NUREG-1437
Supplement 21

Generic Environmental Impact Statement for License Renewal of Nuclear Plants

Supplement 21

Regarding
Browns Ferry Nuclear Plant, Units 1, 2, and 3

Final Report

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

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Office of Nuclear Reactor Regulation
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Abstract

The U.S. Nuclear Regulatory Commission (NRC or Commission) considered the environmental impacts of renewing nuclear power plant operating licenses (OLs) for a 20-year period in its *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (GEIS), NUREG-1437, Volumes 1 and 2, and codified the results in Title 10 of the Code of Federal Regulations (CFR) Part 51. In the GEIS (and its Addendum 1), the staff 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 to NRC by the Tennessee Valley Authority (TVA) to renew the OLs for Browns Ferry Nuclear Plant, Units 1, 2, and 3 (BFN) for an additional 20 years under 10 CFR Part 54. The 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 TVA nor the staff has identified information that is both new and significant for any issue that applies to BFN. In addition, the staff determined that information provided during the scoping process did not call into question the conclusions in the GEIS. Therefore, the staff concludes that the impacts of renewing the BFN OLs will not be greater than impacts identified for these issues in the GEIS. For each of these issues, the staff's conclusion in the GEIS is that the impact is of SMALL[(a)] significance (except for collective offsite radiological impacts from the fuel cycle and high-level waste and spent fuel, which were not assigned a single significance level).

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

The NRC staff recommends that the Commission determine that the adverse environmental impacts of license renewal for BFN are not so great that preserving the option of license

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

renewal for energy-planning decisionmakers would be unreasonable. This recommendation is based on (1) the analysis and findings in the GEIS; (2) the Environmental Report submitted by TVA; (3) consultation and discussions with Federal, State, and local agencies; (4) the staff's own independent review; and (5) the staff's consideration of public comments.

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Executive Summary

By letter dated December 31, 2003, the Tennessee Valley Authority (TVA) submitted an application to the U.S. Nuclear Regulatory Commission (NRC) to renew the operating licenses (OLs) for Browns Ferry Nuclear Plant, Units 1, 2, and 3 (BFN) for an additional 20-year period. If the OLs are renewed, State regulatory agencies and TVA 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 OLs are not renewed, then the plant must be shut down at or before the expiration dates of the current OLs, which are December 20, 2013, for Unit 1, June 28, 2014, for Unit 2, and July 2, 2016, for Unit 3.

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

Upon acceptance of the TVA 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 BFN site in March 2004 and held public scoping meetings on April 1, 2004, in Athens, Alabama. In the preparation of this supplemental environmental impact statement (SEIS) for BFN, the staff reviewed the TVA Environmental Report and compared it to the GEIS, consulted with other agencies, conducted an independent review of the issues following the guidance set forth in NUREG-1555, Supplement 1, *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 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 two public meetings in Athens, Alabama, on January 25, 2005 to describe the results of the NRC environmental review, answer questions, and provide members of the public with information to assist them in formulating comments on this SEIS. When the comment period ended, the staff considered and dispositioned all of the comments received. These comments are addressed in Appendix A, Part 2, of this SEIS.

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

TVA, a Federal corporation wholly owned by the U.S. Government, is a Federal Agency and subject to the requirements of NEPA. In compliance with NEPA, TVA prepared an SEIS to provide the public and TVA decisionmakers with an assessment of the environmental impacts of extending the operating life of the BFN nuclear units. This NRC SEIS draws upon the content of the TVA SEIS, but was prepared by NRC staff independently.

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

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

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

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

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

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

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

(3) Mitigation of adverse impacts associated with the issue has been considered in the analysis, and it has been determined that additional plant-specific mitigation measures are not likely to be sufficiently beneficial to warrant implementation.

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

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

This SEIS documents the staff's consideration of all 92 environmental issues identified in the GEIS. The staff considered the environmental impacts associated with alternatives to license renewal and compared the environmental impacts of license renewal and the alternatives. The alternatives to license renewal that were considered include the no-action alternative (not renewing the BFN OLs) and alternative methods of power generation. Based on projections made by the U.S. Department of Energy's Energy Information Administration, gas- and coal-fired generation appear to be the most likely power-generation alternatives if the power from BFN is replaced. These alternatives as well as coal gasification and a replacement nuclear plant are evaluated.

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

In July 2004, TVA submitted extended power uprate (EPU) applications to increase the licensed power levels of each of the three BFN units to 3952 megawatts-thermal (MW[t]), or 120 percent of the originally licensed power levels, for a total power level of 11,856 MW(t). If approved, the EPUs would take effect during the existing license term. NRC will evaluate the potential environmental impacts of an EPU in a separate Environmental Assessment. Therefore, the impacts associated with the increase in thermal power level from the currently licensed value to the EPU value is not evaluated in this SEIS. However, the staff performed its evaluation of impacts for the license renewal term in this SEIS assuming all three units are operating at 120 percent of the original licensed power level.

The staff determined that there is a potential, at the higher power levels, that BFN may no longer be within the envelope of impacts defined by the GEIS for some Category 1 issues. If the potential impacts are beyond the defined envelope, then the generic conclusions concerning these Category 1 issues may no longer be valid. The staff examined each of the 54 Category 1 issues applicable to BFN and determined that the level of impact for 34 of the Category 1 issues could be influenced by the thermal power level of the reactors. The staff further evaluated each of the 34 issues to determine if increasing the unit power level above the levels considered in the GEIS would affect the generic conclusions. After evaluating all 34 issues the staff determined that the generic conclusions reached in the GEIS are still valid and none of the GEIS conclusions were changed based on the staff's analysis. Therefore, the proposed EPU does not constitute new and significant information and the staff could continue to rely upon the conclusions of the GEIS for all Category 1 issues applicable to BFN.

TVA's license renewal application presents an analysis of the Category 2 issues plus environmental justice and chronic effects from electromagnetic fields. The staff reviewed the TVA analysis for each issue and conducted an independent review of each issue. Three Category 2 issues are not applicable because they are related to plant design features or site characteristics not found at BFN. Four Category 2 issues are not discussed in this SEIS because they are specifically related to refurbishment. TVA 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 BFN for the license renewal term. 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 beyond the bounds of the plant operations evaluated in TVA's 1972 Final Environmental Statement Related to Operation of BFN.

Fourteen Category 2 issues related to operational impacts and postulated accidents during the license renewal term, as well as environmental justice and chronic effects of electromagnetic fields, are discussed in detail in this SEIS. Five of the Category 2 issues and environmental justice apply to both refurbishment and operation during the license renewal term and are only discussed in this SEIS in relation to operation during the license renewal term. For all 14 Category 2 issues and environmental justice, the staff concludes that the potential environmental effects are of SMALL significance in the context of the standards set forth in the GEIS. In addition, the staff determined that appropriate Federal health agencies have not reached a consensus on the existence of chronic adverse effects from electromagnetic fields. Therefore, no further evaluation of this issue is required. For severe accident mitigation alternatives (SAMAs), the staff concludes that a reasonable, comprehensive effort was made to identify and evaluate SAMAs. Based on its review of the SAMAs for BFN, and the plant improvements already made, the staff concludes that none of the candidate SAMAs are cost-beneficial.

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

If the BFN OLs are not renewed and Units 1, 2, and 3 cease operation on or before the expiration of their current licenses, then the adverse impacts of likely alternatives will not be smaller than those associated with continued operation of BFN. The impacts may, in fact, be greater in some areas.

Unit 1 has not operated since 1985, and TVA is currently engaged in activities necessary to return it to service. Almost all of the activities associated with this effort are confined to existing onsite structures, and little new construction is necessary. Impacts arising from these activities are outside the scope of the license renewal review. Any impacts associated with this effort would be bounded by the EIS prepared by TVA when the plant was originally licensed.

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

Abbreviations/Acronyms

°	degree
µCi	microcurie(s)
µCi/ml	microcuries per milliliter
µGy	microgray(s)
µm	micrometer(s)
µSv	microsieverts
ac	acre(s)
ABWR	Advanced Boiling Water Reactor
ACC	averted cleanup and decontamination costs
ADAMS	Agencywide Document Access and Management System
ADCNR	Alabama Department of Conservation and Natural Resources
ADEM	Alabama Department of Environmental Management
ADPH	Alabama Department of Public Health
ADS	automatic depressurization system
ADWFF	Alabama Division of Wildlife and Freshwater Fisheries
AEA	Atomic Energy Act of 1954
ALARA	As Low As Reasonably Achievable
ANHP	Alabama Natural Heritage Program
AOC	averted offsite property damage costs
AOE	averted occupational exposure
AOSC	averted onsite costs
APE	averted public exposure
ATWS	anticipated transient without scram
BA	Biological Assessment
BETX	benzene, ethylbenzene, toluene and xylene isomers
BFN	Browns Ferry Nuclear Power Plant, Units 1, 2, and 3
BLEU	blended low-enriched uranium
BMP	best management practices
Bq	becquerel(s)
Btu	British thermal unit(s)
BWR	boiling water reactor
BWROG	Boiling Water Reactor Owners Group
C	Celsius
CAIR	Clean Air Interstate Rule
CCDP	conditional core damage probability
CCW	condenser circulating water
CDF	core damage frequency
CEQ	Council on Environmental Quality

CFR	Code of Federal Regulations
cfs	cubic feet per second
Ci	curie(s)
cm	centimeter(s)
COE	cost of enhancement
COPC	chemicals of potential concern
CPI	containment performance improvement
CRD	control rod drive
CS	core spray
CVCS	chemical and volume control system
DBA	design-basis accident
DC	direct current
DDT	dichlorodiphenyltrichloroethane
DMR	Discharge Monitoring Report
DOE	U.S. Department of Energy
DPR	demonstration power reactor
DSM	demand-side management
EECW	emergency equipment cooling water
ECCS	emergency core cooling system
EIA	Energy Information Administration (of DOE)
EIS	environmental impact statement
ELF-EMF	extremely low frequency-electromagnetic field
EOP	Emergency Operating Procedure
EPA	U.S. Environmental Protection Agency
EPRI	Electric Power Research Institute
EPU	extended power uprate
EQ	equipment qualification
ER	Environmental Report
ESRP	Environmental Standard Review Plan, NUREG-1555, Supplement 1, Operating License Renewal
F	Fahrenheit
FAA	Federal Aviation Administration
FIVE	fire-induced vulnerability evaluation
FR	Federal Register
fps	feet per second
FPS	fire protection system
FSAR	Final Safety Analysis Report
ft	foot/feet

FWPCA	Federal Water Pollution Control Act of 1972 (also known as the Clean Water Act of 1977)
FWS	U.S. Fish and Wildlife Service
g	gravitational acceleration
gal	gallon
GDC	general design criteria
GEIS	Generic Environmental Impact Statement for License Renewal of Nuclear Plants, NUREG-1437
gpm	gallons per minute
ha	hectare(s)
HVAC	heating ventilation air conditioning
HCLPF	high confidence low probability of failure
HHSI	high head safety injection
HLW	high-level radioactive waste
HPCI	high-pressure coolant injection
hr	hour(s)
Hz	Hertz
in.	inch(es)
IPE	Individual plant examination
IPEEE	individual plant examination of external events
ISFSI	independent spent fuel storage installation
ISLOCA	interfacing systems loss-of-coolant accident
kg	kilogram(s)
km	kilometer(s)
KPDS	key plant damage states
kV	kilovolt(s)
kV/m	kilovolt per meter
kWh	kilowatt hour(s)
L	liter(s)
lb	pound
LERF	large early release frequency
LLNL	Lawrence Livermore National Laboratory
LLW	low level waste
LNG	liquefied natural gas
LOCA	loss of coolant accident
LOOP	loss of offsite power

LWR	light-water reactor
m	meter(s)
mg	milligrams
m/s	meter(s) per second
m^3/d	cubic meters per day
m^3/s	cubic meter(s) per second
mA	milliampere(s)
MAAP	Modular Accident Analysis Program
MACCS2	MELCOR Accident Consequence Code System 2
mi	mile(s)
min	minutes
MGD	millions of gallons per day
mGy	milligray(s)
mL	milliliter(s)
MMNS	Mississippi Museum of Natural Science
MNHP	Mississippi Natural Heritage Program
mph	miles per hour
mrad	millirad(s)
mrem	millirem(s)
mSv	millisievert(s)
MT	metric ton(s) (or tonne[s])
MTU	metric ton(s)-uranium
MW	megawatt(s)
MWd/MTU	megawatt-days per metric ton of uranium
MWh	megawatt hours
MW(e)	megawatt(s)-electric
MW(t)	megawatt(s)-thermal
MWh	megawatt hour(s)
NA	not applicable
NAS	National Academy of Sciences
NCI	National Cancer Institute
NCWRC	North Carolina Wildlife Resources Commission
NEPA	National Environmental Policy Act of 1969
NESC	National Electric Safety Code
ng/J	nanogram per joule
NHPA	National Historic Preservation Act
NIEHS	National Institute of Environmental Health Sciences
NO_x	nitrogen oxide(s)
NPDES	National Pollutant Discharge Elimination System

NRC	U.S. Nuclear Regulatory Commission
NWPPC	Northwest Power Planning Council
ODCM	Offsite Dose Calculation Manual
OL	operating license
OLTP	original licensed thermal power
PAR	passive autocatalytic recombiners
PARS	publicly available records
PDS	plant damage state
PM_{10}	particulate matter, 10 microns or less in diameter
ppt	parts per thousand
PRA	Probabilistic Risk Assessment
PSA	Probabilistic Safety Assessment
PSD	prevention of significant deterioration
PSW	plant service water
PWR	pressurized water reactor
RAB	reactor auxiliary building
RAI	request for additional information
RBCCW	reactor building closed cooling water
RCIC	reactor core isolation cooling
RCP	reactor coolant pump
RCRA	Resource Conservation and Recovery Act
RCS	reactor coolant system
rem	roentogen equivalent man
REM	radiological environmental monitoring
REMP	radiological environmental monitoring program
RHR	residual heat removal
RHRSW	residual heat removal service water (system)
rms	root mean square
RPC	replacement power cost
RWST	refueling water storage tank
ry	reactor year
s	second(s)
SAG	Severe Accident Guideline
SAMA	Severe Accident Mitigation Alternative
SAMG	Severe Accident Management Guideline
SAR	Safety Analysis Report
SBO	station blackout

SCR	selective catalytic reduction
SEIS	Supplemental Environmental Impact Statement
SER	Safety Evaluation Report
SGTR	steam generator tube rupture
SHPO	State Historic Preservation Officer
SLC	standing liquid control
SMZ	steamside management zone
SO_2	sulfur dioxide
SO_x	sulfur oxide(s)
SRV	safety relief valve
SSC	systems, structures, and components
Sv	sievert(s)
SW	service water
TBq	terrabecquerel
TRM	Tennessee River Mile
TVA	Tennessee Valley Authority
UDB	urban development boundary
UFSAR	Updated Final Safety Analysis Report
U.S.	United States
USC	United States Code
USCB	U.S. Census Bureau
USDA	U.S. Department of Agriculture
USFWS	United States Fish and Wildlife Service
yd	yard
yr	year

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

The Tennessee Valley Authority (TVA) operates Browns Ferry Nuclear Plant, Units 1, 2, and 3 (BFN) in northern Alabama under OLs DPR-33, DPR-52, and DPR-68, respectively, which were issued by the NRC. These OLs will expire in December 2013 for Unit 1, June 2014 for Unit 2, and July 2016 for Unit 3. On December 31, 2003, TVA submitted an application to NRC to renew the OLs for BFN for an additional 20 years under 10 CFR Part 54 (TVA 2003a). TVA is a *licensee* for the purposes of its current OLs and an *applicant* for the renewal of the OLs. Pursuant to 10 CFR 54.23 and 51.53(c), TVA submitted an Environmental Report (ER) (TVA 2003b) in which it 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.

