reservoir (KWO 2007) strongly suggest that future actions would be required to ensure the continuity of the water supply. In the worst case, if no actions are taken, the volume of water available within the conservation pool would continue to decrease, and the supply of water to WCGS would compete with the volumes of water available to maintain adequate streamflow and provide flow to the Cottonwood and Neosho River Basins Water Assurance District Number 3. If this situation coincides with a drought condition, continued water withdrawal by WCGS could severely deplete habitat and affect biota within and along the Neosho River. Such conditions could result in derating the plant temporarily during drought periods. Actions that may be taken to increase the water availability during the relicensing period may include additional reallocations of the conservation and flood pools within the reservoir, dredging of sediment from the reservoir, or accessing alternative water supplies (groundwater or surface water based) from the local area. Once a proposal is developed and evaluated, it is likely that the impacts and specific mitigation measures would be evaluated in future environmental analyses and documentation developed by U.S. Army Corps of Engineers (USACE) or the State of Kansas.

4.2 Terrestrial Resources

4.2.1 Terrestrial Upland Plant Communities

4.2.1.1 WCGS Property

The lands on WCGS property outside the immediate area surrounding the station facilities are managed to achieve a balance between agricultural production and conservation. Some land areas have been reserved for educational purposes and maintained as natural communities for wildlife habitat, including a strip around the shoreline of Coffey County Lake. The remaining land has been leased for grazing, hay, and crop production. In 2005, approximately 1,422 ac were leased for grazing, 508 ac were leased for hay production, and 1,282 ac were leased for crops such as soybeans, milo, corn, and wheat. WCNOC's agricultural leases require conservation practices such as contour plowing, construction and/or maintenance of terraces to reduce soil erosion, and at harvest, leaving grain around field edges for wildlife (WCNOC 2006a).

Grazing restrictions, pasture rotation, and controlled burning are used to ensure continued health of the native rangeland on WCGS property (WCNOC 2005). Fire has always been an essential part of prairie communities, and prescribed burning is used on grasslands at WCGS to control woody brush invasion, control less desirable cool-season grasses or weeds, increase wildlife value, and increase prairie vigor and production. Controlled burning was completed on approximately 1,197 ac in 2005. Most grassland units at WCGS are scheduled to be burned once every 3 years (WCNOC 2006a).

A 200 to 400-ft wide strip surrounding the Coffey County Lake shoreline has been managed since 1980 as a buffer zone of natural vegetation between the lake and the agricultural areas. Agricultural activities are not allowed in this area, and previously cultivated lands have been allowed to advance through the stages of natural succession. Native grasses have been re-established in some portions of the lakeside buffer zone, and land management activities here include controlled burning, tree and brush control in native grass prairie areas, and noxious weed control (WCNOC 2006a). Native prairie at WCGS is categorized as "bluestem prairie" and is typically composed of tall grasses and many species of forbs (NRC 1975). Most forested areas on WCGS property are in lowlands and riparian areas upstream and downstream of Coffey County Lake (WCNOC 2007a).

The Wolf Creek Environmental Education Area is an approximately 500-ac nature area near the north end of the site property. It includes five trails that guide visitors through a variety of habitats, including native tall grass prairie, native and planted forests, wetlands, and wildlife food plots. In addition to the natural areas, there are shelterbelts, planted trees, restored native grasses, developed wetlands, and planted winter food plots for wildlife. The Wolf Creek Environmental Education Area is the result of a partnership between private citizens, civic organizations, local, State, and Federal governments, and WCGS (WCNOC 2006a).

The area surrounding the WCGS property consists mainly of rangeland and farmland, with occasional forested areas in bottomlands along the Neosho River and other streams. The rangeland is vegetated mostly by native and tame (introduced) grasses, mixed grass-brush, and managed pastures. There are no Federally designated or proposed critical habitats for threatened or endangered terrestrial species in the vicinity of WCGS or its associated transmission lines (WCNOC 2006a).

4.2.1.2 Transmission Line ROWs

The transmission lines included in this assessment are those with voltages exceeding 98 kV that were originally constructed for the specific purpose of connecting WCGS to the existing transmission system. These transmission lines extend approximately 106 miles and their ROWs cover a total area of approximately 1,922 ac. The ROWs cross land that is primarily agricultural or open range, and the areas are mostly remote with few human residents. The lines also cross numerous county, State, or U.S. highways. ROW that passes through farmland generally is used as farmland. The ROW does not cross any State or Federal parks, wildlife refuges, or wildlife management areas. State and Federal lands in the vicinity of the WCGS transmission line ROW are associated with the John Redmond Reservoir to the west: the John Redmond Wildlife Area, which is managed by the Kansas Department of Wildlife and Parks (KDWP), and the Flint Hills National Wildlife Refuge, an 18,500-ac refuge located on the upstream portion of John Redmond Reservoir on land owned by the USACE and managed by the FWS (WCNOC 2006e).

Wolf Creek – Rose Hill Transmission Line:

The Wolf Creek – Rose Hill 345-kV line extends approximately 98 miles from WCGS in a southwesterly direction to the Rose Hill substation east of Wichita. The ROW is 150 ft in width, resulting in a total of approximately 1,782 ac within the ROW. Land uses in the area traversed by this ROW include cropland (402 ac, 24 percent of the total ROW area), grazing lands (1,187 ac, 70 percent), woodlands (63 ac, 4 percent), idle land (27 ac, 2 percent), and roads (9 ac, 0.5 percent. The Wolf Creek–Rose Hill line passes approximately 6 miles south of the John Redmond Wildlife Area and 9 miles south of the Flint Hills National Wildlife Refuge (WCNOC 2007a).

La Cygne – Benton Transmission Line (rerouted portion):

The portion of the La Cygne – Benton 345-kV transmission line rerouted around Coffey County Lake, which includes sections of the Wolf Creek – Benton line and the Wolf Creek – La Cygne line, is approximately 7.7 miles long. Most of this line was constructed on WCGS property. The ROW is 150 ft wide and covers nearly 140 ac. Land uses within the upland areas of this ROW include cropland (27 ac, 20 percent of the total ROW area); grazing land (43 ac, 31 percent); hay meadow (15 ac, 11 percent); woodland (7 ac, 5 percent); wildlife habitat such as native grasses, grass-brush, and brush habitats (23 ac, 16 percent); and roads, gravel areas, and WCGS yard areas (11 ac, 8 percent) (WCNOC 2007a).

4.2.2 Riparian and Wetland Plant Communities

The WCGS site encompasses approximately 9,818 ac located in Coffey County approximately 3.5 miles east of the Neosho River and 5 miles east of the John Redmond Reservoir. The site includes the 5,090-ac Coffey County Lake, which was formed by the construction of an earthen dam across Wolf Creek, and the 31-ac Lime Sludge Pond.

4.2.2.1 Coffey County Lake and Wolf Creek

The riparian areas of Wolf Creek upstream and downstream of Coffey County Lake are typical of the oak-hickory forests found in east-central Kansas. They are medium to tall, multilayered, broadleaf deciduous forests typically occurring on the first and second terraces adjacent to streams. Within the oak-hickory forest, lowland woods occupy the riparian areas of Wolf Creek. The shoreline and shallow water habitats of Coffey County Lake have been colonized by species typical of wet soils or periodically flooded habitats, such as cottonwood (*Populus* spp.), black willow (*Salix nigra*), and cattails (*Typha* spp.). As the water level of the lake fluctuates, mudflat areas develop and are colonized by common herbaceous and woody species (WCNOC 2007a).

Since WCGS operation began in 1985, activities have been performed to protect and enhance riparian areas on the station property. These have included the construction of approximately 25 ac of shallow-water, ephemeral wetlands; protection of old-growth, oak-hickory woodland; planting of bottomland forest; establishment of native grasses for buffers along the shoreline of Coffey County Lake; preservation of areas for natural succession; and exclusion of livestock (WCNOC 2007a).

4.2.2.2 Lime Sludge Pond

The Lime Sludge Pond is a 31-ac unlined pond located north of the switchyard and adjacent to Coffey County Lake. It was originally constructed to receive lime sludge but was never used for that purpose. The pond provides shoreline and shallow water habitats supporting communities similar to those described above for the lake (WCNOC 2006a).

4.2.2.3 Neosho River and the John Redmond Reservoir

The wetlands and shallow coves of John Redmond Reservoir are dominated by smartweeds (*Polygonum* spp.), rushes (*Juncus* spp.), cattails, and sedges. Some stands of silver maple (*Acer saccharinum*), black willow, and eastern cottonwood (*Populus detoides*) also are present. On the mudflats exposed during reservoir drawdown, weedy annuals such as cocklebur (*Xanthium strumarium*), and grasses are common (WCNOC 2007a).

The riparian areas of the Neosho River upstream and downstream of John Redmond Reservoir are bottomland hardwood forest. Downstream from John Redmond Reservoir, most of the floodplain vegetation along the Neosho River and its major tributaries can be described as riparian woodland. Islands, point bars, and first terraces are dominated by species more tolerant of wet soil, such as eastern cottonwood, silver maple, and box elder (*Acer negundo*). Second terraces, which are slightly higher in elevation, support green ash (*Fraxinas pennsylvanica*), American elm (*Ulmus americana*), black walnut (*Juglans nigra*), hackberry (*Celtis occidentalis*), and bur oak (*Quercas macrocarpa*) (WCNOC 2007a).

4.2.2.4 Transmission Line ROWs

Riparian and wetland communities are a small component of the natural communities present within the transmission line ROWs.

Wolf Creek – Rose Hill Transmission Line:

The Wolf Creek – Rose Hill 345-kV line traverses a total of approximately 4,950 ft (18.2 ac) of riparian woods and 480 ft (1.8 ac) of stream channel. Thus, a total of approximately 1 mile of riparian communities and waterways is traversed by the 98-mi line, representing approximately 1 percent of the total ROW area. Major rivers and associated watersheds traversed by the Wolf Creek – Rose Hill transmission line include the Neosho River, primarily in Coffey County, the Verdigris and Fall Rivers, primarily in Greenwood County, and the Walnut River, primarily in Butler County. Riparian vegetation communities along these rivers are substantially similar to the community described above for the Neosho River (WCNOC 2007a).

La Cygne – Benton Transmission Line (rerouted portion):

The portion of the La Cygne – Benton 345-kV transmission line rerouted around Coffey County Lake is approximately 7.7 miles long and mainly on WCGS property. The ROW is 150 ft wide and covers nearly 140 ac. There are approximately 12 ac of riparian (bottomland woodland), surface water, shoreline, and wetland habitats included in the ROW, or 8.7 percent of the total ROW area (WCNOC 2007a).

5.0 Evaluation of Federally Listed Endangered and Threatened Species

5.1 Neosho Madtom (*Notorus placidus*)

The Neosho madtom, a small catfish usually less than 3 in. long, is listed as Federally threatened. Its typical habitat is riffles and sloping gravel bars with moderate to swift currents in relatively clear rivers of moderate size (KDWP 2004). It prefers a substrate of fine gravel but has been reported in areas with bottoms that have large stones and cobbles or are sandy. It feeds on aquatic insects and has a lifespan of three to four years (FWS 1991).

The Neosho madtom is native to the Neosho River Basin of Kansas, Oklahoma, and Missouri, including its tributaries the Cottonwood and Spring Rivers. The largest populations are believed to be those of the Neosho and Cottonwood Rivers in Kansas. Smaller populations are found in the Spring River in Kansas and in adjacent areas of Oklahoma (Ottawa and Craig Counties) and Missouri (Jasper County). Within this limited range, the Neosho madtom has experienced population declines resulting from factors such as drought-related habitat degradation, removal of gravel bars, and water pollution from feedlot runoff. Habitat loss also has resulted from the construction of mainstream impoundments in Kansas and Oklahoma that inundated Neosho madtom habitat (FWS 1991).

The Neosho madtom occurs in the Neosho River upstream and downstream of its confluence with Wolf Creek. The populations of the Neosho madtom that potentially are affected by WCGS are those inhabiting the Neosho River from the John Redmond Dam downstream and extending past the Wolf Creek confluence. KDWP has designated portions of the Neosho, Cottonwood, and Spring Rivers as critical habitat for the Neosho madtom, including the main stem of the Neosho River from its point of discharge from the John Redmond Reservoir to the Kansas-Oklahoma border (KDWP 2004). There is no Federally designated critical habitat for the Neosho madtom.

In the 1970s, biologists conducting baseline surveys for WCGS occasionally collected Neosho madtoms in kick-seine samples from the Neosho River upstream and downstream of the Wolf Creek-Neosho River confluence. After WCGS became operational in 1985, Neosho madtoms continued to be collected in Neosho River kick-seine samples. Over the period 1985 to 1991, a total of 110 Neosho madtoms was collected (and released unharmed) from Neosho River monitoring stations. In 1992, flooding hindered seining, and no Neosho madtoms were collected. In 1993, WCGS discontinued its monitoring of fish in the Neosho River and changed its focus to the fish community of Coffey County Lake (WCNOC 2006a).