TVA, a Federal corporation wholly owned by the U.S. Government, is a Federal agency and subject to the requirements of NEPA. In compliance with NEPA, TVA prepared a supplemental EIS (SEIS) to provide the public and TVA decisionmakers with an assessment of the environmental impacts of extending the operating life of the BFN nuclear units (TVA 2002). This NRC SEIS draws upon the content of the TVA SEIS, but was prepared by NRC staff independently.

(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.

This SEIS is the plant-specific supplement to the GEIS for the TVA license renewal application. This supplement relies, in part, on the findings of the GEIS. The staff is preparing a separate safety evaluation report in accordance with 10 CFR Part 54.

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 BFN OLs; (3) discuss the purpose and need for the proposed action; and (4) present the status of TVA'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 license 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 the appendixes. Appendix A contains public comments related to the environmental review for license renewal and staff responses to those comments. Appendixes B through G, respectively, list the following:

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

- GEIS environmental issues that are not applicable to BFN
- severe accident mitigation alternatives.

1.2 Background

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

1.2.1 Generic Environmental Impact Statement

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.

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, 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 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 in this SEIS unless new and significant information is identified.

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

In the GEIS, the staff assessed 92 environmental issues and determined that 69 qualified as Category 1 issues, 21 qualified as Category 2 issues, and 2 issues, environmental justice and chronic effects of electromagnetic fields, were not categorized. Environmental justice was not evaluated on a generic basis and must be addressed in a plant-specific supplement to the GEIS. Information on the chronic effects of electromagnetic fields was not conclusive at the time the GEIS was prepared.

Of the 92 issues, 11 are related only to refurbishment, 6 are related only to decommissioning, 67 apply only to operation during the license renewal term, and 8 apply to both refurbishment and operation during the 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 OLs is required to submit an ER as part of its application. The license renewal evaluation process involves careful review of the applicant's ER and assurance that all new and potentially significant information not already addressed in or available during the GEIS evaluation is identified, reviewed, and assessed to verify the environmental impacts of the proposed license renewal.

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

- provide an analysis of the Category 2 issues in Table B-1 of 10 CFR Part 51, Subpart A, Appendix B in accordance with 10 CFR 51.53(c)(3)(ii)

- discuss actions to mitigate any adverse impacts associated with the proposed action and environmental impacts of alternatives to the proposed action.

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

- consider the economic benefits and costs of the proposed action and alternatives to the proposed action except insofar as such benefits and costs are either (1) essential for making a determination regarding the inclusion of an alternative in the range of alternatives considered, or (2) relevant to mitigation

- consider the need for power and other issues not related to the environmental effects of the proposed action and the alternatives

- discuss any aspect of the storage of spent fuel within the scope of the generic determination in 10 CFR 51.23(a) in accordance with 10 CFR 51.23(b)

- contain an analysis of any Category 1 issue unless there is significant new information on a specific issue – this is pursuant to 10 CFR 51.53(c)(3)(i) 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.

TVA, as a Federal agency, met its obligations under NEPA by preparing its own SEIS for BFN license renewal (TVA 2002). In preparing to submit its application to renew the BFN OLs, TVA used its own SEIS as part of a process to ensure that information not addressed in or available during the GEIS evaluation regarding the environmental impacts of license renewal for BFN would be properly reviewed before submitting the ER, and to ensure that such new and potentially significant information related to renewal of the licenses for Units 1, 2, and 3 would be identified, reviewed, and assessed during the period of the NRC review. TVA 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 BFN. This review was performed by personnel from TVA 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 NUREG-1555, Supplement 1, *Standard Review Plans for Environmental Reviews for Nuclear Power Plants, Supplement 1: Operating License Renewal*, (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 BFN. 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.

Section 4.7 addresses potential new and significant information. In July 2004, TVA submitted extended power uprate (EPU) applications (TVA 2004a, b) to increase the licensed power levels of each of the three units to 3952 megawatts-thermal (MW[t]), or 120 percent of the originally licensed power levels, for a total station power level of 11,856 MW(t). The staff determined that there is a potential, at the uprated power level, that BFN may no longer be within the envelope of impacts defined by the GEIS, as amended, for some Category 1 issues.

To address this concern, the staff examined each of the 54 Category 1 issues applicable to BFN and determined that 34 of the Category 1 issues could be influenced by the thermal power level of the reactors. The staff then evaluated each of the 34 issues to determine if increasing the unit power level above the levels considered during the development of the GEIS would affect the specific generic conclusions. After evaluating all 34 issues the staff determined that the generic conclusions reached in the GEIS are still valid and none of the GEIS conclusions were changed based on the staff's analysis. Therefore, the proposed EPU does not constitute new and significant information and the staff could continue to rely upon the conclusions of the GEIS for all Category 1 issues applicable to BFN.

NRC prepares an independent analysis of the environmental impacts of license renewal and compares these impacts to the environmental impacts of alternatives. Evaluation of the TVA license renewal application began with publication of a notice of acceptance for docketing and opportunity for a hearing in the *Federal Register* (69 FR 11460) on March 10, 2004. The staff published a notice of intent to prepare an EIS and conduct scoping (69 FR 11462) on March 10, 2004. Two public scoping meetings were held on April 1, 2004, in Athens, Alabama. Comments received during the scoping period were summarized in the *Environmental Scoping Summary Report – Browns Ferry Nuclear Plant, Units 1, 2, and 3, Limestone County, Alabama* (NRC 2004) dated July 2004. Comments applicable to this environmental review are presented in Part 1 of Appendix A.

The staff followed the review guidance contained in NUREG-1555, Supplement 1, *Standard Review Plans for Environmental Reviews for Nuclear Power Plants, Supplement 1: Operating License Renewal* (NRC 2000). The staff and its contractors visited the BFN site on March 30 and 31, 2004, to gather information and to become familiar with the site and its environs. The staff also reviewed the comments received during scoping, and consulted with Federal, State, regional, and local agencies. A list of the organizations consulted is provided in Appendix D. Other documents related to BFN were reviewed and are referenced.

This SEIS presents the staff's analysis that considers and weighs the environmental effects of the proposed renewal of the OLs for BFN, 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 decisionmakers would be unreasonable.

On December 10, 2004, the NRC published the Notice of Availability of the draft SEIS (69 FR 71855). 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 results of the NRC staff's review. During this comment period, two public meetings were held in Athens, Alabama, on January 25, 2005. During these meetings, the staff described the results of the NRC environmental review, answered questions, and provided members of the public with information to assist them in formulating their comments. The comment period ended on March 2, 2005. Comments made during the 75-day comment period, including those made at the two public meetings, are presented in Part II of Appendix A of this final SEIS. The NRC responses to these comments are also provided.

1.3 The Proposed Federal Action

The proposed Federal action is renewal of the OLs for BFN. BFN is located in northern Alabama on the north shore of Wheeler Reservoir, an impoundment of the Tennessee River. The BFN site is approximately 16 km (10 mi) south of Athens, Alabama; 16 km (10 mi) northwest of Decatur, Alabama; and 48 km (30 mi) west of Huntsville, Alabama. The plant has three General Electric-designed boiling water reactors. Unit 1 is currently licensed at its original power level of 3293 MW(t) and has a net power output of 1065 megawatts-electric (MW[e]). Units 2 and 3 were granted a license amendment during 1998 that raised their authorized thermal power levels by 5 percent to 3458 MW(t), and each unit currently has a net power output of 1118 MW(e). Plant cooling is normally provided by a once-through cooling system that draws water from the Tennessee River. The plant also has mechanical draft cooling towers that are used when needed to provide additional heat dissipation before the cooling water is returned to the river. With all three units operating, enough electricity would be produced to supply the needs of nearly two million homes. The current OL for Unit 1 expires on December 20, 2013; the license for Unit 2 expires on June 28, 2014; and the license for Unit 3 expires on July 2, 2016. By letter dated December 31, 2003, TVA submitted an application to the NRC (TVA 2003a) to renew these OLs for an additional 20 years of operation (i.e., until December 20, 2033, June 28, 2034, and July 2, 2036, for Units 1, 2, and 3, respectively).

All three of the BFN units were shut down in 1985 to review the TVA nuclear power program and to correct significant weaknesses (TVA 2003b). Unit 2 was returned to service in 1991, and Unit 3 was returned to service in 1995. In 2002, TVA began the process of returning Unit 1 to service, with operation expected to resume in 2007. Almost all the activities associated with this effort are confined to existing onsite structures and little new construction is necessary. No licensing action by NRC is required for the restart of Unit 1, and many of the activities that could have had some environmental impact have already been completed. TVA considered these impacts in a separate SEIS (TVA 2002). Therefore, the effects of Unit 1 restart are outside the scope of license renewal and are not considered in this SEIS, although the potential effects of continued operation of Unit 1 are considered in this analysis.

In July 2004, TVA submitted EPU applications (TVA 2004a, b) to increase the licensed power levels of each of the three units to 3952 MW(t), or 120 percent of the originally licensed power levels, for a total station power level of 11,856 MW(t). NRC will evaluate the potential environmental impacts of an EPU in a separate Environmental Assessment. Therefore, the impacts associated with the increase in thermal power level from the currently licensed value to the EPU value is not evaluated in this SEIS. However, the staff performed its evaluation of impacts for the license renewal term in this SEIS assuming all three units are operating at 120 percent of the original licensed power level.

This SEIS was prepared to evaluate the potential environmental impacts of operating the BFN units at 120 percent of their originally licensed power levels for an additional 20 years beyond the current license terms for each unit.

1.4 The Purpose and Need for the Proposed Action

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

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

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

This definition of purpose and need reflects the Commission's recognition that, unless there are findings in the safety review required by the Atomic Energy Act of 1954 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

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

69 FR 11460. March 10, 2004. "Notice of Acceptance for Docketing of the Application and Notice of Opportunity for a Hearing Regarding Renewal of License Nos. DPR-33, DPR-52 and DPR-68 for an Additional Twenty-Year Period." *Federal Register*, U.S. Nuclear Regulatory Commission.

69 FR 11462. March 10, 2004. "Notice of Intent to Prepare an Environmental Impact Statement and Conduct Scoping Process." *Federal Register*, U.S. Nuclear Regulatory Commission.

69 FR 71855. December 10, 2004. "Notice of Availability of Draft Supplement 21 to the Generic Environmental Impact Statement and Public Meeting for the License Renewal of Browns Ferry Nuclear Plant, Units 1, 2, and 3." *Federal Register*, U.S. Nuclear Regulatory Commission.

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

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

Tennessee Valley Authority (TVA). 2002. *Final Supplemental Environmental Impact Statement for Operating License Renewal of the Browns Ferry Nuclear Plant in Athens, Alabama.* Knoxville, Tennessee.

Tennessee Valley Authority (TVA). 2003a. *Application for Renewed Operating Licenses, Browns Ferry Units 1, 2, and 3.* Knoxville, Tennessee.

Tennessee Valley Authority (TVA). 2003b. *Applicant's Environmental Report – Operating License Renewal Stage, Browns Ferry Units 1, 2, and 3.* Knoxville, Tennessee.

Tennessee Valley Authority (TVA). 2004a. *Tennessee Valley Authority Browns Ferry Nuclear Plant (BFN), Unit 1, Proposed Technical Specifications (TS) Change TS-431 – Request for License Amendment for Extended Power Uprate Operation, Browns Ferry Unit 1 Extended Power Uprate Environmental Report.* Tennessee Valley Authority, Decatur, Alabama.

Tennessee Valley Authority (TVA). 2004b. *Tennessee Valley Authority Browns Ferry Nuclear Plant (BFN), Units 2 and 3, Proposed Technical Specifications (TS) Change TS-418 – Request for License Amendment for Extended Power Uprate Operation, Browns Ferry Units 2 and 3 Extended Power Uprate Environmental Report.* Tennessee Valley Authority, Decatur, Alabama.

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

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

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

U.S. Nuclear Regulatory Commission (NRC). 2004. *Environmental Scoping Summary Report – Browns Ferry Nuclear Plant, Units 1, 2, and 3, Limestone County, Alabama.* Washington, D.C.

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

The Browns Ferry Nuclear Power Plant, Units 1, 2, and 3 (BFN) site is located on the north shore of Wheeler Reservoir in Limestone County, Alabama, at Tennessee River Mile (TRM) 294. The plant consists of three boiling water reactors (BWRs) that produce steam, which passes through a turbine to generate electricity. In addition to the nuclear units, the major features of the site are intake and discharge canals, switchyards, a training center, an employee physical fitness center, a materials storage and procurement complex, and structures from a former aquatic research laboratory. The plant and its environment are described in Section 2.1, and the interaction of the plant with the environment is presented in Section 2.2.

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

BFN is located on approximately 340 ha (840 ac) of Federally owned land that is under the custody of the Tennessee Valley Authority (TVA). TVA is a corporate agency and instrumentality of the United States, as described in the TVA Environmental Report (ER) (TVA 2003a). The site is approximately 48 km (30 mi) west of Huntsville, Alabama; 16 km (10 mi) northwest of Decatur, Alabama; and 16 km (10 mi) southwest of Athens, Alabama. Figures 2-1 and 2-2 show the location of BFN and features within an 80-km and 10-km (50-mi and 6-mi) radius of the site.