Researchers from the FWS and U.S. Geological Survey (USGS; Wildhaber et al. 2000) compared densities of the Neosho madtom and several other catfish species from the family Ictaluridae at locations upstream and downstream of John Redmond Reservoir. The study utilized data from an 8-year period (1991 to 1998) to assess the effects of the dam and reservoir on population trends as well as habitat, hydrology, and water quality. The study found that Neosho madtom densities (fish per 100 square mile [sq mi]) were significantly higher above John Redmond Reservoir than below the dam, and researchers concluded that the lower downstream densities may result from the decreased turbidity and increased substrate size created by the operation of the dam and flood control reservoir (Wildhaber *et al.* 2000).

In addition to the removal of particulates, Wildhaber et al. (2000) found that the presence of John Redmond Dam and Reservoir changed annual flow regimes below the dam, resulting in lower minimum flows, more frequent low-flow events, lower short-term (1-day and 3-day) maximum flows, reduced variability in flow rates, increased winter flows, increased long-term (30-day and 90-day) maximum flows, increased length and variability in duration of high-flow events, and a later and more variable date of maximum annual flow below the dam. Thus, the Neosho River below John Redmond Reservoir has become characterized by lower minimum flows, lower short-term flows, and higher long-term flows as a result of management of the reservoir to maintain water levels in the reservoir and minimize downstream flooding. The study results suggested that minimum flows and their timing are critical to the reproductive success of the Neosho madtom and may be critical to its overwinter survival. Certain minimum flows and the timing of the spring water rise appeared to be critical to reproduction, and certain minimum flows in late summer and fall appeared to improve overwinter survival of young of year (YOY) madtoms. The FWS and USGS researchers recommended that additional data be collected on changes in water quality and habitat downstream of the dam and, in order to test their hypotheses about the effects of the flow regime, they also recommended that populations be monitored for several years while flows below the John Redmond Dam are increased during critical periods (Wildhaber *et al.* 2000).

Factors associated with WCGS operations that potentially could affect the Neosho madtom in this reach of the river include: (1) reduction in Neosho River flow due to makeup water withdrawals, (2) increase in mortality due to entrainment and/or impingement, and (3) toxic effects from chemical constituents in surface water of Coffey County Lake and the Neosho River. Each of these factors is addressed below.

(1) The State of Kansas has established MDS levels in the Neosho River that are protective of rare aquatic species. The lowest MDS established for the Neosho River at the Iola river gage station (approximately 55 river mi downstream of the John Redmond Dam) is 40 cfs from July to March. To maintain flows in the Neosho River supportive of fish spawning, the MDS increases to 60 cfs in April and 200 cfs in May and June if the water levels in the reservoir are adequate; otherwise, the MDS in April through June is 40 cfs (KWAA 2004). Calculations performed by WCGS indicate that the lowest MDS of 40 cfs maintained at Iola is sufficient for the needs of the Neosho madtom (WCNOC 2007b). Severe and extended droughts prohibiting the MDS of 40 cfs during the OL renewal period would affect the Neosho madtom as they have historically (FWS 1991). There is a possibility that WCGS may withdraw water from the Neosho River during low-flow or drought events, which could adversely affect habitat of the Neosho madtom.

(2) The MUSH intake in the Neosho River generally is operated only as necessary to provide makeup water to maintain the pool at Coffey County Lake. Therefore, under conditions of normal or higher rainfall, the MUSH would be utilized only sparingly, and entrainment and impingement of organisms from the Neosho River would be minimized. A 1981 study of larval fish drift in the Neosho River included sample locations upstream of John Redmond Reservoir, in the tailwaters of John Redmond Dam, and at Burlington. The only *Noturus* species collected and identified were two individuals at the upstream location, and these were not believed to be the Neosho madtom (Wedd 1985). No data are available regarding the species of fish eggs and larvae that have been entrained by the intake since 1982. However, available lines of evidence indicate that entrainment of the Neosho madtom is very unlikely.

The impingement of healthy juvenile and adult fish at the MUSH is expected to be minimal because the operational intake velocity of up to approximately 0.5 fps is low in comparison to the stream flows in habitats where the Neosho madtom and other native fish occur (WCNOC 2006c). In the MUSH vicinity, Neosho River flows typically range from 0.8 to 4.9 fps (Wedd 1985). Thus, impingement of adult fish is expected to occur rarely and then only when the fish are in a weakened condition or dead and unable to avoid even the low current velocity near the MUSH intake (WCNOC 2006c). In addition, the Neosho madtom was not among the species impinged in a 1-year impingement study at the MUSH conducted between November 1980 and October 1981 (KG&E 1981). These lines of evidence indicate that the potential for Neosho madtom larvae, juveniles, or adults to be present at the intake and subject to entrainment or impingement is very low.

(3) Contaminant concentrations in the aquatic environment at WCGS are monitored on an ongoing basis by WCNOC and Kansas Department of Health and Environment (KDHE). These studies have not found toxic effects levels of any of the constituents evaluated in Coffey County Lake. Given that discharges from Coffey County Lake to Wolf Creek are limited and infrequent, the potential for chemicals that have entered surface water from WCGS operations to reach the Neosho River and result in concentrations that would be toxic to fish, mussels, or other aquatic organisms is negligible.

However, to address possible concerns related to this issue and its potential to affect the Neosho madtom, the concentrations of relevant metals were examined by the applicant. The average concentrations of chromium, copper, iron, mercury, and nickel in Coffey County Lake in 2005 and 2006 were compared to the concentrations of these metals in the Neosho River at Leroy, approximately 10 miles downstream of the Coffey County Lake dam (WCNOC 2007b). Only copper, iron, and nickel were detected, and the concentrations of each of these metals was higher in the Neosho River at Leroy than in Coffey County Lake. The concentrations of these three metals in both the river and Coffey County Lake were well below their respective National Recommended Water Quality Criteria for the protection of freshwater aquatic life under continuous (chronic) exposure conditions (EPA 2006).

Because the future actions needed to minimize water use conflicts in the Neosho River have not yet been proposed, continued operation of the MUSH has the potential to adversely affect the Neosho madtom during low-flow and/or drought conditions in the Neosho River. However, during normal flow conditions, continued operation of WCGS is not expected to adversely affect the Neosho madtom.

5.2 Mead's Milkweed (*Asclepias meadii*)

Mead's milkweed was Federally listed as threatened in 1988. Mead's milkweed is a perennial herb of the tallgrass prairie. It produces a single cluster of greenish-white flowers at the top of a 2-ft stalk in May and early June. Mead's milkweed has low reproductive rates but is a long-lived plant that may persist indefinitely unless destroyed by humans, animals, or pathogens. Studies based on growth of seedlings suggest that Mead's milkweed may require 15 years or more to mature from a germinating seed to a flowering adult. The habitat of Mead's milkweed principally is mesic to dry mesic, upland, tallgrass prairie. It generally is found in full sun and on slopes of less than 20 percent (FWS 2003).

Its populations have declined due to the fragmentation and destruction of tall-grass prairie as a result of intense agricultural use, urban growth, development, recreational use of sites, and hay mowing that disrupts the reproductive cycle. Mead's milkweed continues to be threatened by these factors as well as effects of habitat fragmentation that include the loss of genetic diversity, lack of pollinators, and increased insect predation (FWS 2003).

Mead's milkweed formerly was widespread over much of the eastern tallgrass prairie region of the central United States. It has been extirpated from Wisconsin and Indiana and currently is known to occur at approximately 170 sites within 34 counties in eastern Kansas, Missouri, south-central Iowa, and southern Illinois. Kansas populations are in the eastern counties from north of the Kansas River south to Neosho County in the southeastern corner of the State. Almost all of the Mead's milkweed population sites in Kansas are on privately owned land that is being used as prairie hay meadows. Mowing of these prairies typically occurs in late June to early July and results in the removal of immature fruits, thus preventing the plants from completing their life cycle (FWS 2003). The FWS Mountain-Prairie Region records this species as occurring in Coffey County (FWS 2007c). Surveys to determine the presence of Mead's milkweed on WCGS property or within the transmission line ROWs have not been performed. The presence of tallgrass prairie communities on these properties within Coffey County indicates that habitat with the potential to support Mead's milkweed may be present, although the plant is not currently known to occur in these areas.

Because there is no planned expansion of existing facilities, change in ROW maintenance procedures, or disturbance of additional land anticipated during the renewal period, continued operation of WCGS is not likely to adversely affect Mead's milkweed.

6.0 Conclusions

The Staff has identified two Federally listed threatened species, the Neosho madtom and Mead's milkweed, that are under FWS jurisdiction and have a potential to occur in the vicinity of WCGS or along the associated transmission line ROWs. These species may be affected by continuing operations of WCGS. WCNOC and Westar Energy Inc. (Westar), the owner of the transmission lines, have ongoing ecological studies and monitoring systems in place to evaluate the impacts of these facilities on aquatic and terrestrial organisms. Water use agreements with the State and the use of best management practices for facility operation and maintenance of transmission line corridors are expected to protect endangered, threatened, and candidate species that are present in the affected environment.

The NRC staff has evaluated the species that may be present in the vicinity of WCGS, the known distributions and available habitat for those species, the potential effects of the operation of WCGS on the species, and the studies and mitigation measures that WCNOC and Westar employ to protect the species. Based on this analysis, the Staff has determined that continued operation of WCGS for an additional 20 years is not likely to adversely affect Mead's milkweed. Likewise, during periods with no water use conflicts, the proposed action is not likely to adversely affect the Neosho madtom. However, when water use conflicts exist during low-flow or drought conditions in the Neosho River, continued operation of WCGS may adversely affect the Neosho madtom.

7.0 References

EA Engineering, Science, and Technology, Inc. (EA). 1988. *Wolf Creek Generating Station Operational Phase Environmental Monitoring Program, Final Report.* Prepared for Wolf Creek Nuclear Operating Corporation. Great Plains Regional Office.

Engineering-Environmental Management, Inc. 2002. *Draft Supplement to the Final Environmental Impact Statement prepared for the Reallocation of Water Supply Storage Project: John Redmond Lake, Kansas.* Volume I. USACE, Tulsa District. June.

Environmental Protection Agency (EPA). 2006. "National Recommended Water Quality Criteria." Office of Water.

Fish & Wildlife Service (FWS). 1991. *Neosho Madtom Recovery Plan.* FWS Region 6, Denver, CO.

Fish and Wildlife Service (FWS). 2003. *Mead's Milkweed* (Asclepias meadii) *Recovery Plan.* Great Lakes-Big Rivers Region, Fort Snelling, Minnesota.

Fish and Wildlife Service (FWS). 2007a. Letter from Michael J. LeValley, Field Supervisor, Kansas Ecological Services Field Office, FWS, Manhattan, KS, to Chief, Rules and Directives Branch, NRC, Washington, DC. Response to December 7, 2006 letter from NRC requesting information on Federally listed, proposed, and candidate species and critical habitat that may be in the vicinity of WCGS and its transmission line ROW. January 29, 2007.

Fish and Wildlife Service (FWS). 2007b. "Final Rule: Endangered and Threatened Wildlife and Plants; Removing the Bald Eagle in the Lower 48 States from the List of Endangered and Threatened Wildlife." *Federal Register*, Volume 72, pgs. 37345 - 37372. Washington, DC.

Fish and Wildlife Service (FWS). 2007c. Mountain-Prairie Region, Endangered Species Program. Accessed at: http://www.fws.gov/mountain%2Dprairie/endspp/ on Feb - June 2007.

Hammond, R. 2006. Microfouling, Asiatic Clam and Zebra Mussel Control Program for Wolf Creek Generating Station. Wolf Creek Nuclear Operating Corporation, Burlington, Kansas. WCEM-05-012.

Jirak, Leonard. 2005. Progress and Management Report; John Redmond Reservoir. Kansas Department of Wildlife and Parks.

Juracek, Kyle E. and Perry, Charles A. 2005. Gravel Sources for the Neosho River in Kansas, 2004. USGS Scientific Investigations Report 2005-5282. Accessed at: http://pubs.usgs.gov/sir/2005/5282/ on May 21, 2007.

Kansas Department of Wildlife and Parks (KDWP). 2004. Species Information: Neosho madtom (Noturus placidus). Accessed at: http://www.kdwp.state.ks.us/news/other_services/threatened_and_endangered_species/threatened_and_endangered_species/species_information on Jan – June 2007.

Kansas Department of Wildlife and Parks (KDWP). 2007. "Coffey County Lake". Accessed at: http://kdwp.state.ks.us/news/fishing/where_to_fish_in_kansas/fishing_locations_publicwaters/region_5/coffey_county_lake on May 22, 2007.

Kansas Gas and Electric Company (KG&E). 1981. *Wolf Creek Generating Station, Makeup Screenhouse Impingement Monitoring Report, November 1980 – October 1981.*

Kansas Gas and Electric Company (KG&E). 1984. *Wolf Creek Generating Station Preoperational Fishery Monitoring Report, March 1983-November 1983.*

Kansas Gas and Electric Company (KG&E). 1986. *Wolf Creek Generating Station 1984-1985 Preoperational Wildlife Monitoring Report, May 1984-April 1985.*

Kansas Water Appropriation Act (KWAA). 2004. Statutes K.S.A. 82A-701 through 82A-737, and K.S.A. 42-313, 42-314 as Amended 2004. Accessed at: http://www.accesskansas.org/kda/dwr/laws-rules/kwaa.pdf on March 1, 2007.