Land in the vicinity of BFN is used primarily for agriculture. Population densities are low, with no population centers of significance within 16 km (10 mi) of the plant. The site is surrounded to the north and east by rural countryside. It includes open pasture lands, scattered farmsteads, few residents, and little industry within several miles. The terrain is gently rolling with open views to higher elevations to the north. The south and west side of the plant site abuts Wheeler Reservoir, which is a wide expanse of open river used for a variety of recreational purposes. The reservoir in the vicinity of the plant site is moderately used by recreational boaters and fishermen. There are no homes within the foreground viewing distance to the north and east. However, adjacent to the plant site several developments have partial views of the site – a small residential development is sited to the northwest and another across Wheeler Reservoir to the southwest, and the Mallard Creek public use area is directly across the reservoir. A berm, graded during the initial construction of the plant site and containing approximately 2.5 million m^3 (3.3 million yd^3) of earth excavated to make cooling water channels, lies adjacent to the cooling tower complex and blocks views of the northern and eastern plant areas. Two wildlife management areas – Swan Creek State Wildlife Management

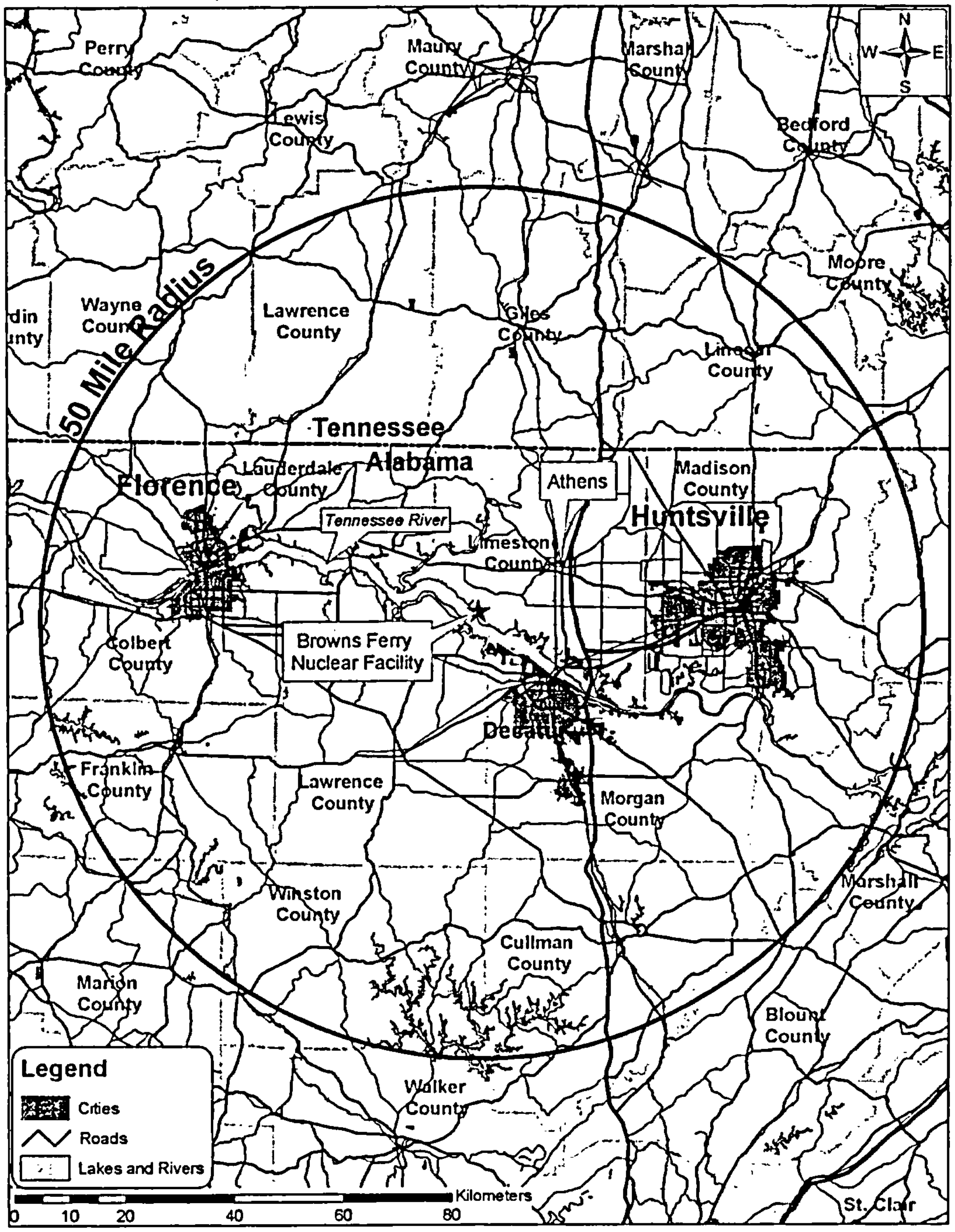

Figure 2-1. Location of Browns Ferry Nuclear Power Plant, Units 1, 2, and 3, 80-km (50-mi) Region

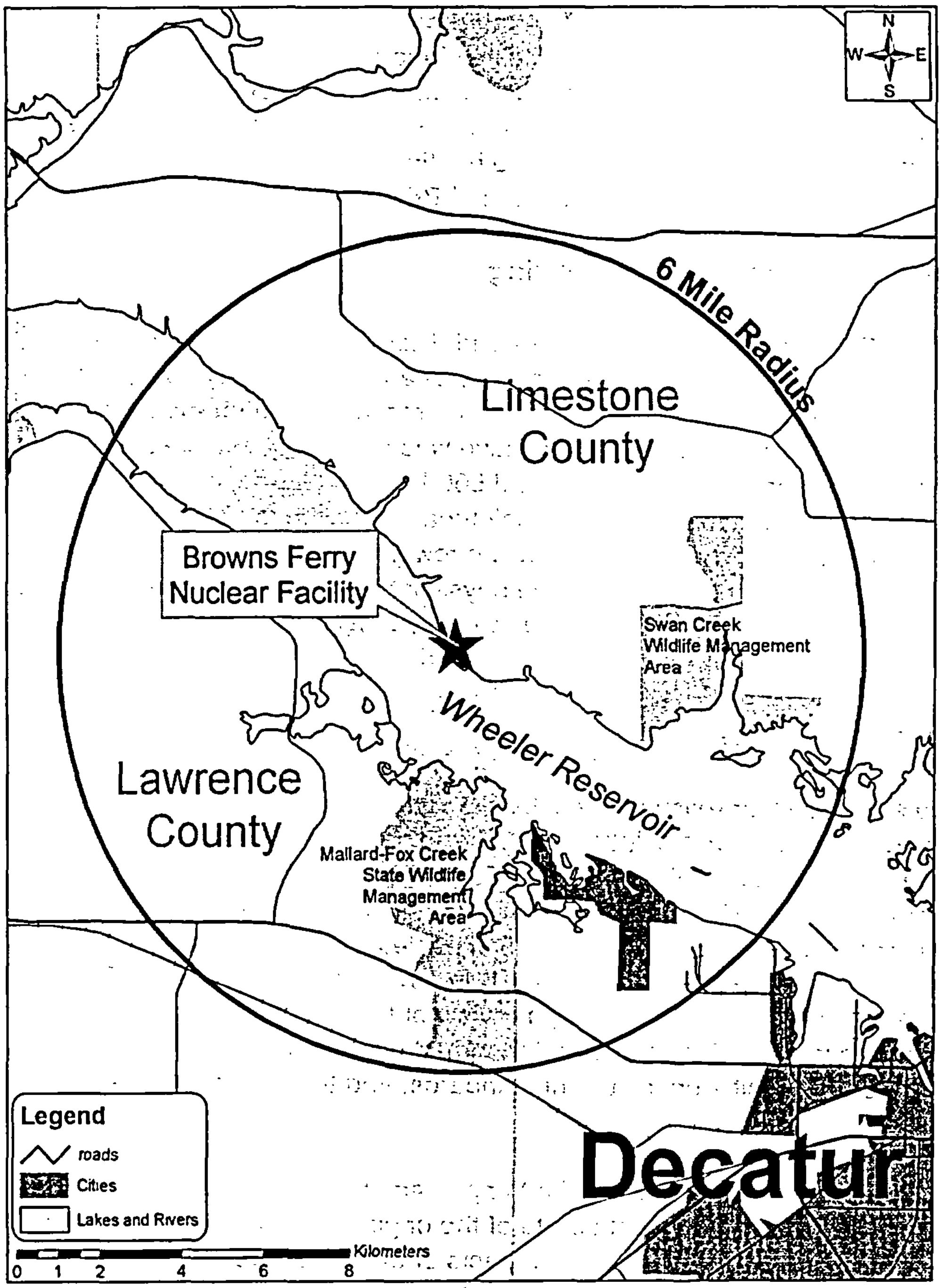

Figure 2-2. Location of Browns Ferry Nuclear Power Plant, Units 1, 2, and 3, 10-km (6-mi) Region

Area and Mallard-Fox Creek State Wildlife Management Area – are within 5 km (3 mi) of the BFN site (TVA 2003a). The Swan Creek Wildlife Management Area includes 1232 ha (3045 ac), and 2357 ha (5825 ac) of water surrounded by numerous industrial facilities. The Mallard-Fox Creek State Wildlife Management Area encompasses approximately 593 ha (1483 ac), and is primarily used for small game hunting. The Round Island Recreation Area is located approximately 5.6 km (3.5 mi) upstream of BFN.

2.1.1 External Appearance and Setting

The three-unit BFN plant, including the intake and discharge canals, is enclosed by a security fence. Primary access to the plant area is by way of an access road through a security gate. The plant has the following principal physical structures in the central site area: reactor containment building, turbine building, radioactive waste building, service building, intake pumping station, transformer yard, 161-kV and 500-kV switchyards, off-gas stack, sewage treatment facilities, and administration and maintenance buildings. The hot and cold water discharge channels and mechanical draft cooling towers are located northwest of the central site area, while the training center, employee physical fitness center, materials storage and procurement complex, and structures from a former aquatic research laboratory are located to the east of the central site area.

2.1.2 Reactor Systems

BFN has two active nuclear reactor units (Units 2 and 3) and one inactive unit (Unit 1) as shown in Figure 2-3. Each unit includes a BWR and a steam-driven turbine generator manufactured by General Electric Company. Each unit originally was licensed for an output of 3293 megawatts-thermal (MW[t]), with a design net electric rating of 1065 megawatts-electric (MW[e]). Major construction on BFN, TVA's first nuclear power plant, began in 1967. Commercial operation began in 1974 for Unit 1, in 1975 for Unit 2, and in 1977 for Unit 3. All three units were shut down in 1985 during a review of the TVA nuclear power program. Unit 2 returned to service in May 1991, and Unit 3 resumed operation in November 1995. Work began in 2002 to bring Unit 1 up to current standards, and the reactor is currently scheduled to restart in 2007.

In 1998, BFN completed an Integrated Plant Improvement Project for Units 2 and 3. Among the improvements made was a 5-percent uprate of the original licensed thermal power (OLTP) for both units from 3293 to 3458 MW(t). The impacts of this action were evaluated in an Environmental Assessment. The U.S. Nuclear Regulatory Commission (NRC) issued the Environmental Assessment and Finding of No Significant Impact related to the October 1, 1997, application for a 5-percent power uprate on August 26, 1998 (NRC 1998). An amendment to

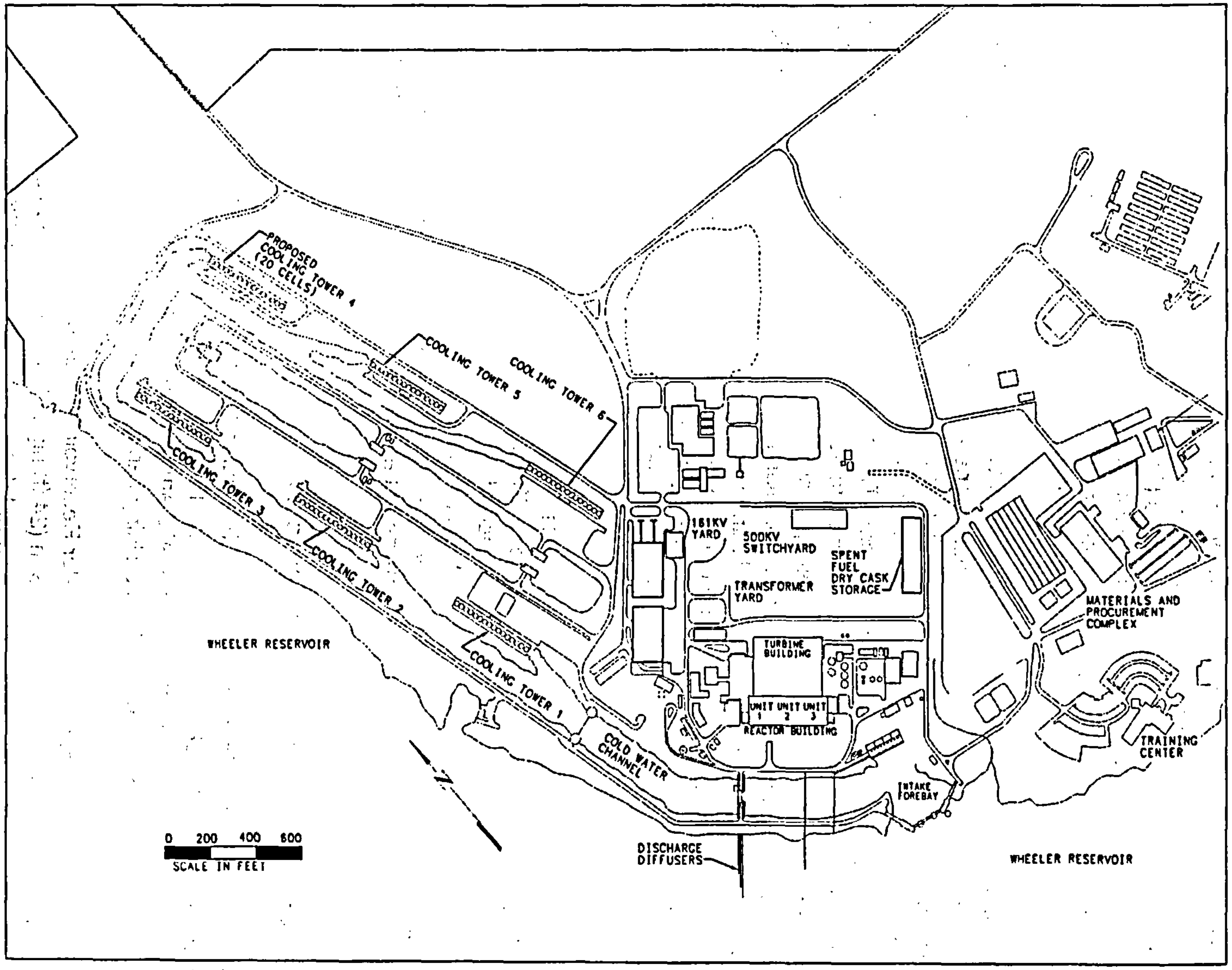

Figure 2-3. Browns Ferry Nuclear Power Plant, Units 1, 2, and 3 Site Features

the BFN operating license (OL) was approved by NRC for the 5-percent uprate on September 8, 1998. In June 2004, TVA submitted applications for extended power uprates (EPUs) to 120 percent of OLTP at each of the three BFN units (TVA 2004a, b). These applications, if approved by the staff, will take effect during the existing license term. The impacts evaluated in this supplemental environmental impact statement (SEIS) include those from operation of all three of the BFN reactor units, each at 120 percent of the OLTP.

The nuclear steam supply system at BFN is typical of General Electric BWRs. Each nuclear system includes a single-cycle, forced-circulation, General Electric BWR that produces steam for direct use in a steam turbine. The design employs a pressure suppression primary containment that houses the reactor vessel, the reactor coolant recirculating loops, and other branch connections of the reactor primary system. The pressure suppression system consists of a drywell, a pressure suppression chamber that stores a large volume of water, connecting vents between the drywell and the pressure suppression chamber, isolation valves, containment cooling systems, and other service equipment. Cooling systems are provided to remove heat from the reactor core, the drywell, and the water in the pressure suppression chamber, thus providing continuous cooling of the primary containment under accident conditions. Appropriate isolation valves are actuated during this period to ensure confinement of radioactive material, which might otherwise be released from the reactor containment during the course of an accident.

The secondary containment substructure consists of poured-in-place, reinforced concrete exterior walls that extend up to the refueling floor. The refueling room floor is also constructed of reinforced, poured-in-place concrete. The secondary containment structure completely encloses the primary containment dry wells, fuel storage and handling facilities, and essentially all of the core standby cooling systems for the three units. During normal operation and when isolated, the secondary containment is maintained at a negative pressure relative to the building exterior.

2.1.3 Cooling and Auxiliary Water Systems

Wheeler Reservoir on the Tennessee River is the source for cooling water and most of the auxiliary water systems for BFN (see Figure 2-3). Potable water is supplied by the City of Athens Utilities Water Department in Athens, Alabama. Groundwater is not used at the site. Figure 2-3 shows the general layout of the buildings and structures at the site.