Kansas Water Office (KWO). 2007. *John Redmond Lake Reservoir Fact Sheet.* Accessed at: http://www.kwo.org/reservoirinformation/reservoirfactsheets/john_redmond_lake.pdf on June 12, 2007).

Nuclear Regulatory Commission (NRC). 1975. *Final Environmental Statement Related to Construction of Wolf Creek Generating Station, Unit 1*, NUREG-175/096, Docket Number STN 50- 482. Office of Nuclear Reactor Regulation, Washington, DC.

Nuclear Regulatory Commission (NRC). 1982. *Final Environmental Statement Related to the Operation of Wolf Creek Generating Station Unit No. 1.* NUREG-0878. Office of Nuclear Reactor Regulation, Washington, DC.

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

Nuclear Regulatory Commission (NRC). 2006. Letter to Mike LeValley, Project Leader, U.S. Fish and Wildlife Service, Manhattan, KS: Request for list of protected species within the area under evaluation for the Wolf Creek Generating Station License Renewal Application review. December 7.

Osterkamp, W. R., and Hedman, E. R. 1981. "Channel geometry of regulated streams in Kansas as related to mean discharge, 1970-1980: Kansas Water Office Technical Report Number 15".

Putnam, J. E., and D. R. Schneider. 2005. *Water Resources Data – Kansas, Water Year 2004.* Water-Data Report KS-04-1. U.S. Geological Survey, Lawrence, Kansas.

Studley, Seth E. 1996. Changes in High-Flow Frequency and Channel Geometry of the Neosho River Downstream from John Redmond Dam, Southeastern Kansas. USGS Water-Resources Investigations Report 96-4243. Accessed at: http://ks.water.usgs.gov/Kansas/pubs/reports/wrir.96-4243.html on May 28, 2007.

U.S. Army Corp of Engineers (USACE). 2002. *Draft Supplement to the Final Environmental Impact Statement Prepared for the: Reallocation of Water Supply Storage Project: John Redmond Lake, Kansas.*

U.S. Army Corp of Engineers (USACE). 2005. *Initial Appraisal of the Neosho River Logjam, John Redmond Reservoir, Kansas.*

U.S. Army Corp of Engineers (USACE). 2007. "Tulsa District, Recreation - John Redmond Reservoir." Accessed at: http://www.swt.usace.army.mil/recreat/ViewHistoryMessage.cfm?tblMessages__LakeName=John%20Redmond%20Reservoir on May 22, 2007.

U.S. Geological Survey (USGS). 2007. "Kansas Minimum Desirable Streamflows (MDS), in cubic feet per second (ft3/s).". Accessed at: http://ks.water.usgs.gov/Kansas/waterwatch/drought/mds.alpha.html on June 8, 2007.

Wedd, G. R. 1985. "Observations on Neosho River Larval Fish in Coffey County, Kansas." *The Emporia State Research Studies*, Volume XXXIV, Number 1. pp. 5-56.

Wildhaber, M. L., V. M. Tabor, J. E. Whitaker, A. L. Allert, D. W. Mulhern, P. J. Lamberson, and K. L. Powell. 2000. "Ictalurid Populations in Relation to the Presence of a Main-Stem Reservoir in a Midwestern Warmwater Stream with Emphasis on the Threatened Neosho Madtom." *Transactions of the American Fisheries Society*, 129, pp. 1264-1280.

Wolf Creek Nuclear Operating Corporation (WCNOC). 2005. *Wolf Creek Generating Station, Annual Environmental Operating Report 2004*. Environmental Management Organization, Burlington, Kansas. April.

Wolf Creek Nuclear Operating Corporation (WCNOC). 2006a. *Applicant's Environmental Report; Operating License Renewal Stage*. Appendix E of License Renewal Application, Wolf Creek Generating Station Unit 1, Docket No. 50-482, Facility Operating License Number NPF-42, (Revision 0).

Wolf Creek Nuclear Operating Corporation (WCNOC). 2006b. *License Renewal Application, Wolf Creek Generating Station*, Docket No. 50-482, Facility Operating License Number NPF-42. Burlington, Kansas.

Wolf Creek Nuclear Operating Corporation (WCNOC). 2006c. Enclosure 3 to WM 06-0046 An Assessment of the Potential Impacts on Fish and Shellfish Resources from Impingement Related to the Operating License Renewal for Wolf Creek Generating Station, Unit No. 1. Contained in: Letter from Matthew W. Sunseri, Wolf Creek Nuclear Operating Corporation to U.S. Nuclear Regulatory Commission regarding Docket 50-482: Supplementary Environmental Information to Support the Application for Renewed Operating License for Wolf Creek Generating Station. WM 06-0046. November 17, 2006.

Wolf Creek Nuclear Operating Corporation (WCNOC). 2006e. *Land Management at Wolf Creek Generating Station: 2005 Progress Report and 2006 Land Management Plan*. March 2006.

Wolf Creek Nuclear Operating Corporation (WCNOC). 2007. "Docket 50-482: Response to NRC Request for Additional Information Related to Wolf Creek Generating Station License Renewal Application." Item Number 31. Cooling Water Intake Structures, Comprehensive Demonstration Study, May 9, 2007.

Wolf Creek Nuclear Operating Corporation (WCNOC). 2007a. Docket 50-482: Wolf Creek Nuclear Operating Corporation's Response to Request for Additional Information Regarding the Review of the License Renewal Application for Wolf Creek Generating Station. ET 07-0001. January 11.

Wolf Creek Nuclear Operating Corporation (WCNOC). 2007b. Docket 50-482: Wolf Creek Nuclear Operating Corporation's Response to Request for Additional Information Regarding the Review of the License Renewal Application for Wolf Creek Generating Station. Item Number 13. ET 07-0001. May 9.

Appendix F

GEIS Environmental Issues Not Applicable to Wolf Creek Generating Station

Appendix F

GEIS Environmental Issues Not Applicable to Wolf Creek Generating Station

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 10 CFR Part 51, Subpart A, Appendix B, Table B-1, that are not applicable to Wolf Creek Generating Station (WCGS) because of plant or site characteristics.

Table F-1. GEIS Environmental Issues Not Applicable to Wolf Creek Generating Station (WCGS)

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	WCGS does not discharge to an estuary or saltwater body.
Temperature effects on sediment transport capacity	1	4.2.1.2.3 4.4.2.2	WCGS does not discharge to a body of water that transports sediment.
Water-use conflicts (plants with once-through cooling systems)	1	4.2.1.3	WCGS is categorized in the GEIS as having a cooling pond cooling system, and does not have a once-through cooling system.
AQUATIC ECOLOGY (FOR ALL PLANTS)			
Thermal plume barrier to migrating fish	1	4.2.2.1.6 4.4.3	WCGS does not discharge to a surface water body that supports migrating fish.

[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. (cont'd)

ISSUE—10 CFR Part 51, Subpart A, Appendix B, Table B-1	Category	GEIS Sections	Comment
AQUATIC ECOLOGY (FOR PLANTS WITH COOLING TOWER BASED HEAT DISSIPATION SYSTEMS)			
Entrainment of fish and shellfish in early life stages	1	4.3.3	This issue is related to heat-dissipation systems that are not installed at WCGS.
Impingement of fish and shellfish	1	4.3.3	This issue is related to heat-dissipation systems that are not installed at WCGS.
Heat shock	1	4.3.3	This issue is related to heat-dissipation systems that are not installed at WCGS.
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	WCGS does not use >100 gpm of groundwater for any purpose.
Groundwater-use conflicts (Ranney wells)	2	4.8.1.4	WCGS does not have or use Ranney wells.
Groundwater quality degradation (Ranney wells)	1	4.8.2.2	WCGS does not have or use Ranney wells.
Groundwater quality degradation (saltwater intrusion)	1	4.8.2.1	WCGS is not located adjacent to saltwater.
Groundwater quality degradation (cooling ponds in salt marshes)	1	4.8.3	WCGS is not located adjacent to salt marshes.
TERRESTRIAL RESOURCES			
Cooling tower impacts on crops and ornamental vegetation	1	4.3.4	This issue is related to a heat-dissipation system that is not installed at WCGS.
Cooling tower impacts on native plants	1	4.3.5.1	This issue is related to a heat-dissipation system that is not installed at WCGS.

Table F-1. (cont'd)

ISSUE—10 CFR Part 51, Subpart A, Appendix B, Table B-1	Category	GEIS Sections	Comment
Bird collisions with cooling towers	1	4.3.5.2	This issue is related to a heat-dissipation system that is not installed at WCGS.

F.1 References

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

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

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, DC.

Appendix G

U.S. Nuclear Regulatory Commission Staff Evaluation of Severe Accident Mitigation Alternatives (SAMAs) for Wolf Creek Generating Station in Support of License Renewal Application Review

Appendix G

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G.1 Introduction

Wolf Creek Nuclear Operating Corporation (WCNOC) submitted an assessment of severe accident mitigation alternatives (SAMAs) for Wolf Creek Generating Station (WCGS) as part of the environmental report (ER) (WCNOC 2006). This assessment was based on the most recent WCGS probabilistic safety assessment (PSA) available at that time, a plant-specific off-site consequence analysis performed using the MELCOR Accident Consequence Code System 2 (MACCS2) computer code, and insights from the WCGS individual plant examination (IPE) (WCNOC 1992), the WCGS IPE update (WCNOC 1996), and the IPE of external events (IPEEE) (WCNOC 1995a). In identifying and evaluating potential SAMAs, WCNOC considered SAMAs that addressed the major contributors to core damage frequency (CDF) and population dose at WCGS, as well as SAMA candidates for other operating plants which have submitted license renewal applications. WCNOC identified 19 potential SAMA candidates. This list was reduced to 15 unique SAMAs by eliminating SAMAs that were determined to provide no measurable benefit or have estimated costs that would exceed the dollar value associated with completely eliminating all severe accident risk at WCGS. WCNOC assessed the costs and benefits associated with each of the potential SAMAs and concluded in the ER that several of the candidate SAMAs evaluated are potentially cost-beneficial.

Based on a review of the SAMA assessment, the U.S. Nuclear Regulatory Commission (NRC) issued a request for additional information (RAI) to WCNOC by letter dated February 7, 2007 (NRC 2007). Key questions concerned: major plant and modeling changes incorporated within each evolution of the PSA model, the peer review of the internal flooding probabilistic risk assessment (PRA), internal flooding analysis results, IPE treatment of Steam Generator Tube Ruptures (SGTRs), and further information on several specific candidate SAMAs and low cost alternatives. WCNOC submitted additional information by letter dated April 20, 2007 (WCNOC 2007a) and by email on June 1, 2007 (WCNOC 2007b). In response to the RAIs, WCNOC provided: a summary of the major changes made to each PSA model version and resultant changes to dominant risk contributors to CDF, a summary of the internal flooding peer review process and comments, a clarification of the internal flooding analysis assumptions and results, the treatment of SGTR in the IPE and its effect on the SAMA analyses, and additional information regarding several specific SAMAs. WCNOC's responses addressed the NRC staff's concerns.

An assessment of SAMAs for WCGS is presented below.

G.2 Estimate of Risk for Wolf Creek Generating Station

WCNOC's estimates of off-site risk at the WCGS are summarized in Section G.2.1. The summary is followed by the NRC staff's review of WCNOC's risk estimates in Section G.2.2.

G.2.1 WCNOC's Risk Estimates

Two distinct analyses are combined to form the basis for the risk estimates used in the SAMA analysis: (1) the WCGS Level 1 and 2 PSA model, which is an updated version of the IPE (WCNOC 1992), and (2) a supplemental analysis of off-site consequences and economic impacts (essentially a Level 3 PSA model) developed specifically for the SAMA analysis. The SAMA analysis is based on the most recent WCGS Level 1 and 2 PSA model available at the time of the ER, referred to as the WCGS 2002 PSA update. The scope of the WCGS PSA does not include external events.

The baseline CDF for the purpose of the SAMA evaluation is approximately 3.0×10^{-5} per year. The CDF is based on the risk assessment for internally-initiated events but does not include internal flooding. WCNOC did not include the contribution from external events and internal flooding within the WCGS risk estimates; however, it did account for the potential risk reduction benefits associated with external events and internal floods by doubling the estimated benefits for internal events. This is discussed further in Sections G.2.2 and G.6.2.

The breakdown of CDF by initiating event is provided in Table G-1. As shown in this table, events initiated by loss of off-site power and small break loss of coolant accident (LOCA) are the dominant contributors to CDF. Although not separately reported, station blackout (SBO) sequences contribute 1.7×10^{-5} per year (about 55 percent of the total internal events CDF), while anticipated transient without scram (ATWS) sequences are not present in the dominant sequences.

The current Level 2 WCGS PSA is based on a simplified model intended to estimate the frequencies of containment failure models that might lead to large early releases of radionuclides. This model, termed a Large Early Release Frequency (LERF) model, quantifies four distinct LERF contributors: Interfacing Systems Loss of Coolant Accidents (ISLOCAs), SGTRs, Containment Isolation Failures and Early Containment Failures. The frequency for each of these contributors was obtained by quantifying the fault tree gate corresponding to the contributor in the LERF model. Given that the LERF model does not explicitly provide risk information on non-LERF sequences, such as late containment failures and sequences involving only leakage or no containment failure, a process was developed to approximate the risk contribution from these non-LERF scenarios using information from the IPE.

The IPE model utilizes a Containment Safeguards Event Tree (CSET) and a Containment Event Tree (CET) that address systemic and phenomenological events, respectively. The significant Level 1 core damage sequences were processed using the CSET to determine the applicable endstates and their frequencies. The CSET derived endstates were used as input into the CET in order to determine the containment response. The CET has 14 possible endstates which provide information about ex-vessel sequence progression, containment status, and source term release. These 14 end states were further binned into seven release categories of which three represent the non-LERF scenarios. The frequency of each release category was obtained by summing the frequency of the individual accident progression CET endpoints binned into the release category. In the SAMA analysis, two of the three IPE non-LERF release categories were combined, resulting in two non-LERF categories: leakage/no containment failure and late containment failure.

The result of the combined model (LERF contributions from the current Level 2 PSA and non-LERF contributions from the IPE) is a set of six release categories with their respective frequency and release characteristics. The results of this analysis for WCGS are provided in Section F.2.8 of the ER (WCNOC 2006). The release frequencies were derived from their respective models as described above. The release characteristics for the LERF and non-LERF release categories are based on Modular Accident Analysis Program (MAAP) 3.0B analyses.

Table G-1. WCGS Core Damage Frequency

Initiating Event	CDF (Per Year)	% Contribution to CDF
Loss of Off-site Power	1.7×10^{-5}	57
Small LOCA	7.0×10^{-6}	23
Interfacing Systems LOCA	1.9×10^{-6}	6
Very Small LOCA	1.3×10^{-6}	4
Steam Generator Tube Rupture	8.7×10^{-7}	3
Transients With Power Conversion Systems Available	3.9×10^{-7}	1
Reactor Vessel Failure	3.0×10^{-7}	1
Steamline Break	2.4×10^{-7}	1
Transients Without Power Conversion Systems Available	1.8×10^{-7}	1
Loss of Vital DC Bus NK04	1.5×10^{-7}	1
Medium LOCA	1.4×10^{-7}	<1
Loss of Vital DC Bus NK01	1.2×10^{-7}	<1

Table G-1. (cont'd)

Initiating Event	CDF (Per Year)	% Contribution to CDF
Loss of All Service Water	8.6 x 10^{-8}	<1
Loss of Component Cooling Water	5.8 x 10^{-8}	<1
Feedwater Line Break	3.3 x 10^{-8}	<1
Large LOCA	2.8 x 10^{-8}	<1
Total CDF	3.0 x 10^{-5}	100

The off-site consequences and economic impact analyses use the MACCS2 code to determine the off-site risk impacts on the surrounding environment and public. Inputs for these analyses include plant-specific and site-specific input values for core radionuclide inventory, source term and release characteristics, site meteorological data, projected population distribution (within an 80-kilometer [50-mile] radius) for the year 2040, emergency response evacuation modeling, and economic data. The magnitude of the on-site impacts (in terms of clean-up and decontamination costs and occupational dose) is based on information provided in NUREG/BR-0184 (NRC 1997a).

WCNOC estimated the dose to the population within 80 kilometers (50 miles) of the WCGS site to be approximately 0.0327 person-sievert (Sv) (3.27 person-rem) per year (WCNOC 2008). The breakdown of the total population dose by containment release mode is summarized in Table G-2. Containment failures within the early time frame (less than 6 hours following accident initiation) dominate the population dose risk at WCGS.

Table G-2. Breakdown of Population Dose by Containment Release Mode

Containment Release Mode	Population Dose (Person-Rem[1] Per Year)	% Contribution
Early Containment Failure	0.18	5
Late Containment Failure	0.10	3
Containment Bypass – SGTR	0.05	2
Containment Bypass – ISLOCA	2.71	83

Table G-2. (cont'd)

Containment Release Mode	Population Dose (Person-Rem[1] Per Year)	% Contribution
Containment Bypass – Isolation Failure	Negligible	<1
Intact Containment	0.23	7
Total	3.27	100

[1] One person-Rem = 0.01 person-Sv

G.2.2 Review of WCNOC's Risk Estimates

WCNOC's determination of off-site risk at WCGS is based on the following four major elements of analysis:

- The Level 1 and Level 2 risk models that form the bases for the 1992 IPE submittal (WCNOC 1992), and the external events analyses of the 1995 IPEEE submittal (WCNOC 1995a),
- The major modifications to the IPE model that have been incorporated in the WCGS 2002 PSA Update,
- The WCGS fire re-analysis completed in March 1998, and
- The MACCS2 analyses performed to translate fission product source terms and release frequencies from the Level 2 PSA model into off-site consequence measures.

Each of these analyses was reviewed to determine the acceptability of WCNOC's risk estimates for the SAMA analysis, as summarized below.

The NRC staff's review of the WCGS IPE is described in an NRC report dated November 18, 1996 (NRC 1996). Based on a review of the IPE submittal and responses to RAIs, the NRC Staff concluded that the IPE submittal met the intent of Generic Letter (GL) 88-20; that is, the licensee's IPE process is capable of identifying the most likely severe accidents and severe accident vulnerabilities. The IPE did not identify any severe accident vulnerabilities associated with either core damage or poor containment performance.

Although no vulnerabilities were identified in the IPE, several plant improvements were identified and considered for implementation at the plant. These enhancements included: (1) installing high temperature qualified reactor coolant pump (RCP) seal O-rings, (2) replacing the positive displacement charging pump with a third centrifugal charging pump, (3) installing a switch to bypass feedwater isolation in order to restore main feedwater, (4) proceduralizing actions to perform alternate cooling for several pumps and the emergency diesel generators (EDGs) to reduce the dependency on room cooling, (5) modifying emergency procedures to directly address total loss of component cooling water and service water initiating events, and (6) performing additional evaluations to identify any procedural or hardware modifications to reduce the risk due to internal flooding (WCNOC 1992).

The WCGS IPE analysis of internal flooding yielded a CDF of 7.6 x 10^{-6} per year. However, WCNOC stated that some of the flooding scenarios included in the IPE submittal were identified late in the IPE process and due to time constraints, were addressed in a conservative manner (WCNOC 1995b). Subsequent to the IPE, a re-analysis of internal flooding was performed to more realistically assess flood-related scenarios. Results for the re-analysis indicate that the CDF from flooding-related scenarios is reduced by approximately 70 percent (from 7.6 x 10^{-6} per year to 2.5 x 10^{-6} per year) (WCNOC 2006).

There have been three revisions to the IPE model since the 1992 IPE submittal, specifically, a 1996 revision to the IPE in response to NRC RAIs, a comprehensive PSA model update in 1998, and a comprehensive PSA model update in 2002 in response to the Westinghouse Owners Group peer review. A comparison of internal events CDF between the 1996 IPE revision and the current PSA model indicates a decrease of approximately 53 percent (from 6.31 x 10^{-5} per year to 2.98 x 10^{-5} per year). A comparison of the contributors to the total CDF indicates that some have increased while others have decreased. A summary listing of those changes that resulted in the greatest impact on the internal events CDF was provided in response to a staff request for additional information and is summarized in Table G-3.

Table G-3. WCGS PSA Historical Summary

PSA Version	Summary of Changes from Prior Model	CDF (per year)
1992	IPE Submittal (including internal flooding CDF of 7.6 x 10^{-6})	4.2 x 10^{-5}
1996	Updated IPE model (including internal flooding CDF of 7.6 x 10^{-6}) - revised common-cause failure events to use generic common cause factor values - revised Human Reliability Analysis (HRA) values to address RAI comments - modeling of additional HRA action dependencies	6.3 x 10^{-5}

Table G-3. (cont'd)

PSA Version	Summary of Changes from Prior Model	CDF (per year)
1998	Comprehensive PSA model update (without internal flooding) - reduced the Loss of Off-site Power initiating event frequency - reduced the Transient with Main Feedwater initiating event frequency - added Test & Maintenance events which result in unavailability of an entire train of a risk significant support system - made data analysis changes; in particular, incorporated NRC common-cause factors and updated plant-specific failure data for the major active risk-significant component groups - re-evaluated Interfacing Systems LOCA using NUREG/CR-5928 and NUREG/CR -5744	5.48×10^{-5}
2002	Comprehensive PSA model update (without internal flooding) - reduced the Large and Medium LOCA initiating event frequencies - removed the "failure to close on demand" failure modes for Essential Service Water System (ESWS) valves EFHV0037 and EFHV0038 - added flag events to indicate that initiation of the feed portion of the feed and bleed function will result in automatic start of the ESWS pumps and isolation of the ESWS from the normal plant service water system	2.98×10^{-5}

The CDF value from the 1996 updated IPE submittal (6.31×10^{-5} per year, including the contribution from internal flooding events) is near the average of the CDF values reported in the IPEs for pressurized water reactor (PWR) plants with dry containments. Figure 11.2 of NUREG-1560 shows that the IPE-based total internal events for these plants ranges from 9×10^{-8} to 8×10^{-5} per year, with an average CDF for the group of 2×10^{-5} per year (NRC 1997b). It is recognized that other plants have updated the values for CDF subsequent to the IPE submittals to reflect modeling and hardware changes. The current internal events CDF result for WCGS (2.98×10^{-5} per year, not including internal flooding) is comparable to that for other plants of similar vintage and characteristics.

The NRC staff considered the peer reviews performed for the WGCS PSA, and the potential impact of the review findings on the SAMA evaluation. In the ER, WCNOC described the peer review by the Westinghouse Owner's Group (WOG) of the 1998 PSA Model conducted in August 2000. The WOG review concluded that all of the PSA technical elements were sufficient to support applications involving risk ranking and that the WCGS PSA provides an appropriate and sufficiently robust tool to support such activities as initial Maintenance Rule implementation, when supported as necessary by deterministic insights and plant expert panel input. The ER states that the 2002 PSA Update resolves nearly all peer review comments on the 1998 revision of the model. The ER lists all significant Facts and Observations (F&Os) and their applicable status in ER Table F.2.2. Twelve of the twenty-seven listed F&Os were not fully resolved. The Staff reviewed the F&Os and requested an assessment of the impact of several open items that could impact the SAMA evaluation (NRC 2007). WCNOC responded with additional discussion and clarification of the impact of these items on the SAMA analysis, and concluded that resolution of these comments would have minimal or no impact on the SAMA evaluation. Based on the information provided by the licensee, the NRC staff concurs with the licensee's conclusion.

The internal flooding analysis was included within the WOG peer review. Recommended areas for improvement consisted of including the contribution of internal flooding to LERF and using more recent and realistic methods to estimate piping failure probabilities and flooding frequencies. In response to an RAI associated with the exclusion of internal flooding from the PRA updates, WCNOC stated that the critical flood areas have been addressed (WCNOC 2007a) and that the WCGS's compartmentalization is expected to minimize any new hypothetical flooding scenarios that result from an update of the flood analysis (WCNOC 2007b).

Given that the WCGS internal events PSA model has been peer-reviewed and the peer review findings were either addressed or judged to have no adverse impact on the SAMA evaluation, and that WCNOC has satisfactorily addressed NRC staff questions regarding the PSA, the NRC staff concludes that the internal events Level 1 PSA model is of sufficient quality to support the SAMA evaluation.

As indicated above, the current WCGS PSA does not include external events. In the absence of such an analysis, WCNOC used the WCGS IPEEE in conjunction with the fire re-analysis to identify the highest risk accident sequences and the potential means of reducing the risk posed by those sequences, as discussed below.

The WCGS IPEEE was submitted in June 1995 (WCNOC 1995a), in response to Supplement 4 of Generic Letter 88-20. This submittal included a seismic margins analysis, a fire PRA, and a screening analysis for other external events. While no fundamental weaknesses or vulnerabilities to severe accident risk in regard to the external events were identified, several opportunities for seismic risk reduction were identified as discussed below. In a letter dated February 29, 2000, the NRC 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 (NRC 2000).

The WCGS IPEEE used a focused scope Electric Power Research Institute (EPRI) seismic margins analysis. This method is qualitative and does not provide numerical estimates of the CDF contributions from seismic initiators (EPRI 1991). For this assessment, a detailed walkdown was performed in which components were screened using an overall high confidence of low probability of failure (HCLPF) capacity of 0.3g, the review level earthquake (RLE) value for the plant, and the screening level that would be used for a focused-scope plant. A judgment was made that certain other components (including four station battery racks and eight cabinets for the engineered safety features actuation system) could not be screened at the RLE level. For these components a HCLPF capacity of 0.2g was assigned, which is the safe shutdown earthquake (SSE) level. WCNOC also identified four issues during the course of plant walkdowns where actual field installation did not conform with the seismic design configuration and several housekeeping issues with respect to temporary items stored near safety-related components. Corrective actions for these items have been completed (NRC 2000).