The intake forebay is separated from Wheeler Reservoir by a gate structure with three bays that are each 12 m (40 ft) wide by about 7.3 m (24 ft) high (TVA 1972). Each bay includes a 6-m (20-ft)-high gate that can be raised or lowered depending on the operational requirements of the plant. The flow velocity through the openings varies depending on the gate position.

When the gates are in their full open position and the plant is operated in either the open or helper modes, the average flow velocity through the openings is about 0.2 m/s (0.6 fps) for the operation of one unit, 0.34 m/s (1.1 fps) for the operation of two units, and 0.52 m/s (1.7 fps) for the operation of all three units (TVA 2003a). These flow velocities are based on an intake flow per unit of about 46,300 L/s (734,000 gpm), which is 46.3 m^3/s (1635 cfs).

The intake pumping station includes 18 bays (i.e., six bays per reactor unit), each with a traveling screen. Each bay has a net opening size of about 2.6 m by 6 m (8.66 ft by 20 ft). The maximum average flow velocity through each bay is about 0.49 m/s (1.6 fps) and is independent of the reservoir surface elevation. The maximum average velocity through a clean screen with net openings of 0.95 cm by 0.95 cm (3/8 in. by 3/8 in.) is about 0.64 m/s (2.1 fps) (TVA 2003a). Flow velocities through the intake pump station bays and traveling screens are independent of the number of units in operation and the reservoir elevation.

The BFN units are normally cooled by pumping water from Wheeler Reservoir into the turbine generator condensers and discharging it back to the reservoir via three large submerged diffuser pipes that are perforated to maximize uniform mixing into the flow stream. These pipes range in diameter from 5.2 m to 6.2 m (17 ft to 20.5 ft). The flow exits each discharge pipe through 7800 5-cm (2-in.) ports (TVA 2003b). This straight-through flow path is known as "open cycle" or "open mode" operation. As originally designed, the maximum thermal discharge from the once-through cooling water system is directed into the Wheeler Reservoir, with a temperature increase across the intake and discharge of 13.9°C (25°F) (TVA 1972). The flow exits the diffusers and mixes with the reservoir flow. At the edge of the discharge mixing zone, the water temperature is required to be less than 5.6°C (10°F) above ambient (ADEM 2003).

Through various gates, some of this cooling water can also be directed through cooling towers to reduce its temperature as necessary to comply with environmental regulations. This flow path is known as the "helper mode."

The capacity also exists to recycle cooling water from the cooling towers directly back to the intake structure without being discharged to the reservoir. This flow path, known as the "closed mode" of operation, has not been used since the restart of Units 2 and 3 because of difficulties in achieving temperature limits in summer months and problems with equipment reliability. TVA does not anticipate using this mode in the future, and no procedures for operating in this mode currently exist.

In recent years, only Units 2 and 3 have been operated, but because of a combination of system upgrades and improved flow calibrations, the measured total per-unit condenser circulating water (CCW) flow rate in open mode (with three CCW water pumps per unit) has increased. The condenser tubes were replaced with stainless steel tubing that have a larger internal diameter and lower flow resistance. This modification increased flow through the condenser by approximately 6 percent. TVA estimates total intake for three-unit operation in open mode to be 139 m^3/s (4907 cfs) or 12,000 m^3/d (3171 million gallons per day [MGD]) (TVA 2003a).

Because of various system limitations, BFN cannot pass all the CCW through the cooling towers when operating in the helper mode. The fraction of cooling water that cannot be passed through the cooling towers is routed directly to the river. Almost all of the cooling water that passes through the cooling towers is returned to the river, but a small amount is lost to the atmosphere during operation. If cooling tower capacity is increased during the license renewal term, this consumptive use could increase proportionately. The cooling towers are only operated when necessary to meet thermal discharge temperature limits specified in the National Pollutant Discharge Elimination System (NPDES) permit issued by the Alabama Department of Environmental Management (ADEM), typically a few weeks during the hottest part of the summer (typically July and August).

For the last 6 years, during which Units 2 and 3 have both been in service, the greatest amount of time cooling tower operation has been required has been about 8 percent of a year (TVA 2003a). Increased thermal power proposed for Units 2 and 3 will result in an additional increase of approximately 2.2°C (4°F) in the circulating water temperature leaving the main condenser (for each operating unit) (Hopping 2004). This increase in water discharge temperature would result in increased use of the cooling towers during summer periods to maintain compliance with discharge limitations. No changes to the plant intake system or to the individual unit intake flow rates are expected to be required as a result of the Unit 2 and 3 EPU project, and operations will continue to meet regulatory limits established in the existing NPDES permit.

Simulations with the near-field hydrothermal model were conducted for the period 1985 through 2002, excluding 2 years (1989 and 1990) for which no river ambient temperature data are available (TVA 2003a). Model results showed that, with Units 2 and 3 operating at 120 percent power, on average the cooling towers will be used approximately 5.3 percent of the time, and derating will be required approximately 0.10 percent of the time (i.e., 6.2 days over the 16-year simulation period). On average, with all three units at 120 percent power, use of the cooling towers will increase to approximately 7.2 percent of the time and derating will increase to approximately 0.29 percent of the time (i.e., 17 days over the 16-year simulation).

The residual heat removal service water (RHRSW) system consists of four pairs of pumps located on the intake structure for pumping raw river water to the heat exchangers in the RHRSW system and four additional pumps for supplying water to the emergency equipment cooling water (EECW) system. The EECW system distributes cooling water supplied by the RHRSW system to essential equipment during normal and accident conditions.

In June 2004, TVA submitted applications for EPUs for the three BFN units (TVA 2004a, b). TVA has stated (TVA 2002a) that "no changes are expected to be required to the plant intake system or to the individual unit intake flow rates as a result of the EPU project." TVA also indicated that existing thermal discharge limits would be met by increased use of the helper towers, and if necessary, derating one or more units. The EPU Environmental Report for BFN, Unit 1 stated that an additional sixth cooling tower, consisting of 20 cells would be built. This sixth cooling tower would be associated only with returning Unit 1 to service (TVA 2004a).

2.1.4 Radioactive Waste Management Systems and Effluent Control Systems

BFN uses various radioactive waste management systems to collect and process the liquid, gaseous, and solid wastes produced during reactor operations. These systems reduce the quantities of radioactive liquid, gaseous, and solid effluents released to the environment. The waste disposal systems meet the design objectives of Title 10 of the Code of Federal Regulations (CFR) Part 50, Appendix I (*Numerical Guide for Design Objectives and Limiting Conditions for Operation to Meet the Criterion "As Low As is Reasonably Achievable" for Radioactive Material in Light-Water-Cooled Nuclear Power Reactor Effluents*), and controls the release of radioactive material to within the limits specified in the Offsite Dose Calculation Manual (ODCM) and NPDES permits. The methods employed for the controlled release of those contaminants depend primarily on the physical state of material (i.e., solid, liquid, or gaseous) (TVA 2004c).

The liquid and solid wastes from BFN are routed to a common radioactive waste building for collection, treatment, sampling, and disposal. Packaged solid wastes and reusable radioactive material may be temporarily stored in the onsite radioactive waste storage facility or in approved outside storage locations. Gaseous wastes are processed and routed to a common tall stack for release to the atmosphere. The liquid and gaseous radioactive waste systems are designed to reduce the activity in the liquid and gaseous wastes such that the concentrations in routine discharges are below the applicable regulatory limits. The liquid and gaseous effluents are continuously monitored, and the discharge is stopped if the effluent concentrations exceed predetermined levels.

Radioactive fission products build up within the fuel as a consequence of the fission process. These fission products are contained in the sealed fuel rods, but small quantities may escape from the fuel rods into the reactor coolant. Neutron activation of components in the primary coolant system also results in release of radioactive material into the coolant. Non-fuel solid wastes result from treating and separating radionuclides from gaseous and liquid effluents and from removing contaminated material from various reactor areas. Solid wastes also consist of reactor components, equipment, and tools removed from service, as well as contaminated protective clothing, paper, rags, and other trash generated from plant operations, design modifications, and routine maintenance activities. Solid wastes may be shipped to a waste processor for volume reduction before disposal, or they may be sent directly to a licensed burial site. Spent resins and filters are stored or packaged for shipment to an offsite processing or disposal facility.

Spent fuel consists of fuel rods that have exhausted a certain percentage of their fissile fuel material; they are periodically removed from the reactor core for disposal. Units 2 and 3 currently operate on a 24-month refueling cycle per unit, with each unit refueling in alternate years. Spent fuel is stored onsite in the spent fuel pool. TVA is constructing an independent spent fuel storage installation (ISFSI) for storage of spent fuel in dry storage casks.

The ODCM for BFN (TVA 2004c) is subject to NRC inspection and describes the methods and parameters used for calculating offsite doses resulting from radioactive gaseous and liquid effluents. It is also used for calculating gaseous and liquid effluent monitoring alarm/trip setpoints for release of effluents from BFN. Operational limits for releasing liquid and gaseous effluents are specified to ensure compliance with NRC regulations.

In June 2004, TVA submitted a request for a license amendment for a power uprate at BFN Units 2 and 3 from 3458 MW(t) to 3952 MW(t) (TVA 2004b). Also, TVA plans to return Unit 1 to commercial operation and increase the power level from 3293 MW(t) to 3952 MW(t) (TVA 2004a). The net result of these plans is that TVA intends to operate all three units at the combined total power level of 11,856 MW(t) during the license renewal term. TVA has estimated that operation at the combined total power level of 11,856 MW(t) could increase the amount of radioactive material released in liquid and gaseous effluents and solid radioactive wastes by as much as a factor of 1.8 over the current operation.

2.1.4.1 Liquid Waste Processing Systems and Effluent Controls

The function of the liquid radioactive waste control system is to collect, treat, store, and dispose of all radioactive liquid wastes. Liquid waste is collected in sumps and drain tanks at various locations throughout the plant and is then transferred to the appropriate collection tanks in the Radwaste Building for treatment, storage, and disposal. Waste to be discharged from the system is processed on a batch basis, with each batch being processed by such method or methods appropriate for the quality and quantity of materials determined to be present. Processed liquid waste may be returned to the condensate system for reuse within the plant, or it may be discharged to the environment through the circulating water discharge canal. The liquid waste in the discharge canal is diluted with condenser effluent circulating water to achieve permissible radionuclide concentrations at the site boundary.

Batches of low-conductivity liquid waste are processed through a filter and a waste demineralizer. Demineralizer effluent is sent to a waste sample tank. Depending on the conductivity and level of radioactivity, the liquid may then be discharged to the circulating water discharge canal or the cooling tower blowdown line, transferred to condensate storage tanks, or returned for further processing through the demineralizer.

High-conductivity liquids are processed through a filter and are collected in a floor drain sample tank. If the concentration after dilution is within the applicable limits, the filtered liquid may be discharged.

An alternate method of processing low- and high-conductivity liquid is the use of vendor-supplied, portable equipment that can be interconnected to the permanent radioactive waste system. Depending on effluent quality and plant needs, the liquid can either be transferred to the waste sample tank or the floor drain sample tank. Processing from the waste sample tank or floor drain sample tank is identical to that described above.

All systems are protected against overflow and other unplanned releases by appropriate alarms and shutdown devices. The ODCM prescribes the alarm/trip setpoints for the liquid effluent radiation monitors (TVA 2004c).

During the years 1999 through 2003, the volume of liquid effluents from Units 2 and 3 ranged from 0 to 4.9 million L (0 to 1.3 million gal) per year, including a total of 79 batch releases (TVA 2000, 2001, 2002b, 2003c, 2004c). During 3 of those 5 years, there were no batch releases because liquids were processed and returned to the condensate system for reuse within the plant. The total radioactivity released in liquid effluents during that time was 6.3×10^{11} Bq (17 Ci). The largest annual release during this period was 4.1×10^{11} Bq (11 Ci), which occurred in 1999. Section 2.2.7 describes the hypothetical doses to a maximally exposed individual as a result of those releases.

These liquid radiological effluent releases are typical of the annual releases for operation of BFN, Units 2 and 3 without the power uprates. As discussed earlier, operation at the combined total power level of 11,856 MW(t) during the license renewal term could increase liquid effluent releases by as much as a factor of 1.8 over these typical values.

2.1.4.2 Gaseous Waste Processing Systems and Effluent Controls

Radioactive gaseous effluents include low concentrations of fission-product noble gases (such as krypton and xenon), halogens (mainly iodines), tritium in the form of water vapor, and particulate material containing both fission products and activated corrosion products. The gaseous radioactive waste system is designed to collect and process potentially radioactive effluents prior to discharge through the elevated main plant stack. The system receives gaseous discharges from each main condenser air ejector, startup vacuum pump, condensate drain tank vent, and steam packing exhauster. Gases from each main condenser air ejector are passed through a preheater, catalytic recombiner, condenser, moisture separator, and dehumidification coil. The gases then enter a decay pipe that provides a retention time of approximately 6 hours, during which nitrogen-16 and oxygen-19 decay to negligible levels. The gases are then passed through a cooler condenser, moisture separator, reheater, prefilter, six charcoal beds, and an afterfilter before they are mixed with dilution air and exhausted to the main stack. The charcoal beds provide about 9.7 hours of retention time for krypton isotopes and 7.3 days of retention time for xenon isotopes. Gases from the gland seals and startup vacuum pumps are held for approximately 1.75 minutes, to allow for decay of nitrogen-16 and oxygen-19, and then are passed directly to the stack for release.

The ODCM prescribes alarm/trip setpoints for the gaseous effluent radiation monitors (TVA 2004c). The actual gaseous effluents for the period from 1999 to 2003 averaged about 6.7×10^{13} Bq (1800 Ci)/yr, with a maximum of 1.8×10^{14} Bq (4900 Ci) in 2003 (TVA 2000, 2001, 2002b, 2003c, 2004c). Section 2.2.7 describes hypothetical doses to a maximally exposed individual as a result of these releases.

These gaseous radiological effluent releases are typical of the annual releases for operation of Units 2 and 3 without the power uprates. As discussed earlier, operation at the combined total power level of 11,856 MW(t) during the license renewal term could increase gaseous effluent releases by as much as a factor of 1.8 over these typical values.

2.1.4.3 Solid Waste Processing

Solid waste from routine operations at Units 2 and 3 consists of spent (dewatered) resin, solidified resin, filters, sludge, evaporator bottoms, dry compressible waste, irradiated components (control rods, etc.), and other non-compressible waste. The solid radioactive waste system consists of systems and components that are used to process and package wet and dry solid wastes so that the waste is suitable for transport and disposal. The system is not used for spent fuel storage and shipment.

Solid waste is typically stored onsite for a period of time to allow for decay of short-lived radionuclides. Solid waste from equipment originating in the nuclear system is stored in the fuel storage pool to allow for radioactive decay before it is prepared for reprocessing or offsite storage. Examples of the waste include components such as activated control rods and in-core instrumentation.

Methods used for processing and packaging solid radioactive waste depend primarily on the waste characteristics. Process solid wastes, such as spent demineralizer resins and filter materials, are collected and dewatered to meet burial site and 10 CFR 61.56 requirements.

These wastes are either temporarily stored onsite in concrete storage modules or shipped directly for burial offsite in a licensed disposal facility. High-integrity containers are used to package waste when the waste classification requires that it meet stability requirements. High-integrity containers used for disposal of this waste are certified for acceptance at the disposal facility to which the waste is shipped.

Dry active waste from operation and maintenance activities is collected throughout the radiologically controlled areas of the facility. Dry active waste such as paper, rags, or used clothing is either placed into containers for storage or shipped directly to a waste processor for volume reduction and subsequent transport to an offsite licensed disposal facility. Most dry active waste has relatively low radionuclide content and may be handled manually. Dry active waste that does not meet the criteria for processing by the offsite processor may be packaged for direct shipment to a disposal facility. Where practical, selected items may be decontaminated onsite for reuse or release. Dry active waste is monitored during packaging to ensure applicable controls are maintained.

Disposal and transportation of solid radioactive waste are performed in accordance with the applicable requirements of 10 CFR Parts 61 and 71, respectively. During the period from 1999 to 2002, generation rates for radioactive solid wastes from routine operation and maintenance activities at Units 2 and 3 ranged from 514 to 654 m^3 (18,200 to 23,100 ft^3)/yr (Pierce 2004). During the period from 1999 to 2002, Units 2 and 3 made 133 shipments of solid radioactive waste with a total activity of 3.0×10^{13} Bq (820 Ci) (TVA 2000, 2001, 2002b, 2003c).

These quantities of solid radioactive waste are typical for operation of BFN, Units 2 and 3 without the power uprates. As discussed earlier, operation at the combined total power level of 11,856 MW(t) during the license renewal term could increase the quantities of solid radioactive waste by as much as a factor of 1.8 over these typical values.

2.1.5 Nonradioactive Waste Systems

The principal nonradioactive effluents from BFN consist of hazardous (chemical), lubrication oil, construction, and sanitary wastes. As is the case with any large industrial facility, BFN generates a variety of wastes that are classified as hazardous under the Resource Conservation and Recovery Act (RCRA). Such wastes include paint-related materials, spent solvents used for cleaning and degreasing, and universal wastes such as batteries, fluorescent light tubes, etc. TVA operates a Hazardous Waste Storage Facility in Muscle Shoals, Alabama, that holds a RCRA Part B permit for temporary storage of hazardous waste. The Hazardous Waste Storage Facility serves as a central collection point for TVA-generated hazardous wastes, and maintains contracts with facilities used to process and dispose of the waste. All hazardous waste generated at BFN is shipped to the Hazardous Waste Storage Facility for consolidation, storage, and transfer to licensed facilities for treatment and disposal. BFN recycles paint solvents (primarily methyl ethyl ketone) using an onsite still. Universal wastes are collected and shipped to recycling firms. Hazardous waste generation rates for BFN average approximately 1540 kg (3400 lbs) per calendar year. Although it is not a hazardous waste as defined in the RCRA regulations, used oil also is generated at BFN as a result of maintenance activities on plant equipment. All used oil is collected, stored onsite, and shipped to an approved recycling center for energy recovery.

Following restart of Unit 1, hazardous waste generation rates during routine operation of all three units are expected to fall within the normal year-to-year variation currently experienced with two-unit operations. Existing waste management systems are capable of handling the hazardous wastes anticipated from operation of all three units at the uprated power level throughout the license renewal term.

General plant trash such as paper, metals, garbage, and other items collected as part of routine plant operation activities is managed through a TVA system-wide contract with a licensed waste disposal company. This waste material is collected and transported to a State-licensed regional landfill. Generation rates for this type of material are currently approximately 45 MT (50 tons) per month. BFN has an active recycling program to segregate and recycle scrap metal, cardboard, paper, batteries, and aluminum cans at approved State and local recycling facilities (TVA 2003a).

Once Unit 1 is operational, the amount of trash generated would be similar to that of the other operating units, and the overall amount generated would increase slightly (approximately 12.5 percent) from the current level because of the incremental increase in permanent plant staff necessary to operate three units. The existing contractor is capable of handling the increased waste volumes anticipated. Landfill capacity and projections for availability of landfill space in Alabama indicate that sufficient space to accommodate this material from BFN should be available for the duration of the license renewal term (TVA 2003a).

For construction and demolition debris associated with ongoing site activities, such as modifications and additions to facilities, BFN operates a State-permitted construction/demolition landfill within the confines of the BFN site. This landfill is permitted to accept non-hazardous, non-radioactive solid wastes at an average volume of 4.5 MT (5 tons) per day from the BFN site. Materials permitted for disposal include scrap lumber, bricks, sandblast grit, crushed metal drums, glass, wiring, non-asbestos insulation, roofing materials, building siding, scrap metal, concrete with reinforcing steel, and similar construction and demolition wastes. The landfill occupies approximately 3.1 ha (7.7 ac). The generation rate for this type of material over the past 2 years was approximately 0.036 MT (0.04 tons) per day (TVA 2003a).

Once Unit 1 resumes operation, the amount of construction/demolition waste generated as a result of the three-unit operation would not be expected to increase substantially over the rates experienced for two-unit operations.

2.1.6 Plant Operation and Maintenance

The BFN maintenance and modification program supports operation of the nuclear power plant and ensures that equipment, systems, and structures are maintained and modified in accordance with applicable requirements and at a quality level required for them to perform their intended functions as specified in the original design, material specifications, and inspection requirements. Additionally, the following guidance from the Institute of Nuclear Power Operations has been incorporated into the maintenance and modification program as appropriate:

- Inspections are performed by qualified individuals in nuclear assurance or other TVA nuclear organizations where necessary to ensure quality.
- Inspections are performed by individuals other than those who performed or directly supervised the activity being inspected. Inspection results are documented and maintained as records.
- The inspection program provides assurance that plant quality-related items and activities within the scope of the Nuclear Quality Assurance Plan conform to predetermined quality requirements called for in specifications, procedures, and drawings.
- The inspection program includes quality control inspections, nondestructive examinations, line verifications, and special inspections.

TVA Nuclear Standard Programs and Processes address procedural requirements for material receipt and inspection, the American Society of Mechanical Engineers Section XI in-service inspection program, special nuclear material control, and nuclear fuel management (TVA 2003a).

2.1.7 Power Transmission System

BFN is connected into the TVA system network by seven 500-kilovolt (kV) lines via the 500-kV switchyard (Figure 2-4). One line is to the Madison substation, two lines are to the Trinity substation, one line each are to the West Point, Maury, and Union substations, and one line is to the Limestone 500-kV substation (TVA 2003a). In addition, there are two 161-kV lines, one to the Athens substation and one to the Trinity substation. All lines occupy portions of four

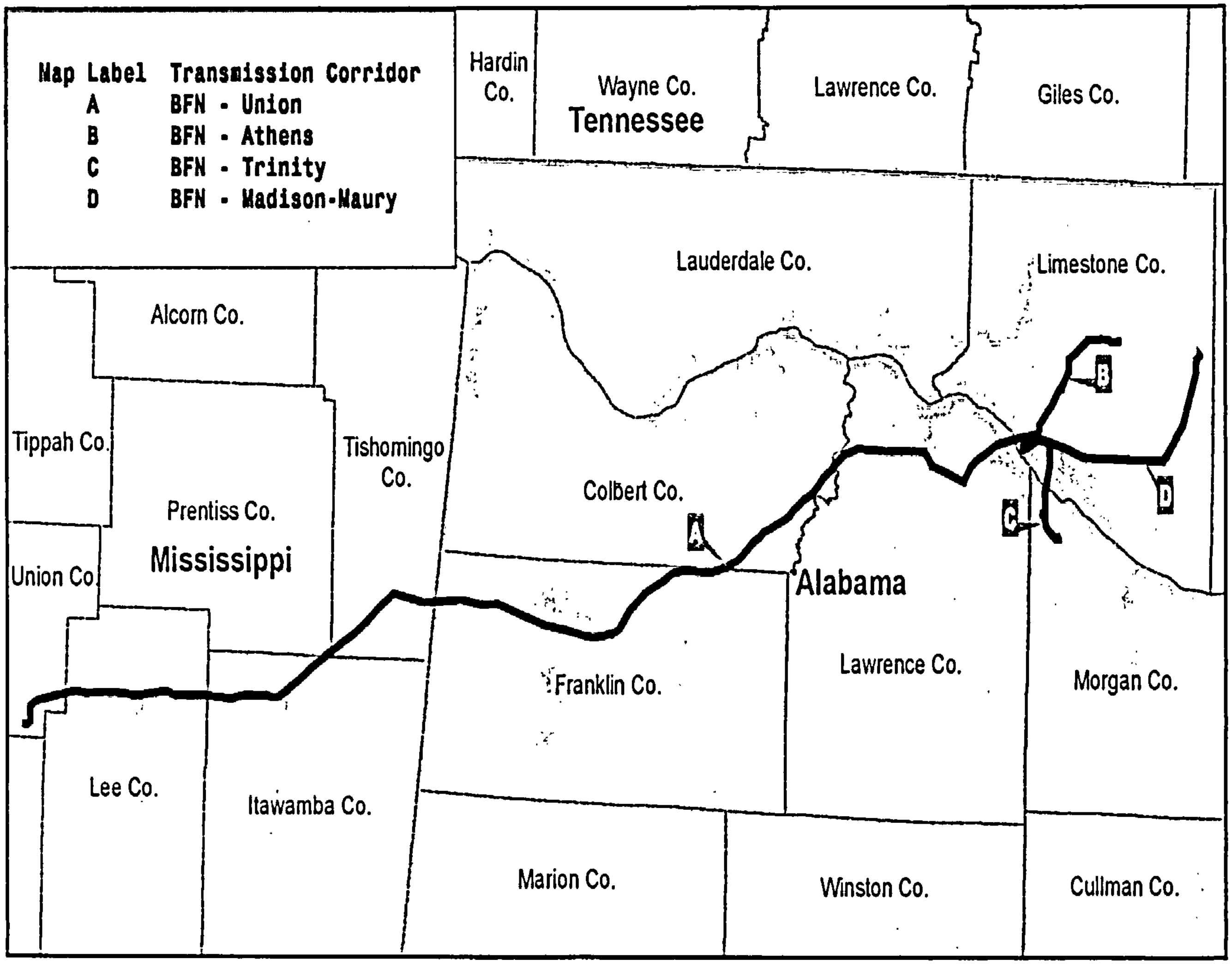

Figure 2-4. Map of Transmission Line Rights-of-Way for Browns Ferry Nuclear Power Plant, Units 1, 2, and 3

transmission line rights-of-way, one to the Maury substation, one to the Trinity substation, one to the Athens substation, and one to the Union, Mississippi, substation (Figure 2-4, Table 2-1). There are portions of other transmission lines within these rights-of-way that were not constructed specifically to connect BFN to the TVA power system. However, for the sake of simplicity and a comprehensive analysis, all the rights-of-way are included in the assessment.

Table 2-1. Browns Ferry Nuclear Power Plant, Units 1, 2, and 3 Transmission Line Rights-of-Way

Right-of Way	Line	kV	Year Completed	Length km	Length mi
BFN to Trinity	BFN-Trinity	500	1968	17.8	11.1
	BFN-Trico	500	1996		
	Trinity-BFN	161	1968		
BFN-Maury	BFN-Madison	500	1968	37.2	23.1
	BFN-West Point	500	1968		
	BFN-Maury	500	1968		
	BFN-Limestone	500	1995		
BFN-Athens	BFN-Athens	161	1968	23.1	14.3
BFN to Union	BFN-Union	500	1980	176.8	109.9

Maintenance of the transmission line rights-of-way is the responsibility of the TVA Transmission and Power Supply – Transmission Operations and Maintenance organization (TVA 2003a). Maintenance activities include vegetation management, pole replacement, installation of lightning arresters and counterpoise, and equipment upgrades. Regular maintenance activities are conducted on a 3- to 5-year cycle. Detailed discussion on transmission line maintenance activities is found in Section 4.2. All activities are reviewed by specialists in the TVA Regional Natural Heritage and Cultural Resources Program. The TVA program maintains a detailed Geographic Information System database of natural and cultural resources along the entire TVA distribution system. The database includes daily updates of Federally and State-listed species habitat and occurrence records (TVA 2003a). Maintenance activities that have the potential to impact sensitive resources are carefully planned and implemented to minimize disturbance.

2.2 Plant Interaction with the Environment

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

BFN is located on the north shore of Wheeler Reservoir in an unincorporated portion of Limestone County, Alabama. Limestone County does not have land-use zoning applicable to unincorporated portions of the county. Wheeler Reservoir is formed by Wheeler Dam, which is owned and operated by TVA and is approximately 32 km (20 mi) downriver from BFN. The reservoir is 119 km (74 mi) long (TVA 2003a).

BFN is approximately 48 km (30 mi) west of Huntsville, Alabama; 16 km (10 mi) northwest of Decatur, Alabama; and 16 km (10 mi) southwest of Athens, Alabama. The site is a 340-ha (840-ac) tract just south of U.S. Highway 72 and is directly accessible from County Road 25 (Nuclear Plant Road). County Road 25 intersects U.S. Highway 72 approximately 10 km (6 mi) north of the site; it also intersects U.S. Highway 31 approximately 14 km (9 mi) east of the site.

The Swan Creek State Wildlife and Mallard-Fox Creek State Wildlife Management Areas are within 5 km (3 mi) of the plant site. The Swan Creek Wildlife Management Area includes 1232 ha (3045 ac) of land and 2357 ha (5825 ac) of water surrounded by numerous industrial facilities (TVA 2003a). The Mallard-Fox Creek State Wildlife Management Area encompasses approximately 593 ha (1483 ac), and is primarily used for waterfowl and small game hunting (TVA 2005).

2.2.2 Water Use

At the BFN site, the Tennessee River flows from southeast to northwest; and the average width of Wheeler Reservoir ranges from 1.6 to 2.4 km (1 to 1.5 mi). Wheeler Reservoir extends from Guntersville Dam at TRM 349 downstream to Wheeler Dam at TRM 274.9. The drainage area upstream of Wheeler Dam is 76,640 km^2 (29,590 mi^2). The reservoir was created in 1936 as one of the first major dam projects on the Tennessee River for flood control, power generation, and navigation. Wheeler Reservoir has a normal summer pool elevation of 169.5 m (556 ft) above mean sea level and a minimum water elevation of 168 m (550 ft). The lake usually reaches its summer pool elevation by mid-April. Fall drawdown, in anticipation of winter rains, usually begins around August 1. At summer pool elevation, the reservoir has an area of 27,140 ha (67,070 ac), a volume of 1290 million m^3 (1.05 million ac-ft), a mean depth of 4.8 m (15.7 ft), and a hydraulic residence time of 10.7 days (TVA 2002a).

The most recent total BFN intake flow reported to ADEM in the monthly Discharge Monitoring Report (December 2003) and to the Alabama Department of Economic and Community Affairs in the Annual Certificate of Use Report is 8 million m^3/d (2114 MGD), which is approximately 46.3 m^3/s (734,000 gpm) per unit. With the resumption of Unit 1 operations, the total intake flow would be approximately 12 million m^3/d (3171 MGD) or 139 m^3/s (4907 cfs), which represents an increase over the previous high reported flow (10.8 million m^3/d or 2855 million gpm) of 11 percent.

TVA is pursuing EPUs, which would increase the total combined power level to 11,856 MW(t) with no further increase in intake flows. The additional heat would be routed through the diffusers for discharge. TVA has modeled the mixing zone and believes BFN can continue to meet current ADEM regulatory limits of the NPDES permit by employing various mitigating measures such as derating and use of the cooling tower helper mode of operation.