The WCGS IPEEE fire analysis employed a combination of a probabilistic risk analysis and Electric Power Research Institute's fire-induced vulnerability evaluation (FIVE) methodology. The evaluation was performed in four phases: (1) qualitative screening, (2) quantitative screening, (3) fire damage evaluation screening, and (4) fire scenario evaluation and quantification. Each phase focused on those fire areas that did not screen out in the prior phases. The final phase involved using the IPE model for internal events to quantify the CDF resulting from a fire-initiating event. The CDF for each area was obtained by multiplying the frequency of a fire in a given fire area by the conditional core damage probability associated with that fire area including, where appropriate, the impact of fire suppression and fire propagation. In most cases, it was assumed that all equipment in the area was damaged by the fire. The potential impact on containment performance and isolation was evaluated following the core damage evaluation.

The total fire CDF from the IPEEE was estimated to be 7.6×10^{-6} per year. In the ER, WCNOC indicated that the fire CDF was subsequently revised to 5.9×10^{-6} per year. In response to an RAI on the March 1998 fire re-analysis, WCNOC states that this value excludes control room fires (WCNOC 2007a). Thus, the total fire CDF, including control room fires, is 8.1×10^{-6} per year. WCNOC also stated that the fire re-analysis used the same methodology as the original IPEEE, but quantified the model using the results from the 1996 updated IPE, which contained improvements to the human reliability analysis and common cause portions of the model (WCNOC 2007a). The dominant fire areas and their contributions to the fire CDF are listed in Table G-4. Excluding control room fires, although non-conservative, does not change any conclusion associated with the cost effectiveness of the evaluated SAMAs. The ER uses the assumption that the external event contributions are equal to the internal event contributions. With the addition of control room fires, the total external contribution remains comparable. Excluding control room fires, the external events and internal flooding contribution is 2.8×10^{-5} per year compared to 2.98×10^{-5} per year for internal events. Including control room fires, this comparison becomes 3.1×10^{-5} per year compared to 2.98×10^{-5} per year.

Table G-4. Fire Areas and Their Contribution to Fire CDF

Fire Area	Area Description	CDF (per year)	
		IPEEE	Fire Re-Analysis
A-8D	Auxiliary Building - El. 2000	3.43×10^{-7}	2.96×10^{-7}
A-16	Auxiliary Building - El. 2026	2.19×10^{-7}	1.60×10^{-7}
A-17	Electrical Penetration Room (south)	1.83×10^{-7}	1.97×10^{-7}
A-18	Electrical Penetration Room (north)	5.36×10^{-7}	5.88×10^{-7}
A-21	Control Room AC and Filtration Units Room1501	N/A	3.21×10^{-7}
A-22	Control Room AC and Filtration Units Room1512	N/A	8.76×10^{-7}
A-27	Reactor Trip Switchgear Room	1.98×10^{-7}	2.12×10^{-7}
C-9	ESF Switchgear Room (north)	2.55×10^{-6}	1.76×10^{-6}
C-10	ESF Switchgear Room (south)	2.12×10^{-6}	1.52×10^{-6}
C-27	Control Room	1.43×10^{-6}	2.22×10^{-6}
Total Fire CDF		7.59×10^{-6}	8.14×10^{-6}

In the ER, WCNOC states that the use of the fire analysis results as a reflection of CDF may be inappropriate and that while the fire analysis is generally self-consistent within its calculational framework, the fire analysis does not compare well with internal events PSAs because of the number of conservative assumptions that have been included in the fire analysis process. Several specific examples of conservatisms in the fire analysis are provided in the ER and include: conservative fire modeling to initially screen rooms and scenarios, generic cabinet fire analyses assuming non-IEEE-383 cables in the cabinets, no credit for manual suppression for any fire, no credit for Halon systems protecting cables that were directly above the fire, no credit for thermo-lag fire barrier wrap, and the failure of the entire cabinet is assumed for an electrical cabinet fire. The ER also provides a list of fire analysis topics (involving technical inputs, data and modeling) that prevent the effective comparison of the CDF between the internal events PSA and the fire analysis. In response to an RAI requesting the applicability of the general topics to the WCGS fire analysis (NRC 2007), WCNOC provided WCGS-specific examples (WCNOC 2007a). Although arguments regarding the conservatisms in the fire analysis are presented in the ER, WCNOC used the baseline fire CDF of 5.92×10^{-6} per year, with control room fires excluded, in the SAMA analysis rather than some reduced value.

The IPEEE analysis of high winds, floods, and other external events followed the screening and evaluation approaches specified in Supplement 4 of FL 88-20 (NRC 1991) and did not identify any significant sequences or vulnerabilities (WCNOC 1995a). Based on this result, WCNOC concluded that these other external hazards would not be expected to impact the conclusions of the SAMA analysis and did not consider specific SAMAs for these events. However, for purposes of estimating the benefits of other SAMAs in these events, WCNOC assumed that the CDF from each other external initiator is comparable to the fire CDF (i.e., a CDF of 5.0×10^{-6} per year each for high wind events, external floods, and transportation and nearby facility accidents). It is noted that the risks from deliberate aircraft impacts were explicitly excluded since this was being considered in other forums along with other sources of sabotage.

Based on the aforementioned results, WCNOC estimated that the external events CDF is approximately equal to the internal events CDF (based on a fire CDF of 5.92×10^{-6} per year, a combined CDF from seismic, high wind, external flood, and transportation/nearby facility accidents of 2.0×10^{-5} per year, and an internal flooding CDF of 2.53×10^{-6} per year, compared to an internal events CDF of 2.98×10^{-5} per year). Accordingly, the total CDF from internal and external events would be approximately 2 times the internal events CDF. In the SAMA analysis submitted in the ER, WCNOC doubled the benefit that was derived from the internal events model to account for the combined contribution from internal and external events. This doubling was not applied to the two SAMAs that specifically address fire risk. Doubling the benefit for these SAMAs is not appropriate since these SAMAs are specific to external event risks and would not have a corresponding benefit on the risk from internal events. The NRC staff agrees with the licensee's overall conclusion concerning the impact of external events and concludes that the licensee's use of a multiplier of 2 to account for external events is reasonable for the purposes of the SAMA evaluation.

The NRC staff reviewed the general process used by WCNOC to translate the results of the Level 1 PSA into containment releases, as well as the results of the Level 2 analysis, as described in the ER and in response to NRC staff requests for additional information (WCNOC 2007a). The current Level 2 WCGS PSA is based on a simplified model intended to estimate the frequencies of containment failure modes that might lead to large early releases of radionuclides. This model, the LERF model, quantifies four distinct LERF contributors: ISLOCAs, SGTRs, Containment Isolation Failures and Early Containment Failures. As the current WCGS Level 2 analysis is only a LERF model, WCNOC developed a process to approximate the contributions from late containment failures and leakage/no containment failure scenarios to address the non-LERF cases. To accomplish this, WCNOC used the conditional probabilities of the various non-LERF release categories from the IPE model to obtain the release category frequencies for the current PSA. In response to an RAI requesting justification for this assumption, WCNOC provided the results of a sensitivity analysis in which all of the non-LERF contributors were assigned to the late containment failure release category (WCNOC 2007a). This sensitivity analysis produced an increase in the off-site economic cost risk of about 3 percent. As a result of this increase, three SAMAs that were not cost-beneficial in the baseline analysis would become marginally cost-beneficial (SAMAs 1, 3, and 13). However, these SAMAs were already identified as potentially cost-beneficial in the ER based on consideration of analysis uncertainties.

WCNOC characterized the releases for the spectrum of possible radionuclide release scenarios using a set of 6 release categories, defined based on the timing and magnitude of the release and whether the containment remains intact or is bypassed. Each Level 2 endstate was assigned to one of the 6 release categories. The Staff noted that sequences assigned to Release Category A (no containment failure within mission time) were grouped with Release Category S (no containment failure), and requested an assessment of the impact on the SAMA analysis if the sequences were alternatively assigned to Release Category K (late containment failure) (NRC 2007). In response to the Staff's request, WCNOC demonstrated that changing the assigned categories would result in an increase in the off-site economic cost risk of about 1 percent (WCNOC 2007a). This impact is bounded by the sensitivity analysis discussed above, and does not change the results of the SAMA analysis. The source term release fractions for the CET endstates were estimated based on the results of plant-specific analyses of the dominant scenarios using the MAAP computer program. The release categories and their frequencies and release characteristics are presented in Table F.3-2 of the ER.

During the NRC staff review of the IPE, staff noted that the WCGS had excluded the possibility of natural circulation-induced creep rupture of hot legs and steam generator tubes in high pressure accident sequences. In response to a RAI requesting a description of the current treatment of induced SGTRs, WCNOC asserted that only 2 percent of the high pressure melt scenarios with dry steam generators would result in an induced SGTR while the remaining fraction of the scenarios would result in hot leg creep ruptures. They further stated that the applicability of this percentage is predicated on the conditions that the secondary side is not depressurized and that the RCPs are not operated, and demonstrated that the small increase in the Modified Maximum Averted Cost-Risk (MMACR) would not result in any additional cost-beneficial SAMAs (WCNOC 2007a). The Staff asked a follow-up question on how the increased likelihood of induced SGTR for sequences with RCP Seal LOCAs are accounted for in the risk assessment. In its response, WCNOC indicated that making this adjustment to the total SGTR probability would result in a significant increase in the SGTR specific contribution, but demonstrated that there would be no impact on the overall SAMA conclusions (WCNOC 2007b). Based on the information provided by the licensee, the NRC staff finds the treatment of induced SGTR events to be reasonable for the purposes of the SAMA analysis.

The NRC staff's review of the Level 2 IPE concluded that it addressed the most important severe accident phenomena normally associated with large, dry containments, and identified no significant problems or errors (NRC 1996). Based on the NRC staff's review of the Level 2 methodology, the fact that the Level 2 model was reviewed in more detail as part of the WOG peer review, and the responses to the RAIs, the NRC staff concludes that the Level 2 PSA, as supplemented with additional modeling for non-LERF releases, provides an acceptable basis for evaluating the benefits associated with various SAMAs.

As indicated in the ER, the reactor core radionuclide inventory used in the consequence analysis was derived from the plant's safety analysis based on Westinghouse Letter SAP-99-145 (WEST 1999). In response to an RAI, WCNOC confirmed that the current core design practice is consistent with this letter and there are no plans to change the operating strategy (WCNOC 2007c). All releases were modeled as occurring at ground level. WCNOC assessed the impact of alternatively assuming an elevated release. The results of this sensitivity study showed that the elevated release produces about a 3 percent reduction in off-site economic cost risk.

The NRC staff reviewed the process used by WCNOC to extend the containment performance (Level 2) portion of the PSA to an assessment of off-site consequences (essentially a Level 3 PSA). This included consideration of the source terms used to characterize fission product releases for the applicable containment release categories and the major input assumptions used in the off-site consequence analyses. The MACCS2 code was utilized to estimate off-site consequences. Plant-specific input to the code includes the source terms for each release category and the reactor core radionuclide inventory (both discussed above), site-specific meteorological data, projected population distribution within an 80-kilometer (50-mile) radius for the year 2040, emergency evacuation modeling, and economic data. This information is provided in Attachment F of the ER.

WCNOC used site-specific meteorological data for the 2001 calendar year as input to the MACCS2 code. The data were collected from the on-site meteorological tower. Data from 2000 through 2004 were also considered, but the 2001 data were chosen because they were the most complete and because results of a MACCS2 sensitivity case comparing the use of 2001 data to 2004 data indicated that the 2001 data produced slightly more conservative results (i.e., about a 9 percent increase in off-site economic cost risk). Missing data were obtained by interpolation from 2004 data. Suspect data were taken from a backup meteorological system located three miles from the WCGS site. The NRC staff notes that previous SAMA analyses results have shown little sensitivity to year-to-year differences in meteorological data and concludes that the use of the 2001 meteorological data in the SAMA analysis is reasonable.

The population distribution the licensee used as input to the MACCS2 analysis was estimated for the year 2040, based on the U.S. Census Bureau (USCB) population data for 2000, as provided by the sector population, land fraction and economic estimation program (SECPOP) 2000 program (NRC 2003), and the expected annual population growth rate (UCSB 2000a). The 2000 population was adjusted to account for transient population. The 1990 and 2000 county-level census data were used to estimate the annual population growth rate (USCB 2000b). If a negative growth rate was calculated, then a growth rate of zero percent per year was used. It was assumed that the growth rate would remain the same as the average rate reported between 1990 and 2000. Using sector-specific population growth rates, projections were made by extrapolating the 2000 sector population data to year 2040. A population sensitivity case was performed by using a 30 percent uniform increase in population for all sectors. The 30 percent population case showed about a 14 percent change in population dose and a 29 percent change in off-site economic cost risk. The NRC 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 kilometers (10 miles) from the plant. It was assumed that 95 percent of the population would move at an average speed of approximately 1.6 meters per second with a delayed start time of 30 minutes (WCNOC 2006). 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 was performed in which the evacuation speed was decreased by 50 percent. The result was a 0.3 percent increase in the total population dose, which is insignificant. The NRC staff concludes that the evacuation assumptions and analysis are reasonable and acceptable for the purposes of the SAMA evaluation.