BFN cannot put all of the CCW through the cooling towers when operating in the helper mode because of various system limitations. TVA reports the maximum practical throughput for the six cooling towers as 105.5 m^3/s (3725 cfs) (TVA 2004a). Remaining CCW flow bypasses the cooling towers and is routed directly to the river. Almost all the cooling tower flow is also returned to the river, but there is a small amount lost into the air during operation due to evaporation and "drift." These consumptive losses would not exceed 2.3 percent of the total cooling tower flow, even under worst-case conditions. TVA estimates a loss of 1.5 m^3/s (54 cfs) at 105 percent and 1.8 m^3/s (62 cfs) at 120 percent OLTP for Units 2 and 3 (Hopping 2004). TVA stated (TVA 2004a) that "...restart of Unit 1 will require construction of a sixth cooling tower..."; therefore, the consumptive use of cooling water would increase. TVA estimates a loss of 2.0 m^3/s (71 cfs) at 105 percent OTLP and 2.3 m^3/s (82 cfs) at 120 percent OLTP for all three units (Hopping 2004). The cooling towers are only operated when necessary to meet thermal discharge temperature limits specified in the NPDES permit, typically a few weeks during the hottest part of the summer (usually during July and August).

Although most of the intake water is used for condenser cooling, a small amount (approximately 3 percent) of it is used for other plant uses such as emergency equipment cooling water, residual heat removal, raw cooling water, fire protection, and raw service water systems (TVA 2003a). Almost all of this water is ultimately returned to the river, either directly or indirectly through leakage drains. The only consumption of this water at the site would be from a negligible and unquantifiable amount of evaporation when the water is exposed to air.

BFN also consumes a relatively small amount of river water for use in making highly purified or "demineralized" water for various uses in the plant that require high-grade water. On average, this consumptive rate is approximately 5.7 million L/month (1.5 million gal/month) in the summer, which is somewhat higher than the winter consumption because of running the turbine building air wash system to keep equipment operating temperatures down. This consumptive rate is equivalent to 2.2 L/s (0.077 cfs) (TVA 2003a).

Using an unsteady flow model of Wheeler Reservoir, the measured releases from Guntersville Dam and Wheeler Dam were used to compute the hourly flow in Wheeler Reservoir at BFN (TVA 1977a). TVA analyzed these data to obtain a time series of the daily average flow for the period 1976 to 2002. For this period, the following statistical properties have been identified for the flow at BFN: the average daily flow was 1320 m^3/s (46,606 cfs), ranging from 10,700 m^3/s (378,742 cfs) to 75 m^3/s (2638 cfs), and the 7Q10 (the lowest average flow for seven consecutive days with a 10-year recurrence) is 250 m^3/s (8700 cfs) (TVA 2003a). Therefore, the total intake water flow of 139 m^3/s (4907 cfs) can encompass a significant fraction of the daily average river flow past the plant.

Target minimum flows currently used for TVA river operations were established by an environmental impact statement in 2004 (TVA 2004f). The target minimum daily average flows in the Tennessee River at BFN are 280 m^3/s (10,000 cfs) for July through September, 310 m^3/s (11,000 cfs) for December through March, and 200 m^3/s (7000 cfs) otherwise.

Based on the information given above, the Tennessee River average annual flow at BFN for the period 1976 to 2002 equates to 4.16×10^{10} m^3/yr (1.47×10^{12} ft^3/yr). This is less than the 9×10^{10} m^3/yr (3.15×10^{12} ft^3/yr) criterion stated by NRC in 10 CFR 51.53(c)(3)(ii)(A) as the value beneath which "an assessment of the impact of the proposed action on the flow of the river and related impacts on in-stream and riparian ecological communities must be provided."

The critical time for approaching the maximum river water temperature limits specified in the BFN NPDES permit, and therefore requiring the use of cooling towers or plant derates, is July and August. Based on the time series data from 1976 to 2002, the average flow in Wheeler Reservoir at BFN was 964 m^3/s (34,028 cfs) during July and August (TVA 2003a). During these same months and same period, the minimum daily average flow observed at BFN was 80 m^3/s (2815 cfs), occurring on July 1, 1987. For comparison, the 7Q10 low-flow value given in the rationale for the BFN NPDES permit is 250 m^3/s (8700 cfs) (ADEM 2003). The daily average flow exceeded the 7Q10 low-flow value 98.6 percent of the time in July and 98.8 percent of the time in August.

The Athens Utilities Water Department supplies potable water to BFN. Potable water consumption at the site is partly a function of the number of people working at the site. Besides drinking fountains and bathrooms, potable water is also used for fire protection, supplied to a 1.9-million-L (500,000-gal) fire protection water bladder tank, and for various clean water uses, such as window and building wash water and pressurized spray water for equipment cleaning.

Some flow is lost to occasional leaks. BFN typically uses 15,000 to more than 30,000 m^3 per month (4 to 8 million gal per month) of potable water (TVA 2003a).

There is no groundwater use at BFN.

2.2.3 Water Quality

Pursuant to the Federal Water Pollution Control Act Amendments of 1972 (FWPCA), the water quality of the plant effluents is regulated through the NPDES, and ADEM is delegated to issue NPDES permits In Alabama. The current permit (AL0022080) was issued December 29, 2000, and is due to expire January 31, 2006. The NPDES permit specifies the discharge standards and monitoring requirements for each discharge. This permit specifies effluent limits for pH, total residual chlorine, oil, grease, biological oxygen demand, fecal coliform, total suspended solids, temperature, naphthalene, and BETX (i.e., benzene, ethyl benzene, toluene, and xylene isomers). Any new regulations promulgated by the U.S. Environmental Protection Agency (EPA) or the State of Alabama would be reflected in future permits.

Compliance with the NPDES process, other provisions of the FWPCA (e.g., Sections 316 (a), 316 (b), 401, 404), and other regulatory requirements is expected to adequately control potential chemical effluent effects. In general, under these regulatory programs, TVA treats waste water effluents, collects and properly disposes of potential contaminants, and undertakes pollution prevention activities that comply with regulatory requirements and minimize the risk of adverse environmental impacts. The NPDES permit contains temperature limits based on a 316(a) demonstration that EPA approved in June 1977. The NPDES permit can be re-opened and modified in the event ADEM determines, through biological and/or water quality monitoring, that more stringent limitations and/or monitoring requirements are necessary to ensure the protection and propagation of aquatic life in the Tennessee River.

BFN has recently experienced sanitary waste violations (total coliform and total suspended solids) because of the increased number of workers at BFN for the Unit 1 restart activity. ADEM has treated these as minor violations, resulting in warning notices and no fines. Upon further review, ADEM revised the maximum allowed values for Outfall DSN13a for total suspended solids up from 45 to 135 mg/L and for fecal coliform up from 400 to 2000 organisms/100 mL to address this issue in the NPDES permit modification effective October 31, 2003. Aerators designed to stabilize fecal coliform below the NPDES permit limits were installed and began operation in December 2003. Subsequent to aerator installation, no NPDES violations were reported for calendar year 2004.

Effluent discharges from plant systems such as yard drains, station sumps, and sanitary waste water would not be expected to change significantly through the license renewal term.

Considering that the plant waste water lagoons and sedimentation ponds possess clay and Hypalon liners, respectively, no impacts to groundwater resources are anticipated. The changes in pond/lagoon discharges to the river would remain within the bounding conditions established in the NPDES.

2.2.4 Air Quality

The climate at the BFN site varies between continental in the fall to maritime in the summer. During the winter and spring seasons, the climate is variable between the two classifications. The climate at Huntsville, Alabama, which is well documented, is generally considered representative of the BFN site.[a] Climatological records for Huntsville indicate that precipitation is fairly evenly distributed among all months, but the winter and spring seasons are wetter than the fall and summer. Normal monthly precipitation ranges from 17 cm (6.7 in.) in March to 8.4 cm (3.3 in.) in August. Normal daily maximum temperatures for Huntsville range from 9.4°C (48.9°F) in January to a high of slightly more than 32°C (89°F) in July. Normal minimum temperatures range from almost -0.6°C (31°F) in January to almost 21°C (70°F) in July. During the period from 1968 to 2002, the highest recorded temperature at Huntsville was 40°C (104°F), which occurred in July, while the lowest recorded temperature was -24°C (-11°F), which occurred in January. The temperatures generally drop below 0°C (32°F) about 63 days annually.

Thunderstorms are reported about 57 days annually in the Huntsville area. Although thunderstorms occur in all months of the year, most occur during the months of May, June, July, and August. Thunderstorms can have windstorms and sometimes hail associated with them, and in some cases produce tornadoes. The highest reported wind speed at Huntsville during the period from 1968 to 2002 was 28.2 m/s (63 mph) from the north-northeast direction. During the period from January 1, 1950, to December 31, 2003, 50 days of hail events were reported in Limestone County. The largest reported hailstones were 9.5 cm (3.75 in.), which fell on the City of Athens, Alabama, on May 18, 1995 (NOAA 2004). During the same time period, 24 tornados were reported in Limestone County. The most violent storm occurred on April 3, 1974, when 11 deaths were reported and 80 people were injured. The most property damage occurred during a tornado on May 18, 1995, when property damage amounting to $5 million was reported along with one death and 55 injuries (NOAA 2004).

The National Severe Storms Laboratory in Kansas City, Missouri, calculated the tornado return probability for the BFN site based on tornado occurrences within a 56-km (30-nautical-mi)

(a) Climatological data for Huntsville is available at http://www.ncdc.noaa.gov/ol/climate/climatedata.html.

radius during the period from 1950 to 1986. Based on 48 tornado occurrences having path size estimates during that 37-year period, the return probability for the site is 6.979 x 10^{-4} with a mean return interval of 1433 years.

The wind energy resource in northern Alabama is limited. The annual average wind power density in Alabama is almost exclusively Class 1 on a scale of 1 through 7 (Elliott et al. 1987). Areas suitable for wind turbine applications have a rating of 3 or higher. The only areas that meet this criterion are ridge tops in northeastern Alabama where the Appalachian foothills begin, along the exposed Gulf Coast shoreline of Alabama, and in the Mobile Bay area during the winter and spring seasons.

The BFN site is located within the Tennessee River Valley-Cumberland Mountains Interstate Air Quality Control Region (40 CFR 81.72). Presently, this region is considered in attainment for all criteria pollutants (40 CFR 81.301). The EPA is in the process of promulgating new, more restrictive standards for ozone and particulate matter. For ozone, the current 1-hour ozone standard will be replaced by an 8-hour standard. Once these new standards are implemented, several counties that are part of the control region may not be in compliance.

The Sipsey Wilderness area is the only area in Alabama designated in 40 CFR 81.401 as a mandatory Class 1 Federal area in which visibility is an important value. The wilderness area is located about 45 km (28 mi) southwest of the BFN site. All other Class 1 areas located in Tennessee or Mississippi are greater than 80 km (50 mi) from BFN.

Diesel-power auxiliary (emergency) generators, auxiliary boilers, and other small sources such as fuel storage facilities emit various non-radiological pollutants. Emissions from these sources are regulated by ADEM under a Synthetic Minor Operating Permit (ADEM Administrative Code 335-3-15-02-10). This permit remains in effect until the existing administrative code is amended. The terms of that permit require the site to track actual emissions. The most recent report (for 2003) indicated that a total of 35.3 MT (38.9 tons) of pollutants were discharged to the atmosphere from these sources (TVA 2004d). For the period from 1998 to 2003, annual emissions have varied between 27.2 and 40.8 MT (30 and 45 tons).

2.2.5 Aquatic Resources

The aquatic resources in the vicinity of the BFN site are associated primarily with the Wheeler Reservoir portion of the Tennessee River. Wheeler Reservoir is the source and receiving body for the BFN cooling system. The BFN site has about 3772 m (12,375 ft) of Wheeler Reservoir frontage (TVA 2003a). Other nearby aquatic habitats include the following tributaries to Wheeler Reservoir: Paint Rock and Flint Rivers in the upper reach; Indian, Cotaco, and Flint Creeks in the middle reach; and Limestone, Piney, Swan, Fox, Mallard, Spring, First, and

Second Creeks and the Elk River in the lower section. Elk River is the largest of these tributaries, and flows into Wheeler Reservoir about 16 km (10 mi) downstream of BFN. Guntersville Reservoir is located upstream of Wheeler Reservoir, while Wilson Reservoir is located downstream from Wheeler Reservoir.

The seven transmission lines associated with BFN cross a number of streams ranging in size from small intermittent streams to the Tennessee River. Rivers and larger streams crossed by or near the transmission lines include Limestone, Piney, Round Island, Swan, Big Nance, Town, Spring, Cedar, Little Bear, and Bear Creeks in Alabama, and Bear, Little Brown, Donivan, Twentymile, Mantachie, Mud, and Bridge Creeks and the Tennessee-Tombigbee Waterway in Mississippi.

TVA began its Vital Signs Monitoring Program in 1990 to systematically monitor key physical, chemical, and biological indicators (i.e., dissolved oxygen, chlorophyll, sediments, benthic macroinvertebrates, and fish) to evaluate the ecological conditions of its reservoirs and to target detailed assessment studies if significant problems are found (Dycus 1998). Monitoring is conducted in the inflow area (generally riverine in nature), transition zone (mid-reservoir area), and forebay area (generally lacustrine or lake-like in nature). The Vital Signs Monitoring Program transition zone sampling station for Wheeler Reservoir is located at TRM 295.9, a short distance upstream of BFN (TVA 2003a). The ecological health rating for a sample site can range from a minimum of 4.5 (all indicators poor) to 22.5 (all indicators excellent). The overall health evaluation for a reservoir is determined by summing the ratings from all sites and dividing by the maximum possible combined rating for the sites, expressed as a percentage. This approach provides a potential range of scores from 20 to 100 percent and applies to all reservoirs regardless of the number of indicators or sample sites. The percent scoring range is then divided into categories representing good (greater than 72 percent), fair (52 to 72 percent), and poor (less than 52 percent) ecological health conditions for run-of-the-river reservoirs (the cut off between a poor and fair rating for tributary and storage reservoirs is 57 percent rather than 52 percent) (Dycus 1998). Between 1991 and 2003, the ecological health scores for Wheeler Reservoir ranged from a low of 61 (fair) in 1999 to a high of 76 (good) in 1997, with a 1993 to 1997 average of 73 (good) (Dycus 1998). Ecological health scores in 2001 and 2003 were 65 and 72, respectively, indicating a continuing fair rating in recent years (TVA 2004e).

A total of 63 fish species plus hybrid sunfish, hybrid striped bass x white bass (*Morone saxatilis* x *M. chrysops*), and hybrid walleye x sauger (*Stizostedion vitreum* x *S. canadense*) were collected from 1995 through 2002 in the vicinity of BFN (TVA 2002a, 2003a). A total of 72 fish species were collected in impingement samples between 1974 and 1977 (TVA 1978). Important commercial fish species that occur in Wheeler Reservoir include blue catfish (*Ictalurus furcatus*), channel catfish (*I. punctatus*), flathead catfish (*Pylodictis olivaris*), bigmouth buffalo (*Ictiobus cyprinellus*), smallmouth buffalo (*I. bubalus*), and common carp (*Cyprinus carpio*). Gizzard shad (*Dorosoma cepedianum*) and threadfin shad (*D. petenense*) are the dominant forage species in Wheeler Reservoir (TVA 2003a). Threadfin shad has been the dominant species numerically in Wheeler Reservoir since 1990 (Baxter and Buchanan 1998).

Game fish species include largemouth bass (*Micropterus salmoides*), smallmouth bass (*M. dolomieu*), spotted bass (*M. punctulatus*), black crappie (*Pomoxis nigromaculatus*), white crappie (*P. annularis*), bluegill (*Lepomis macrochirus*), longear sunfish (*L. megalotis*), redear sunfish (*L. microlophus*), sauger, striped bass, hybrid striped bass, yellow bass (*Morone mississippiensis*), and yellow perch (*Perca flavescens*). Largemouth bass is the species most often sought by sport fishermen, followed by crappie. Bluegill are the most numerous game fish in Wheeler Reservoir (Baxter and Buchanan 1998). The sport fishery is supplemented by stockings of striped bass, hybrid striped bass, largemouth bass, and channel catfish.

The Vital Signs Monitoring Reservoir Fish Assemblage Index metric scores are based primarily on fish community structure and function, but also consider percentage of sample represented by omnivores and insectivores, overall number of fish collected, and the occurrence of fish with anomalies (e.g., diseases, lesions, parasites, and deformities). The Reservoir Fish Assemblage Index scores from 1993 to 2002 have equated to a rating of fair upstream of BFN (TRM 295.9) and good downstream of BFN at TRM 277. Monitoring done at TRM 292.5 just downstream of BFN from 2000 through 2002 have equated to a rating of good (Baxter and Gardner 2003). There are no health advisories against the consumption of fish from Wheeler Reservoir. However, there are advisories against consuming bigmouth and smallmouth buffalo from two tributaries of upper Wheeler Reservoir (Indian Creek and Huntsville Spring Branch from Redstone Arsenal to the Tennessee River) because of DDT contamination (ADPH 2002, 2003).

The Sport Fishing Index was developed to quantify sport fishing quality for individual sport fish species. The Sport Fishing Index uses information from population sampling (e.g., catch per unit effort from electrofishing and gill netting) and creel results (e.g., angler success) to describe the quality of the resident fishery. Parameters measured include the length and weight of fish in various categories (e.g., preferred-size fish, memorable-size fish, and trophy-size fish). The Sport Fishing Index can range from 20 (very poor) to 60 (excellent) (Hickman 2000). The 2002 scores for Wheeler Reservoir and the TVA system-wide average (given in parentheses) were bluegill, 26 (29); channel catfish, 28 (26); hybrid striped bass, 44 (40); largemouth bass 34 (33); sauger, 42 (30); smallmouth bass, 36 (35); and spotted bass, 42 (35) (TVA 2002c). While the sport fishery in Wheeler Reservoir cannot be considered excellent clam (*Corbicula fluminea*), and zebra mussel (*Dreissena polymorpha*). The Asiatic clam and zebra mussel are the most problematic of these species because of their impacts on power plants and city water supplies, as well as to their potential ecological impacts (TVA 2004f). The grass carp has been introduced into TVA reservoirs to control heavy infestations of aquatic vegetation. The introduced grass carp are sterile, and the population can be maintained at desired levels by adjusting stocking rates. Grass carp have been collected infrequently in gill net and electroshock samples at TRM 295.9 (TVA 2002a). Other non-native species such as the striped bass, hybrid striped bass, and yellow perch have become popular game species in the Wheeler Reservoir (Baxter and Buchanan 1998).

The phytoplankton community of Wheeler Reservoir is diverse. As many as 27 Chrysophyta (yellow-green or yellow-brown algae), 52 Chlorophyta (green algae), and 17 Cyanophyta (blue-green algae) taxa have been documented (TVA 1977b). The zooplankton assemblage is also diverse, with 32 cladoceran, 24 copepod, and 47 rotifer taxa having been reported (TVA 1977b). The non-native cladoceran *Daphnia lumholtzi* has been documented throughout the Tennessee River system (Baker 2001), and is therefore expected to occur in Wheeler Reservoir (TVA 2003a). It may eventually become a dominant zooplankton species in the southern United States (CARS 2004).

During 2002, there were an estimated 1820 ha (4500 ac) of aquatic plant coverage in Wheeler Reservoir. Between 1976 and 2002, this coverage has varied from a low of 8 ha (20 ac) (1976 to 1978) representing a trace percentage of the reservoir to a high of 3983 ha (9843 ac) (in 1988) or about 14 percent of the reservoir (TVA 2004f). The aquatic plants that commonly occur in Wheeler Reservoir include the invasive exotic Eurasian watermilfoil (*Myriophyllum spicatum*), hydrilla (*Hydrilla verticillata*), spinyleaf naiad (*Najas minor*), the invasive native coontail (*Ceratophyllum demersum*), and southern naiad (*N. guadalupensis*). Most of these plants occur in the broad, shallow overbank habitat upstream of BFN between TRM 296 and 305 (TVA 2002a). Eurasian watermilfoil, hydrilla, and spinyleaf naiad are submersed aquatic plants that can be severely problematic to reservoir use. Although the submersed aquatic southern naiad and the free-floating coontail are generally considered beneficial species, they can occasionally reach nuisance levels (TVA 2004f).

The overbank areas support communities of Asiatic clams, fingernail clams, burrowing mayflies, aquatic worms, and chironomids, while cobble and bedrock areas (found mainly in the old channel) support Asiatic clams, bryozoans, sponges, caddisflies, snails, and some leeches (TVA 2002a). The Vital Signs Monitoring Program transition station at TRM 295.5 had benthic community scores of excellent in 1994, good in 1995, and excellent in both 1997 and 1999 (Dycus and Baker 2000). Benthic macroinvertebrate monitoring was initiated in 2000 in support of the BFN thermal variance monitoring. The benthic community was rated excellent at TRM 295.9 (upstream of the BFN diffusers) in 2000 and good in 2001 and 2002. At TRM 291.7 (downstream of the BFN diffusers) the rating was excellent in 2001 and good in 2002 (Baxter and Gardner 2003). The average mean density of benthic macroinvertebrates collected upstream (TRM 295.9) and downstream (TRM 291.7) of BFN in November 2002 were 473 and 445/m^2 (5091 and 4790/ft^2), respectively (Baxter and Gardner 2003). In comparison, downstream reaches of Wheeler Reservoir at TRM 277 and Elk River had average ratings of poor between 1994 and 2002, while the upstream reach of Wheeler Reservoir at TRM 347 had an average rating of good over this time period (Baxter and Gardner 2003).

Historically, 39 mussel species occurred in Wheeler Reservoir. Thirty-one of these species were considered riverine (i.e., those that evolved in free-flowing reaches), with 19 of these species now considered non-reproducing riverine species within Wheeler Reservoir (Ahlstedt and McDonough 1992). In 1982, 12 mussel species were collected during a survey for the proposed barge facility at BFN (Pryor 1982), and 11 species were collected across the river during a survey for a proposed barge terminal for the Mallard-Fox Creek Development Project (Carroll 1982). The washboard (*Megalonaias nervosa*) was the most common species collected during both surveys. It is currently the predominant species that is commercially harvested (TVA 2003a). The Ohio pigtoe (*Pleurobema cordatum*) was previously the most valuable commercial species, but its numbers have decreased as a result of habitat alterations caused by impoundment (Ahlstedt and McDonough 1992). None of the species collected were Federally or State protected.

In 1991, 24 species of mussels were collected from Wheeler Reservoir, with six species represented by weathered, empty shells (Ahlstedt and McDonough 1992). The 24 species included all species previously collected near BFN in the two 1982 collections by Pryor (1982) and Carroll (1982). It was estimated that 460 million mussels or 2.33 mussels/m^2 (0.22 mussels/ft^2) occurred in the reservoir in 1991 (Ahlstedt and McDonough 1992). The most common species (and estimated number within Wheeler Reservoir) collected in 1991 were the elephant-ear (*Elliptio crassidens,* 116 million), washboard (88 million), pink heelsplitter (*Potamilus alatus,* 56 million), and threehorn wartyback (*Obliquaria reflexa,* 44 million) (Ahlstedt and McDonough 1992). In addition to the habitat alteration resulting from reservoir creation, over-harvesting and periods of drought (e.g., from 1983 to 1988) may have affected reproduction and/or survival of most thick-shelled mussel species in Wheeler Reservoir (Ahlstedt and McDonough 1992). Water-quality impairments and loss of necessary fish hosts have also contributed to the decline of mussel populations. The biodiversity of mussel communities in the mainstem Tennessee River reservoirs is anticipated to continue the long-term downward trend in terms of abundance and diversity (TVA 2004f).

In 1998, 17 mussel species were collected on the east channel of Wheeler Reservoir near Hobbs Island, more than 64 river kilometers (40 river miles) upstream of BFN, between TRMs 336.4 and 335.5. The two most common mussel species were the elephant-ear and the Ohio pigtoe. Two Federally endangered species were also collected: one specimen of the rough pigtoe (*Pleurobema plenum*) and 16 specimens of the pink mucket (*Lampsilis abrupta*)

(Yokely 1998). In 1999, 16 native mussel species were collected in the vicinity of BFN: 14 species at TRM 298 upstream of BFN and 12 species at TRM 292 downstream of BFN. None of these were Federally listed species (TVA 2003a). Eleven commercial mussel species have been reported near BFN from TRM 305 to TRM 275 (Ahlstedt and McDonough 1992).

Two areas of Wheeler Reservoir are designated as State-protected mussel sanctuaries where commercial mussel fishing is not permitted. One sanctuary extends from Guntersville Dam (TRM 349) downstream to the mouth of Shoal Creek (TRM 347); the second extends from the upstream end of Hobbs Island (TRM 337) downstream to Whitesburg Bridge (TRM 333) (TVA 2003). In the reservoir overbanks, mussels are generally spread over large areas and are not concentrated in mussel beds (TVA 2003a).

The Asiatic clam was first reported in Alabama in 1962, and is now widespread throughout the state (Foster et al. 2000). It inhabits lakes and streams of all sizes and occurs in silt, mud, sand, or gravel substrates (Cummings and Mayer 1992). The major impact caused by the Asiatic clam is biofouling, particularly of power plant and industrial water systems. It also modifies benthic substrates and competes with native species (Foster et al. 2000). The Asiatic clam is consumed by a number of fish, birds, and mammals. Its population density and distribution can be affected by excessively high or low temperatures, salinity, drying, low pH, silt, low dissolved oxygen, and diseases and parasites. The Asiatic clam can often dominate the benthic community, occurring at densities of thousands per square meter (Foster et al. 2000).

Between 1969 and 1976, densities of the Asiatic clam between TRM 307.5 and TRM 278 ranged from 103 to 167 clams/m^2 (9.6 to 15.5 clams/ft^2) (TVA 1977b). The Asiatic clam competes with native mussels for food, nutrients, and space. Dense populations of the Asiatic clam may ingest large numbers of unionid sperm, glochidia, and newly metamorphosed juveniles. They may also completely cover sediments; therefore, dense populations may reduce suitable habitat space for juvenile native mussels. Periodic Asiatic clam die-offs may produce enough ammonia and consume enough oxygen to kill native mussels (Butler 2002).

The zebra mussel had established populations in the Tennessee River by 1992 and had been reported in Alabama by 1994 (Benson 2004). It has continued to spread throughout the river system. Zebra mussel densities in the Tennessee River have remained low, but are now abundant enough below Wilson Dam that they can be measured quantitatively (Butler 2002). The zebra mussel inhabits lakes and streams of all sizes, attaching to rocks, freshwater mussels, or almost any other hard surface (Cummings and Mayer 1992). Their increase causes a decline among many native mussels, as it can out-compete native species for oxygen and food and is so prolific that it can smother native mussel beds (GSMFC 2003).

The raw water intake for BFN is treated biannually with a molluscide to control biofouling by zebra mussels and Asiatic clams. Also, biweekly raw water samples are analyzed from April through October for zebra mussel veligers as an early warning for potential biofouling (TVA 2002a). Data from these samples indicate that zebra mussel reproduction near BFN remains at a low level and that the zebra mussel should not pose a threat to plant operations in the immediate future (TVA 2003a). However, the primary means of keeping the condenser tubes clear of Asiatic clams is the use of a system that uses small sponge rubber balls that are continuously recirculated through the condenser tubes (TVA 1972).

There are 38 Federally listed aquatic species (including three candidate species) whose distribution includes, or has historically included, the Wheeler Reservoir portion of the Tennessee River or its tributaries, or other streams, rivers, or caves within the counties of Alabama and Mississippi through which the BFN transmission line rights-of-way pass (Table 2-2). One of the BFN transmission lines crosses designated critical habitat for one Federally protected species of freshwater mussel. All but nine of the Federally protected 38 species would not currently be expected to occur within Wheeler Reservoir or the streams crossed by the transmission line rights-of-way associated with BFN for the following reasons: (1) the species are presumed to be extinct, (2) the species are presumed to be extirpated in the region, (3) there are no recent records for the species in the region, (4) there are no collection records for the species from pertinent locations, and/or (5) project areas of concern do not have appropriate habitat for the species (e.g., County records are for streams or caves that are not crossed by the BFN transmission lines). Additional information on these 29 Federally listed species is provided in the Biological Assessment in Appendix E.

Table 2-2. Federally and State-Listed Aquatic Species Potentially Occurring in Colbert, Franklin, Lawrence, Limestone, or Morgan Counties, Alabama and/or Itawamba, Lee, Tishomingo, or Union Counties, Mississippi

Scientific Name	Common Name	Status[a]			Habitat
		Federal	AL	MS	
		Aquatic Snails			
Athearnia anthonyi	Anthony's riversnail	E	P	--	Large rivers and lower reaches of large creeks on cobble/boulder substrates near riffles
Campeloma decampi	slender campeloma	E	P	--	Large creeks in soft sediments (sand or mud) or detritus
Lithasia lima	warty rocksnail	--	NOST	--	Rocky riffles of low gradient large-sized rivers or moderate gradient medium-sized rivers

Table 2-2. (contd)

Scientific Name	Common Name	Status(a) Federal	AL	MS	Habitat
Lithasia verrucosa	varicose rocksnail	--	NOST	--	Rocky shoals and riffles in moderate currents of medium to large rivers at depths up to 1 m (3 ft)
Pyrgulopsis pachyta	armored snail (armored marstonia)	E	P	--	Shallow, still water along the edge of pools on tree roots and detritus of creeks
		Mussels			
Cumberlandia monodonta	spectaclecase	C	P	--	Large rivers with swiftly flowing water, among boulders in patches of sand, cobble, or gravel in areas where current is reduced
Cyclonaias tuberculata	purple wartyback	--	--	S1	Medium or large rivers in gravel or mixed sand and gravel
Cyprogenia stegaria	fanshell	E	P	--	Medium to large rivers
Dromus dromas	dromedary pearlymussel	E	P	--	Sand and gravel substrates in ruffles and shoals of medium to large rivers
Ellipsaria lineolata	butterfly	--	NOST	S3	Large rivers in sand or gravel
Elliptio arca	Alabama spike	--	--	S3	Shoreline of rivers in sand, sand and gravel, or rock substrates
Epioblasma brevidens	Cumberlandian combshell	E	P	S1	Coarse sand to mixtures of gravel, cobble and boulder-sized rocks in medium to large rivers; tends to occur at depths <1m (3 ft)
Epioblasma capsaeformis	oyster mussel	E	P	--	Usually in small- to medium-sized rivers in the substrates of coarse sand to boulder substrates and moderate to swift currents
Epioblasma florentina florentina	yellow-blossom pearlymussel	E	P	--	Riffle and shoal areas of small- to medium-sized streams
Epioblasma florentina walkeri	tan riffleshell	E	X	--	Headwaters, riffles, and shoals in sand and gravel substrates

Table 2-2. (contd)