Much of the site-specific economic data was provided from SECPOP2000 (NRC 2003) by specifying the data for each of the counties surrounding the plant to a distance of 50 miles. SECPOP2000 utilizes economic data from the 1997 Census of Agriculture (USDA 1998). In addition, generic economic data that applied to the region as a whole were revised from the MACCS2 sample problem input when better information was available. Some of this data was adjusted using the consumer price index of 1.75. These revised parameters included the value of farm and non-farm wealth.

The NRC staff concludes that the methodology used by WCNOC to estimate the off-site consequences for WCGS provides an acceptable basis from which to proceed with an assessment of risk reduction potential for candidate SAMAs. Accordingly, the NRC staff based its assessment of off-site risk on the CDF and off-site doses reported by WCNOC.

G.3 Potential Plant Improvements

The process for identifying potential plant improvements, an evaluation of that process, and the improvements evaluated in detail by WCNOC are discussed in this section.

G.3.1 Process for Identifying Potential Plant Improvements

WCNOC's process for identifying potential plant improvements (SAMAs) consisted of the following elements:

- Review of the most significant basic events from the current plant-specific PSA,
- Review of potential plant improvements identified in the WCGS IPE and IPEEE,
- Review of dominant fire areas from the Fire Re-Analysis and SAMAs that could potentially reduce the associated fire risk,
- Review of Phase II SAMAs from license renewal applications for six other U.S. nuclear sites, and
- Review of other industry documentation discussing potential plant improvements.

Based on this process, an initial set of 19 potential SAMA candidates, referred to as Phase I SAMAs, was identified. In Phase I of the evaluation, WCNOC performed a qualitative screening of the initial list of SAMAs and eliminated SAMAs from further consideration using the following criteria:

- The SAMA was determined to provide no measurable benefit, or
- The SAMA has estimated costs that would exceed the dollar value associated with completely eliminating all severe accident risk at WCGS.

Based on this screening, 4 SAMAs were eliminated leaving 15 unique SAMAs for further evaluation (13 SAMA candidates with two containing two options). The remaining SAMAs, referred to as Phase II SAMAs, are listed in Table F.5-4 of the ER (WCNOC 2006). In Phase II, a detailed evaluation was performed for each of the 15 remaining SAMA candidates, as discussed in Sections G.4 and G.6 below. To account for the potential impact of external events, the estimated benefits based on internal events were multiplied by a factor of 2 (except for those SAMAs specific to fire events, since those SAMAs would not have a corresponding benefit on the risk from internal events).

G.3.2 Review of WCNOC's Process

WCNOC's efforts to identify potential SAMAs focused primarily on areas associated with internal initiating events, but also included explicit consideration of potential SAMAs for fire events. The initial list of SAMAs generally addressed the accident sequences considered to be important to CDF from functional, initiating event, and risk reduction worth perspectives at WCGS, and included selected SAMAs from prior SAMA analyses for other plants.

WCNOC provided a tabular listing of the PSA basic events sorted according to their risk reduction worth (RRW) (WCNOC 2006). SAMAs impacting these basic events would have the greatest potential for reducing risk. WCNOC used a RRW cutoff of 1.02, which corresponds to about a two-percent change in CDF given 100-percent reliability of the SAMA. This equates to a benefit of approximately $36,000 (after the benefits have been multiplied to account for external events). WCNOC also provided and reviewed the LERF-based RRW events down to an RRW of 1.02. WCNOC correlated the basic events with highest risk importance in the Level 1 and 2 PSA with the SAMAs evaluated in Phase I or Phase II, and showed that, with a few exceptions, all of the significant basic events are addressed by one or more SAMAs (WCNOC 2006). Of the basic events of high risk importance that are not addressed by SAMAs, each is closely tied to other basic events that had been addressed by one or more SAMAs.

For a number of the Phase II SAMAs listed in the ER, the information provided did not sufficiently describe the proposed modification. Therefore, the NRC staff asked the applicant to provide more detailed descriptions of the modifications for several of the Phase II SAMA candidates (NRC 2007). In response to the RAI, WCNOC provided the requested information (WCNOC 2007a).

The NRC staff questioned WCNOC about lower cost alternatives to some of the SAMAs evaluated (NRC 2007), including:

- Maintaining actions to improve the ability to align the Sharpe Station diesel generators to the WCGS emergency buses during an SBO, as an alternative to SAMA 2,
- Installing a manual fuel oil transfer pump, as an alternative to SAMA 13,
- Alternatives for reducing failure of the Sharpe Station,
- Using a portable generator to extend the coping time in loss of alternating current (AC) power events (to power selected instrumentation and direct current (DC) power to the turbine-driven [TD] auxiliary feedwater pump[AFW])
- Providing alternate DC feeds (using a portable generator) to panels supplied only by DC bus, and
- Adding an alternate AC source to the site as an alternative to Sharpe Station.

In response to an RAI, WCNOC addressed the suggested lower cost alternatives (WCNOC 2007a). This is discussed further in Section G.6.2.

Although the IPE did not identify any vulnerabilities, six potential enhancements to the plant, procedures, and training at WCGS were identified as part of the IPE process. WCNOC noted that two of these enhancements had been implemented. A third enhancement, to replace the positive displacement charging pump with a centrifugal pump has been implemented but does not include a backup AC supply. WCNOC has included a backup power source for the normal charging pump in the list of SAMA candidates (WCNOC 2006). The fourth enhancement, proceduralizing actions to perform alternate room cooling methods, has not been implemented, but has been included in the list of SAMA candidates. WCNOC indicated that the remaining two IPE-identified enhancements were not pursued further as they were screened out during the Phase I SAMA analysis. One enhancement, addition of a switch to bypass feedwater isolation for restoring main feedwater, was indicated in the IPE Safety Evaluation Report (SER) to have an impact on CDF of about 19 percent (NRC 1996), but in the ER was indicated to have an RRW of only 1.001. In response to a staff RAI, the licensee identified the significant reduction in the frequency of transients with power conversion systems available (from 4.3 to 1.05 events per year) and improvements in modeling of such transients as the major model changes that reduced the importance of this enhancement (WCNOC 2007a). The remaining IPE-identified enhancement involved performing an additional evaluation to identify any procedural or hardware modifications to reduce the risk due to internal flooding. Section F.5.1.7 of the ER presents a bounding estimate for internal flooding SAMAs and concludes that based on the total risk associated with all internal flooding events and the high costs associated with installing systems that could mitigate all flood scenarios or combinations of scenarios, no further investigation of internal flooding-based SAMAs would be warranted.

Based on this information, the NRC staff concludes that the set of SAMAs evaluated in the ER, together with those identified in response to NRC staff RAIs, addresses the major contributors to internal event CDF.

WCNOC did not identify WCGS-specific candidate SAMAs for seismic events. In the WCGS IPEEE, all HCLPF values were greater than the 0.3g review level earthquake except for four station battery racks and eight electrical cabinets, which had a HCLPF value of 0.20g. In the ER, WCNOC indicated that subsequent efforts by the plant resulted in the modification of the station battery racks to meet the 0.30g peak ground acceleration HCLPF criteria. WCNOC states that seismic-specific SAMAs were not included and that no further review is required because that HCLPF value is acceptable for reduced scope plants, such as WCGS. NRC staff requested that WCNOC evaluate modifications that would raise the HCLPF values for the electrical cabinets to 0.3g (NRC 2007). In response to the RAI, WCNOC showed that the maximum averted risk of this improvement did not justify its cost, even when the benefits and costs of the enhancement are conservatively assessed (WCNOC 2007a). Based on the information provided by the licensee, the NRC staff finds WCNOC's consideration of further seismic improvements to be reasonable for the purposes of the SAMA analysis.

Based on the licensee's efforts to identify and address seismic outliers and the expected cost associated with further seismic risk analysis and potential plant modifications, the NRC staff concludes that the opportunity for seismic-related SAMAs has been adequately explored and that it is unlikely that there are any cost-beneficial, seismic-related SAMA candidates.

While the IPEEE did not identify opportunities for improvements with respect to fire events, the licensee did consider potential SAMAs for fire, and identified SAMA 15, which includes two different alternatives, i.e., Case 1 - rerouting cables in the fire areas with the largest contributions to CDF, and Case 2 - placing protective barriers around these cables. The NRC staff concludes that the opportunity for fire-related SAMAs has been adequately explored and that it is unlikely that there are additional potentially cost-beneficial, fire-related SAMA candidates.

The NRC staff notes that the set of SAMAs submitted is not all inclusive, since additional, possibly even less expensive, design alternatives can always be postulated. However, the NRC 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 NRC staff concludes that WCNOC used a systematic and comprehensive process for identifying potential plant improvements for WCGS, and that the set of potential plant improvements identified by WCNOC is reasonably comprehensive and therefore acceptable. This search included reviewing insights from the plant-specific risk studies and reviewing plant improvements considered in previous SAMA analyses. 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 and fire 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

WCNOC evaluated the risk-reduction potential of the 15 remaining SAMAs that were applicable to WCGS. The SAMA evaluations were performed using realistic assumptions with some conservatism. On balance, such calculations overestimate the benefit and are conservative.

For most of the SAMAs, WCNOC used model re-quantification to determine the potential benefits. The CDF and population dose reductions were estimated using the 2002 version of the WCGS PSA model. The changes made to the model to quantify the impact of the SAMAs are detailed in Section F.6 of Attachment F to the ER. Table G-5 lists the assumptions considered to estimate the risk reduction for each of the evaluated 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 estimated benefits reported in Table G-5 reflect the combined benefit in both internal and external events. The determination of the benefits for the various SAMAs is further discussed in Section G.6.

Table G-5. SAMA Cost/Benefit Screening Analysis for WCGS [(a)]

SAMA	Assumptions	% Risk Reduction		Total Benefit Using 7% Discount Rate ($)	Total Benefit Using 3% Discount Rate (b) ($)	Cost ($)
		CDF	Population Dose			
1 - Install a permanent, dedicated generator for the normal charging pump (NCP) with local operation of a TD AFW pump after 125V DC depletion.	Reduce the total CDF frequency of SBO sequences SBOS02 through SBOS32 by a factor of ten.	49	5	650,000	810,000	800,000
2 - Modify the controls and operating procedures for Sharpe Station to allow for rapid response.	Modify the SBO flag event to reduce the failure probability of the Sharpe Station to deliver power to the WCGS switchyard from a value of 1.0 to 0.294.	40	5	530,000	660,000	400,000
3 - Provide AC cross-tie capability	Modify cutset frequencies to mimic the availability of the cross-tie. The cross-tie was assumed to have a failure probability of 5.0E-02. A cutset review/manipulation process was used for each Level II release category.	18	2	240,000	300,000	330,000
4 - ISLOCA isolation.	Include isolation credit for the Low Pressure Safety Injection (LPSI) Cold Leg Injection line ISLOCA scenarios.					
Case 1: Install new valves that are capable of isolating against RCS pressure.	Set failure probabilities of the new valves to values developed as part of the previous WCGS PSA ISLOCA analysis.	5	69	180,000	270,000	600,000

Table G-5. (cont'd)

SAMA	Assumptions	% Risk Reduction		Total Benefit Using 7% Discount Rate ($)	Total Benefit Using 3% Discount Rate (b) ($)	Cost ($)
		CDF	Population Dose			
4 - ISLOCA isolation Case 2: Proceduralize operator actions to perform local isolations of any valves that fail to close remotely.	Set the local isolation failure probability to 3 times the remote isolation failure probability to account for stress and environmental challenges (approximately 0.4).	4	50	130,000	190,000	50,000
5 - Open doors for alternate EDG room cooling.	Reduce the failure probability of the basic event representing outside temperature in the EDG rooms could exceed 79 degrees (OTH-OAT-OVER-78F) by a factor of ten.	3	0	44,000	57,000	50,000
6 - Improve reliability of manual recirculation switchover given refueling water storage tank (RWST) level instrumentation failure.	Reduce the failure probability of common cause failure of 2 of 4 RWST level instrumentation channels (CABN–RWSTLLO-SA) by a factor of ten.			NOT ESTIMATED		
7 - Improve reliability of manual recirculation switchover given auto initiation failure.	Reduce the failure probability of common cause failure of the Channel 1 and IV LOCA Sequencer (ESNFLOCASEQ12SF1) by a factor of ten.			NOT ESTIMATED		
8 - Install a hard piped connection to the fire protection system (FPS) to provide high volume makeup to the RWST.	Reduce the failure probability of common cause failure of the RHR pumps to start (MPEJ-01AB-12-BS1) by a factor of 100.	3	0	35,000	44,000	570,000

Table G-5. (cont'd)

SAMA	Assumptions	% Risk Reduction		Total Benefit Using 7% Discount Rate ($)	Total Benefit Using 3% Discount Rate (b) ($)	Cost ($)
		CDF	Population Dose			
13 - Install an alternative fuel oil tank with gravity feed capability.	Reduce the failure probability of the largest contributing fuel oil transfer events (MPEJ-01AB-12-BS1) by a factor of 100.	7	1	90,000	110,000	150,000
14 - Install a permanent, dedicated generator for the NCP, one motor driven AFW pump and a battery charger.	Reduce all of the SBO sequences failure probabilities by a factor of 20.	54	5	720,000	890,000	1,200,000
15 - Prevention of propagation of the initial cabinet fire.	Eliminate fire CDF contribution from propagation of the initial fire cabinet.	16 (c)	16(c)	320,000	420,000	
Case 1: Reroute the safe shutdown equipment (SSE) cables so that they do not pass over other cabinets.						3,300,000
Case 2: Provide fire barriers capable of preventing fire propagation and damage to the overhead cables.						1,000,000
16 - Install inter-train CCW cross-tie lines for emergency operation.	Reduce the failure probability by a factor of ten for all event sequences that would realize a risk benefit from a cross-tie between the two trains of CCW.	1	<1	18,000	23,000	570,000
17 - Install a cross-tie between 125V DC divisions.	Reduce all of the battery failure basic events failure probabilities by a factor of 100.	4	0	53,000	67,000	550,000

(a) SAMAs in bold are potentially cost-beneficial.
(b) Estimated benefits reflect revised values provided after correction of three SECPOP2000 economic data file errors (WCNOC 2008).
(c) Estimated benefits are derived from information provided in the ER (WCNOC 2006) are stated as a percentage reduction of risk from external events, where risk from fire is assumed to be 85 percent of the total risk from external events.

The NRC staff questioned the assumptions used in evaluating the benefits or risk reduction estimates of certain SAMAs provided in the ER (NRC 2007). For example, the NRC staff requested the bases for the assumption in SAMA 16 of a 0.1 failure probability for the operator action to diagnose and cross-tie the component cooling system (CCW) system. The licensee described the scenario involving the operator actions and justified the failure probability based on the complexity of the scenario. The licensee also provided a qualitative argument that the cost-risk assessment is not particularly sensitive to changes in SAMA failure probabilities in ranges below 0.1, as this value will provide 90 percent of the SAMA benefit. The NRC staff considers the assumptions, as clarified, to be reasonable and acceptable for purposes of the SAMA evaluation.

For those SAMAs that specifically address fire events (i.e., SAMA 15, Cases 1 and 2), the reduction in CDF and population dose was not directly calculated. For these SAMAs, a bounding estimate of the impact of the SAMA was made based on general assumptions regarding the approximate contribution to total risk from external events (relative to that from internal events), the fraction of the external event risk attributable to fire events, and the fraction of the fire risk affected by the SAMA and associated with each fire compartment (based on information from the IPEEE.) For example, it is assumed that the contribution to risk from external events is approximately equal to that from internal events, and that internal fires contribute 85 percent of the external events risk. The fire re-analysis was then used to identify the fraction of the fire risk that could be eliminated by potential enhancements in various fire areas. A similar process was applied to the proposed fire enhancements for each fire area considered. (It was assumed that the SAMA was implemented in all 3 dominant fire areas.)

The NRC staff has reviewed WCNOC'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 NRC staff based its estimates of averted risk for the various SAMAs on WCNOC's risk reduction estimates.

G.5 Cost Impacts of Candidate Plant Improvements

WCNOC estimated the costs of implementing the 15 candidate SAMAs through the application of engineering judgment and use of other licensees' 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 contingency costs associated with unforeseen implementation obstacles. The cost estimates provided in the ER also did not account for inflation, which is considered another conservatism.

The NRC staff reviewed the bases for the licensee's cost estimates (presented in Section F.6 of Attachment F to the ER). For certain improvements, the NRC 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 NRC staff reviewed the costs and found them to be reasonable, and generally consistent with estimates provided in support of other plants' analyses.

The NRC staff concludes that the cost estimates provided by WCNOC are sufficient and appropriate for use in the SAMA evaluation.

G.6 Cost-Benefit Comparison

WCNOC's cost-benefit analysis and the NRC staff's review are described in the following sections.

G.6.1 WCNOC's Evaluation

The methodology used by WCNOC was based primarily on NRC's guidance for performing cost-benefit analysis, i.e., NUREG/BR-0184, *Regulatory Analysis Technical Evaluation Handbook* (NRC 1997a). The guidance involves determining the net value for each SAMA according to the following formula:

Net Value = (APE + AOC + AOE + AOSC) - COE,
where

APE = present value of averted public exposure ($)
AOC = present value of averted off-site property damage costs ($)
AOE = present value of averted occupational exposure costs ($)
AOSC = present value of averted on-site costs ($)
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. WCNOC's derivation of each of the associated costs is summarized below.

NUREG/BR-0058 has recently been revised to reflect the agency's policy on discount rates. Revision 4 of NUREG/BR-0058 states that two sets of estimates should be developed: one at 3 percent and one at 7 percent (NRC 2004). WCNOC provided both sets of estimates (WCNOC 2006).

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 (15.04 based on a 20-year period with a 3-percent discount rate).

As stated in NUREG/BR-0184 (NRC 1997a), 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, which assumes elimination of all severe accidents due to internal events, WCNOC calculated an APE of approximately $98,400 for the 20-year license renewal period.

Averted Off-site Property Damage Costs (AOC)

The AOCs were calculated using the following formula:

AOC = Annual CDF reduction
x off-site 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 due to internal events are eliminated, WCNOC calculated an annual off-site economic risk of about $3,000 based on the Level 3 risk analysis. This results in a discounted value of approximately $44,800 for the 20-year license renewal 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.

WCNOC derived the values for averted occupational exposure from information provided in Section 5.7.3 of the regulatory analysis handbook (NRC 1997a). 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 3 percent, and a time period of 20 years to represent the license renewal period. For the purposes of initial screening, which assumes all severe accidents due to internal events are eliminated, WCNOC calculated an AOE of approximately $18,500 for the 20-year license renewal period.

Averted On-site Costs (AOSCs)

The AOSCs 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. WCNOC derived the values for AOSC based on information provided in Section 5.7.6 of NUREG/BR-0184, the regulatory analysis handbook (NRC 1997a).

WCNOC divided this cost element into two parts – the on-site cleanup and decontamination cost, also commonly referred to as averted cleanup and decontamination costs, and 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 NUREG/BR-0184 to be $\$1.3 \times 10^9$ (discounted over a 10-year cleanup period). This value is integrated over the term of the proposed license extension. For the purposes of initial screening, which assumes all severe accidents due to internal events are eliminated, WCNOC calculated an ACC of approximately $581,000 for the 20-year license renewal 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

WCNOC based its calculations on the value of 1165 megawatt electric (MWe), which is the current electrical output for WCGS. Therefore, WCNOC applied a power scaling factor of 1165/910 to determine the replacement power costs. For the purposes of initial screening, which assumes all severe accidents due to internal events are eliminated, WCNOC calculated an RPC of approximately $211,000 for the 20-year license renewal period. For the purposes of initial screening, which assumes all severe accidents are eliminated, WCNOC calculated the AOSC to be approximately $792,000 for the 20-year license renewal period.

Using the above equations, WCNOC estimated the total present dollar value equivalent associated with completely eliminating severe accidents due to internal events at WCGS to be about $954,000. Use of a multiplier of two to account for external events increases the value to $1.91M (WCNOC 2008) and represents the dollar value associated with completely eliminating all internal and external event severe accident risk at WCGS, also referred to as the Modified Maximum Averted Cost Risk (MMACR).

WCNOC's Results

If the implementation costs for a candidate SAMA exceeded the calculated benefit, the SAMA was considered not to be cost-beneficial. In the baseline analysis contained in the ER (using a 3 percent discount rate), WCNOC identified three potentially cost-beneficial SAMAs. The potentially cost-beneficial SAMAs are:

- SAMA 2 - Modify controls and operating procedures to permit the diesel generators at the Sharpe Station to be more rapidly aligned to the WCGS emergency buses in SBO events.

- SAMA 4, Case 2 - Proceduralize operator actions to perform local isolations of any valves that fail to close remotely in an interfacing system LOCA.

- SAMA 5 - Modify procedures to open emergency diesel generator room doors to provide alternate room cooling given failure of the heating ventilation and air-conditioning (HVAC) supply fan.

WCNOC performed additional analyses to evaluate the impact of parameter choices and uncertainties on the results of the SAMA assessment (WCNOC 2006). If the benefits are increased by a factor of 1.9 to account for uncertainties, four additional SAMA candidates were determined to be potentially cost-beneficial (SAMAs 1, 3, 13, and 14).

- SAMA 1 - Install a permanent, dedicated generator for the NCP in order to provide RCP seal cooling in SBO events.

- SAMA 3 - Provide the capability to cross-tie between 4-kilovolts (kV) AC buses in the event of a loss of power to one bus.

- SAMA 13 - Install an alternative fuel oil tank with gravity feed capability to address fuel oil transfer failure events.

- SAMA 14 - Install a permanent, dedicated generator for the NCP (similar to SAMA 1), and a motor-driven AFW pump and battery charger to address SBO events in which the TD AFW pump is unavailable.

Subsequent to the ER, WCNOC identified three problems related to use of the SECPOP2000 code. These deal with: (1) a formatting error in the regional economic data block text file generated by SECPOP2000 for input to MACCS2 which results in MACCS2 mis-reading the data, (2) an error associated with the formatting of the COUNTY97.DAT economic database file used by SECPOP2000 which results in SECPOP2000 processing incorrect economic and land use data, and (3) gaps in the numbered entries in the COUNTY97.DAT economic database file which result in any county beyond county number 955 being handled incorrectly in SECPOP2000. The impact of correcting the first two problems was addressed by WCNOC in an August 15, 2007 letter (WCNOC 2007e), and described in the DSEIS.

Subsequent to the DSEIS, WCNOC provided a re-analysis of the population dose and benefit estimates based on correction of all three SECPOP2000 problems (WCNOC 2008). Relative to the values reported in the ER, the re-analysis produced a 12 percent increase in total population dose (from 2.86 to 3.27 person-rem per year), a 3 percent increase in the MMACR (from $1.85M to $1.91M), and an increase in the estimated benefits for the various SAMAs ranging from 1 to 11 percent. The corrections resulted in no change to the Phase I screening results, but resulted in one additional SAMA (SAMA 1) becoming potentially cost-beneficial in the baseline analysis. However, this SAMA was already identified as potentially cost-beneficial in the ER based on consideration of analysis uncertainties. Thus, the overall results of the SAMA assessment were not affected. The population dose and benefit estimates reported in the FSEIS reflect the correction of the three SECPOP2000 problems.

The potentially cost-beneficial SAMAs and WCNOC's plans for further evaluation of these SAMAs are discussed in more detail in Section G.6.2.

G.6.2 Review of WCNOC's Cost-Benefit Evaluation

The cost-benefit analysis performed by WCNOC was based primarily on NUREG/BR-0184 (NRC 1997a) and was implemented consistent with this guidance.

To account for external events, WCNOC multiplied the internal event benefits by a factor of 2 for each SAMA, except those SAMAs that specifically address external events (i.e., SAMA 15, Cases 1 and 2). Doubling the benefit for these SAMAs is not appropriate since these SAMAs are specific to external events and would not have a corresponding benefit in risk from internal events. Given that the CDF from internal flooding, internal fires, and other external events as reported by WCNOC is less than the CDF for internal events, the NRC staff agrees that the factor of 2 multiplier for external events is reasonable.

WCNOC considered the impact that possible increases in benefits from analysis uncertainties would have on the results of the SAMA assessment. In the ER, WCNOC presents the results of an uncertainty analysis of the internal events CDF which indicates that the 95th percentile value is a factor of 1.9 times the mean CDF. WCNOC reexamined the initial set of SAMAs to determine if any additional Phase I SAMAs would be retained for further analysis if the benefits MMACR were increased by a factor of 1.9. One such Phase I SAMA was identified, i.e., SAMA 12 - install SG isolation valves on the primary loop side. However, based on further consideration of the limited benefit of eliminating the events addressed by this SAMA, WCNOC concluded that this SAMA would not be cost-beneficial even if it were completely reliable. The specific rationale is provided in Section F.7.2.1 of the ER.

WCNOC also considered the impact on the Phase II screening if the estimated benefits were increased by a factor of 1.9 (in addition to the factor of 2 multiplier). Four additional SAMAs became cost-beneficial in WCNOC's analysis (SAMAs 1, 3, 13, and 14 as described above.) Although not cost-beneficial in the baseline analysis, WCNOC included these four SAMAs within the set of potentially cost-beneficial SAMAs that they intend to examine further for implementation.

WCNOC did not develop a cost-risk analysis for two Phase II SAMAs:

- SAMA 6 - Manual recirculation with RWST level instrumentation failure
- SAMA 7 - Manual recirculation with auto-initiation failure

In the ER, WCNOC noted that the event importance measure values addressed by these SAMAs were calculated without credit for manually aligning safety injection to the recirculation mode. To address this issue, WCNOC used conservative human reliability estimates to show that the importance values were inflated, and that the incorporation of actions to manually initiate recirculation reduces the importance of the common cause failure of RWST level instrumentation channels and the failure of auto initiation logic to below the review threshold. Therefore, the benefits and costs of these SAMAs were not evaluated. In response to an RAI, WCNOC stated that manual initiation of recirculation mode is fully proceduralized and guidance is available to direct manual initiation even if two of the four RWST level indicators fail (WCNOC 2007a). The NRC staff found this approach to be reasonable.

The NRC staff noted that for certain SAMAs considered in the ER, there may be alternatives that could achieve much of the risk reduction at a lower cost. The NRC staff asked the licensee to evaluate several lower cost alternatives to the SAMAs considered in the ER, including an alternative to SAMA 2, which was already determined to be potentially cost-beneficial in the baseline analysis. The alternative, referred to as SAMA 2a, would involve continuously maintaining actions to improve the ability to align the diesel generators at the nearby Sharpe

Station to the WCGS emergency buses during an SBO. These actions, which include training for operators, Sharpe Station battery bi-weekly surveillance testing, and additional dedicated operation staff, are currently only credited during an extended EDG maintenance period. In response to an RAI requesting an evaluation of this option, the licensee indicated that this alternative is also cost-beneficial, contingent on the ability to maintain the option to enter the extended EDG completion time (WCNOC 2007a). This option was approved in License Amendment 163 (NRC 2006).

The NRC staff also asked the licensee to evaluate several lower cost alternative SAMAs that had been found to be potentially cost-beneficial at other PWR plants. These alternatives were: (1) using a portable generator to extend the coping time in loss of AC power events (to power selected instrumentation and DC power to the turbine-driven auxiliary feedwater pump), (2) providing alternate DC feeds (using a portable generator) to panels supplied only by a DC bus, and (3) adding an alternate AC source to the site as an alternative to Sharpe Station (NRC 2007). WCNOC provided a further evaluation of these alternatives, as summarized below.

- Using a portable generator during a loss of AC power to power selected instrumentation and DC power - The impact of this SAMA on risk would be small because WCGS has reasonable means of coping with SBO events until seal LOCA induced core damage occurs, i.e., using existing procedures for operating the turbine-driven AFW pump after battery depletion. Therefore, there is a greater benefit by addressing primary side makeup, as provided through SAMAs 1, 2, and 14.

- Providing alternate DC feeds to panels supplied only by the DC bus - The benefit of this alternative is similar to the one above, but does not require the battery chargers. The risk reduction worth of the battery chargers is 1.000, below the SAMA review threshold. Therefore, this alternative would not be cost-beneficial.

- Including an alternate AC source as an alternative to Sharpe Station - The cost of a full-size EDG or equivalent has been shown to be several million dollars. The benefits of this alternative are accomplished with SAMAs 1, 2, and 14 for a fraction of the cost.

The NRC staff notes that the seven potentially cost-beneficial SAMAs 1, 2, 3, 4-2, 5, 13, and 14 identified in either WCNOC's baseline analysis, or uncertainty analysis, are included within the set of SAMAs that WCNOC will consider for implementation.

The NRC staff concludes that, with the exception of the potentially cost-beneficial SAMAs discussed above, the costs of the SAMAs evaluated would be higher than the associated benefits.

G.7 Conclusions

WCNOC compiled a list of 19 SAMAs based on a review of the most significant basic events from the current plant-specific PSA, insights from the plant-specific IPE and IPEEE, dominant fire areas from the Fire Risk Re-Analysis, Phase II SAMAs from license renewal applications for other plants, and review of other industry documentation. An initial screening removed SAMA candidates that (1) were determined to provide no measurable benefit, or (2) had estimated costs that would exceed the dollar value associated with completely eliminating all severe accident risk at WCGS. Based on this screening, 4 SAMAs were eliminated leaving 15 candidate SAMAs for evaluation.

For the remaining SAMA candidates, a more detailed design and cost estimate was developed as shown in Table G-5. The cost-benefit analyses in the ER showed that three SAMA candidates were potentially cost-beneficial in the baseline analysis (Phase II SAMAs 2, 4-2, and 5). WCNOC performed additional analyses to evaluate the impact of parameter choices and uncertainties on the results of the SAMA assessment. As a result, four additional SAMAs (Phase II SAMAs 1, 3, 13 and 14) were identified as potentially cost-beneficial.[a] WCNOC has indicated that all seven potentially cost-beneficial SAMAs (1, 2, 3, 4-2, 5, 13, and 14) will be considered for implementation at WCGS.

The NRC staff reviewed the WCNOC analysis and concludes that the methods used and the implementation of those methods were sound. The treatment of SAMA benefits and costs support the general conclusion that the SAMA evaluations performed by WCNOC are reasonable and sufficient for the license renewal submittal. Although the treatment of SAMAs for external events was somewhat limited, the likelihood of there being cost-beneficial enhancements in this area was minimized by improvements that have been realized as a result of the IPEEE process, and inclusion of a multiplier to account for external events.

The NRC staff concurs with WCNOC's identification of areas in which risk can be further reduced in a cost-beneficial manner through the implementation of the identified, potentially cost-beneficial SAMAs. Given the potential for cost-beneficial risk reduction, the NRC staff agrees that further evaluation of these SAMAs by WCNOC 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 Title 10 of the *Code of Federal Regulations*, Part 54.

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[a] Based on subsequent corrections involving the SECPOP2000 code, SAMA 1 was also identified as potentially cost-beneficial in the baseline analysis.

G.8 References

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

Electric Power Research Institute (EPRI). 1991. *A Methodology for Assessment of Nuclear Power Plant Seismic Margins*, Revision 1. EPRI Report NP-6041-SL.
Nuclear Regulatory Commission (NRC). 1990. *Severe Accident Risks: An Assessment for Five U.S. Nuclear Power Plants.* NUREG-1150, Washington, D.C.

Nuclear Regulatory Commission (NRC). 1991. "Individual Plant Examination of External Events (IPEEE) for Severe Accident Vulnerabilities," Supplement 4 to Generic Letter 88-20, June 28, 1991

Nuclear Regulatory Commission (NRC). 1996. Letter from James C. Stone, U.S. NRC, to Neil S. Carns, WCNOC. Subject: Staff Evaluation Report for the Review of the Wolf Creek Generating Station Individual Plant Examination (TAC No. M74490), November 18, 1996.

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

Nuclear Regulatory Commission (NRC). 1997b. *Individual Plant Examination Program: Perspectives on Reactor Safety and Plant Performance.* NUREG-1560, Washington, D.C.

Nuclear Regulatory Commission (NRC). 2000. Letter from Jack Donohew, U.S. NRC to Otto L. Maynard, WCNOC. Subject: Review of Individual Plant Examination of External Events (IPEEE) for Wolf Creek Generating Station (TAC No. M83696), February 29, 2000.

Nuclear Regulatory Commission (NRC). 2003. *SECPOP 2000: Sector Population, Land Fraction, and Economic Estimation Program*. NUREG/CR-6525 Revision 1, Washington, D.C., August 2003.

Nuclear Regulatory Commission (NRC). 2004. *Regulatory Analysis Guidelines of the U.S. Nuclear Regulatory Commission.* NUREG/BR-0058, Washington, D.C., September 2004.

Nuclear Regulatory Commission (NRC). 2006. Letter from Jack Donohew, U.S. NRC to Rick A. Muench, WCNOC. Subject: Wolf Creek Generating Station - Issuance of Amendment Regarding Extended Diesel Generator Completion Times (TAC No. MC1257), April 26, 2006.

Nuclear Regulatory Commission (NRC). 2007. Letter from Christian Jacobs, U.S. NRC, to Terry Garrett, WCNOC. Subject: Request for Additional Information Regarding Severe Accident Mitigation Alternatives for Wolf Creek Generating Station, Docket 50-482, February 7, 2007.

U.S. Census Bureau (USCB). 2000a. Census 2000 Summary File 1 (SF 1) - 100 percent data. Available online at: http://www.census.gov/Press-Release/www/2001/sumfile1.html

U.S. Census Bureau (USCB). 2000b. Census 2000 Redistricting Data (P.L. 94-171) Summary File and 1990 Census. Table 1 – Counties in Alphabetical Sort within State, 1990 and 2000 Population, Numeric and Percent Change: 1990 to 2000. April 2, 2001. Available online at: <http://www.census.gov/population/cen2000/phc-t4/tab01.xls>

U.S. Department of Agriculture (USDA). 1998. 1997 Census of Agriculture, National Agriculture Statistics Service, 1998. Available online at: <http://www.nass.usda.gov/census/census97/volume1/vol1pubs.htm>.

Westinghouse (WEST). 1999. Core Inventory Radiation Sources. Letter. SAP-99-145. September 3, 1999.

Wolf Creek Nuclear Operating Corporation (WCNOC). 1992. Letter from Bart D. Withers, WCNOC to U.S. Nuclear Regulatory Commission Document Control Desk. Subject: Docket No. 50-482: Wolf Creek Generating Station Individual Plant Examination. September 28, 1992.

Wolf Creek Nuclear Operating Corporation (WCNOC). 1995a. Letter from Robert C. Hagan, WCNOC to U.S. Nuclear Regulatory Commission Document Control Desk. Subject: Docket No. 50-482: Final Response to Generic Letter 88-20. Supplement 4 (IPEEE Submittal). June 27, 1995.

Wolf Creek Nuclear Operating Corporation (WCNOC). 1995b. Letter from Neil S. Carns, WCNOC to U.S. Nuclear Regulatory Commission Document Control Desk. Subject: Docket No. 50-482: Response to Request for Additional Information Concerning the Individual Plant Examination. August 30, 1995.

Wolf Creek Nuclear Operating Corporation (WCNOC). 1996. Letter from Richard A. Muench, WCNOC to U.S. Nuclear Regulatory Commission Document Control Desk. Subject: Docket No. 50-482: Response to Request for Additional Information Associated to the Human Reliability Analysis. May 30, 1996.

Wolf Creek Nuclear Operating Corporation (WCNOC). 2006. Letter from Terry J. Garrett, WCNOC to U.S. Nuclear Regulatory Commission Document Control Desk. Subject: Docket No. 50-482: Application for Renewed Operating License, September 27, 2006.

Wolf Creek Nuclear Operating Corporation (WCNOC). 2007a. Letter from Terry J. Garrett, WCNOC to U.S. Nuclear Regulatory Commission Document Control Desk. Subject: Docket 50-482: Response to Request for Additional Information Regarding Severe Accident Mitigation Alternatives for Wolf Creek Generating Station, April 20, 2007.

Wolf Creek Nuclear Operating Corporation (WCNOC). 2007b. Letter from Terry J. Garrett, WCNOC to U.S. Nuclear Regulatory Commission Document Control Desk. Subject: Docket No. 50-482: Response to NRC Requests for Follow-up Information Regarding Severe Accident Mitigation Alternatives for Wolf Creek Generating Station License Renewal Application, ET 07-0023, June 26, 2007.

Wolf Creek Nuclear Operating Corporation (WCNOC). 2007c. Letter from Terry J. Garrett, WCNOC to U.S. Nuclear Regulatory Commission Document Control Desk. Subject: Docket No. 50-482: Response to NRC Requests for Follow-up Information Regarding Severe Accident Mitigation Alternatives for Wolf Creek Generating Station License Renewal Application, ET 07-0026, June 26, 2007.

Wolf Creek Nuclear Operating Corporation (WCNOC). 2007d. Letter from Terry J. Garrett, Wolf Creek Nuclear Operating Corporation, to NRC, ET 07-0029, Docket No. 50-482: Summary of the Impact to Wolf Creek Generating Station License Renewal Application Severe Accident Mitigation Alternatives Analysis due to Computer Program Error. July 13, 2007.

Wolf Creek Nuclear Operating Corporation (WCNOC). 2007e. Letter from Terry J. Garrett, Wolf Creek Nuclear Operating Corporation, to NRC, ET 07-0035, Docket No. 50-482: Summary of the Impact to Wolf Creek Generating Station License Renewal Application Severe Accident Mitigation Alternatives Analysis due to Computer Program Error. August 15, 2007.

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10\. SUPPLEMENTARY NOTES

Docket 50-482

11\. ABSTRACT *(200 words or less)*

This supplemental environmental impact statement (SEIS) has been prepared in response to an application submitted by Wolf Creek Nuclear Operating Corporation (WCNOC) to the NRC to renew the Operating License for Wolf Creek Generating Station, Unit 1 (WCGS) 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.

The NRC staff's recommendation is that the Commission determines that the adverse environmental impacts of license renewal for WCGS are not so great that preserving the option of license renewal for energy-planning decision makers would be unreasonable. This recommendation is based on (1) the analysis and findings in the GEIS; (2) the Environmental Report submitted by WCGS; (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 review process.

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