Scientific Name	Common Name	Status[a] Federal	AL	MS	Habitat
Epioblasma penita	southern combshell	E	--	S1	Riffles or shoals of medium-sized rivers with sandy gravel to gravel-cobble substrates in moderate to swift current
Epioblasma torulosa torulosa	tubercled blossom	E	P	--	Sandy gravel substrates in riffles and shoals in rapid currents of medium to large rivers
Epioblasma triquetra	snuffbox	--	--	S1	Medium to large rivers in clear, gravel riffles
Epioblasma turgidula	turgid blossom pearlymussel	E	P	--	Sand and gravel substrates of shallow, fast-flowing streams
Fusconaia barnesiana	Tennessee pigtoe	--	NOST	S1	Cracks in bedrock to mixtures of coarse sand, gravel, cobble and boulders in riffle and shoal areas with moderate to swift currents of medium to large rivers; seldom in depths >1m (3 ft)
Fusconaia cor	shiny pigtoe	E	P	--	Shoals and riffles in clear streams with moderate to fast current
Fusconaia cuneolus	fine-rayed pigtoe	E	P	--	Firm cobble and gravel substrates of clear, high gradient streams
Hemistena lata	cracking pearlymussel	E	P	--	Sand, gravel and cobble substrates in swift currents or mud and sand in slower currents of medium to large rivers
Lampsilis abrupta	pink mucket	E	P	--	Larger rivers in gravel or sand
Lampsilis cardium	plain pocketbook	--	--	S3S4	Small creeks to large rivers in mud, sand or gravel
Lampsilis ovata	pocketbook	--	NOST	--	Large rivers in coarse sand or gravel
Lampsilis perovalis	orangenacre mucket	T	--	S1	Medium and large rivers in gravel/cobble or gravel/coarse sand substrates
Lampsilis virescens	Alabama lampmussel	E	P	--	Sand and gravel substrates in shoal areas of medium to large rivers

Table 2-2. (contd)

Scientific Name	Common Name	Status[a] Federal	AL	MS	Habitat
Lemiox rimosus	birdwing pearlymussel	E	NOST	--	Riffle areas with sand and gravel substrates in moderate to fast currents of creeks to medium-sized rivers
Lexingtonia dolabelloides	slabside pearlymussel	C	P	S1	Moderate to high gradient riffles in medium to large rivers
Ligumia recta	black sandshell	--	--	S2	Gravel-cobble and possibly coarse sand substrates in shoals in medium to large rivers
Medionidus conradicus	Cumberland moccasinshell	--	NOST	--	Sand and gravel substrates or in cracks or under rocks in creeks to medium-sized rivers
Obovaria jacksoniana	southern hickorynut	--	--	S2	Medium-sized gravel substrates in river areas of low to moderate currents
Obovaria retusa	ring pink	E	P	--	Gravel and sand bars of large rivers
Obovaria unicolor	Alabama hickorynut	--	--	S3	Sand/gravel substrates in river areas of moderate current
Plethobasus cicatricosus	white wartyback pearlymussel	E	P	--	Gravel substrates of large rivers
Plethobasus cooperianus	orangefoot pimpleback	E	P	--	Sand, gravel and cobble substrates in riffles and shoals in deep water and steady current of large rivers
Pleurobema clava	clubshell	E	P	--	Medium to large rivers in gravel or mixed gravel and sand
Pleurobema curtum	black clubshell	E	--	SH	Sandy gravel to gravel-cobble substrates in riffles and shoals with moderate to fast currents in medium to large rivers
Pleurobema decisum	southern clubshell	E	--	S1S2	Sand and gravel substrates of medium to large rivers

Table 2-2. (contd)

Scientific Name	Common Name	Status[a] Federal	AL	MS	Habitat
Pleurobema oviforme	Tennessee clubshell	--	NOST	--	Sand and gravel substrates (occasionally mud or cracks between bedrock slabs) in vicinity of riffles and shoals of medium to large rivers
Pleurobema perovatum	ovate clubshell	E	--	S1	Moderate gradient pools and riffles of medium to large rivers
Pleurobema plenum	rough pigtoe	E	P	--	Medium to large rivers in sand or gravel
Pleurobema taitianum	heavy pigtoe	E	--	SH	Riffles and shoals on sandy gravel to gravel-cobble substrates in areas of moderate to fast currents of medium to large rivers
Potamilus alatus	pink heelsplitter	--	--	S2	Medium to large rivers in mud or mixed mud, sand and gravel
Potamilus ohiensis	pink papershell	--	NOST	--	Medium to large rivers in silt, mud or sand
Ptychobranchus fasciolaris	kidneyshell	--	NOST	S1	Rivers with coarse sand and gravel substrates
Ptychobranchus subtentum	fluted kidneyshell	C	NOST	–	Small to medium rivers in areas with swift current or riffles; larger rivers in shoal areas
Quadrula intermedia	Cumberland monkeyface	E	P	--	Sand and gravel substrates in shallow riffle and shoal areas of headwater streams to bigger rivers at depths to 0.6 m (2 ft)
Quadrula metanevra	monkeyface	--	NOST	SH	Gravel or mixed sand and gravel substrates in medium to large rivers
Quadrula rumphiana	ridged mapleleaf	--	--	S2	Medium-sized rivers in sand/gravel substrates in moderately silty waters of moderate gradient
Strophitus subvexus	southern creekmussel	--	--	S2	Small to large creeks in sand or sandy mud substrates in areas of low to no current

Table 2-2. (contd)

Scientific Name	Common Name	Status[a] Federal	AL	MS	Habitat
Toxolasma cylindrellus	pale lilliput	E	P	--	Firm rubble, gravel, and sand substrates in shallow riffles and shoals of clean, fast-flowing streams
Toxolasma lividus	purple lilliput	--	NOST	--	Small to medium-sized rivers in mud, sand and gravel substrates
Truncilla truncata	deertoe	--	--	S3	Medium to large rivers in mud, sand or gravel substrates
Villosa taeniata	painted creekshell	--	NOST	--	Smaller streams in sand/gravel substrates
Villosa trabalis	Cumberland bean	E	NOST	--	Sand, gravel, and cobble substrates in waters of moderate to swift currents and depths <1m (3 ft) in medium to large rivers
Villosa vanuxemensis	mountain creeksheel	--	NOST	--	Smaller streams in sand/gravel substrates
		Crayfish and Shrimp			
Palaemonias alabamae	Alabama cave shrimp	E	S1	--	Silt-bottom pools in caves
Cambarus jonesi	Alabama cave crayfish	--	NOST	--	Subterranean pools
Cambarus veitchorum	White Spring Cave crayfish	--	NOST	--	Subterranean pools
Hobbseus petilus	Tombigbee riverlet crayfish	--	--	S2	Slow to moderately flowing small, shallow streams in sand/gravel substrates
Procambarus ablusus	crayfish	--	--	S3	Streams
Procambarus pecki	phantom cave crayfish	--	NOST	--	Subterranean pools with silty bottoms

Table 2-2. (contd)

Scientific Name	Common Name	Status[a] Federal	AL	MS	Habitat
		Fishes			
Clinostomus funduloides	rosyside dace	--	--	S2	Rocky flowing pools of headwaters, creeks and small rivers
Cottus carolinae	banded sculpin	--	--	S1	Gravel and rubble riffles of headwaters, creeks and small rivers; springs and their effluents
Crystallaria asprella	crystal darter	--	--	S1	Clean sand and gravel runs of small to medium rivers
Cyprinella callistia	Alabama shiner	--	--	S2	Gravel- and rubble-bottomed pools and runs of creeks and small to medium rivers
Cyprinella monacha	spotfin chub	E	P	--	Rocky riffles and runs of clean small to medium riffles
Cyprinella spiloptera	spotfin shiner	--	--	S2	Sand and gravel runs and pools of creeks and small, medium and sometimes large rivers
Cyprinella whipplei	steelcolor shiner	--	--	S3	Rocky and sandy runs and, less often, pools of creeks and small to medium rivers
Elassoma alabamae	spring pygmy sunfish	--	P	--	Spring systems
Etheostoma blennioides	greenside darter	--	--	SH	Rocky riffles of creeks and small to medium rivers; shores of large lakes
Etheostoma boschungi	slackwater darter	T	P	--	Gravel-bottomed pools and runs of creeks and small rivers
Etheostoma douglasi	Tuskaloosa darter	--	NOST	--	Fast rocky riffles of creeks and small to medium rivers
Etheostoma flabellare	fantail darter	--	--	S2	Rocky riffles of creeks and small to medium rivers
Etheostoma kennicotti	stripetail darter	--	--	S2	Rocky pools of headwaters, creeks and small rivers
Etheostoma nigripinne	blackfin darter	--	--	S2	Rocky pools and adjacent riffles of headwaters, creeks and small rivers

Table 2-2. (contd)

Scientific Name	Common Name	Status[a] Federal	AL	MS	Habitat
Etheostoma rufilineatum	redline darter	--	--	S2	Clear, fast rocky riffles of creeks and small to medium rivers
Etheostoma tuscumbia	Tuscumbia darter	--	P	--	Springs and spring runs
Etheostoma wapiti	boulder darter	E	P	--	Fast, rocky riffles of small to medium rivers
Etheostoma zonistium	bandfin darter	--	--	S2	Sand- and gravel-bottomed pools of headwaters, creeks and small rivers
Ichthyomyzon castaneus	chestnut lamprey	--	--	S3	Lakes and streams
Ictiobus niger	black buffalo	--	--	S3	Pools and backwaters of small to large rivers, impoundments and lakes
Lythrurus ardens	rosefin shiner	--	--	S2	Rocky pools and runs of clear, fairly fast headwaters, creeks and small rivers
Moxostoma duquesnei	black redhorse	--	--	S1	Sand- to rock-bottomed pools and runs of creeks and small to medium rivers; impoundments
Moxostoma macrolepidotum	shorthead redhorse	--	--	S1	Rocky pools, runs and riffles in small to large rivers; lakes
Notropis boops	bigeye shiner	--	--	S1	Flowing, usually clear and rocky, pools of creeks and small to medium rivers
Notropis rubellus	rosyface shiner	--	--	S1	Rocky runs and flowing pools of small to medium rivers
Noturus exilis	slender madtom	--	--	S1	Rocky riffles, runs and flowing pools of clear creeks and small rivers; rarely along wave-swept margins of large impoundments
Noturus munitus	frecklebelly madtom	--	--	S2	Rocky riffles and runs of medium to large rivers, often near vegetation
Percina evides	gilt darter	--	--	S1	Rocky riffles of small to medium riffles

Table 2-2. (contd)

Scientific Name	Common Name	Status[a] Federal	AL	MS	Habitat
Percina lenticula	freckled darter	--	--	S2	Fast, deep rocky riffles of small to medium rivers
Percina phoxocephala	slenderhead darter	--	--	S1	Gravel runs and riffles of creeks and small to medium rivers
Phenacobius mirabilis	suckermouth minnow	--	--	S1	Gravel and rubble riffles and runs of creeks and small to medium, sometimes large, rivers.
Phoxinus erythrogaster	southern redbelly dace	--	--	S2	Rocky, usually spring-fed pools of headwaters and creeks
Polyodon spathula	paddlefish	--	NOST	S3	Slow-moving water of large rivers
Rhinichthys atratulus	blacknose dace	--	--	S1	Rocky pools of headwaters and creeks
Typhlichthys subterraneus	southern cavefish	--	P	--	Subterranean waters
		Amphibians			
Cryptobranchus alleganiensis alleganiensis	eastern hellbender	--	P	S1	Rocky, clear creeks and rivers with large shelter rocks
Gyrinophilus palleucus	Tennessee cave salamander	--	P	--	Clean, permanent streams and pools of limestone caves

(a) C = candidate; E = endangered; NOST (State ranking developed by Alabama National Heritage Program) = considered rare or sensitive, but has no official status; P = protected; S1 = critically imperiled; S2 = imperiled; S3 = rare or uncommon; S4 = widespread, abundant and apparently secure; SH = of historical occurrence; T = threatened, X = extirpated; -- = not listed.

Sources: ADCNR 2003; Cummings and Mayer 1992; FWS 1990a, 2000a, b, 2004a,b; Johnson and Wehrle 2004; MMNS 2002; MNHP 2002; NatureServe 2004; NCWRC 2004; Page and Burr 1991; TVA 2003a.

The following discussion first addresses the nine Federally listed species that are known to presently occur in Wheeler Reservoir or one or more of the streams crossed by the transmission line rights-of-way associated with BFN. However, no Federally protected aquatic species have been collected, or are currently known to occur, in the immediate vicinity of the BFN site based on TVA's Vital Signs Monitoring Program data and Regional Natural Heritage Programs database (Baxter and Gardner 2003). Following the discussion of the Federally listed aquatic species is a discussion of the aquatic species that are only State-listed for Alabama or Mississippi.

- **Federally Listed Species**

Anthony's riversnail (*Athearnia anthonyi*) is Federally listed as endangered (FWS 1994). It was known to occur in Alabama, Georgia, and Tennessee (FWS 2004c). It has been extirpated from most of its historic range because of pollution, siltation, and habitat modification or destruction. Many populations were lost when the Tennessee River and the lower reaches of its tributaries were impounded (FWS 1994). Only two populations of Anthony's riversnail are known to survive. The largest of these occurs in the Tennessee River in Jackson County, Alabama, and Marion County, Tennessee, a short distance downstream of Nickajack Dam. This population also extends a short distance into the lower sections of the Sequatchie River, Marion County, Tennessee. The other surviving population is restricted to a relatively short reach of lower Limestone Creek, Limestone County, Alabama (FWS 1997a). Limestone Creek is crossed three times by a BFN transmission line and is closely paralleled by the transmission line along two stream segments. However, the BFN transmission line does not cross or parallel the lower section of Limestone Creek where the snail is known to occur. Anthony's riversnail inhabits large rivers and the lower reaches of larger creeks, and occurs on cobble/boulder substrates in the vicinity of riffles. However, it does not always occur in strongly flowing sections (NatureServe 2004). At the two sites in Limestone Creek where Anthony's riversnail occurs, its density ranges up to several hundred individuals per square meter. However, Limestone Creek has been severely impacted in the past by heavy siltation and probably other sources of pollution (e.g., pesticide spraying and mining effluents). A single catastrophic pollution event could potentially destroy all populations of the snail in the creek (FWS 1994; NatureServe 2004). A recovery plan for the Anthony's riversnail has been prepared (FWS 1997a).

The slender campeloma (*Campeloma decampi*) is Federally listed as endangered (FWS 2000b). It is known to exist in only several isolated populations along Limestone, Piney, and Round Island Creeks in northern Alabama (NatureServe 2004). All three creeks are crossed by BFN transmission lines. The slender campeloma typically burrows in soft sediments or detritus. Impacts to the slender campeloma include siltation and other pollutants from poor land-use practices and waste discharges (FWS 2000b).

The armored snail (or armored marstonia) (*Pyrgulopsis pachyta*) is Federally listed as endangered (FWS 2000b). It is known to occur in Alabama from several isolated sites in Limestone and Piney Creeks near Mooresville, Alabama (NatureServe 2004). Piney Creek was formerly a tributary of Limestone Creek before the construction of Wheeler Reservoir (NatureServe 2004). Both creeks are crossed by a BFN transmission line; however, these crossings occur several miles upstream from Mooresville. The armored snail is found in shallow, still water along the edge of pools on tree roots and detritus. It probably also occurs on mud substrates (NatureServe 2004). Impacts to the armored snail include siltation and other pollutants from poor land-use practices and waste discharges (FWS 2000b).

The spectaclecase (*Cumberlandia monodonta*) is a candidate for Federal listing. Its historic range includes Alabama, Arkansas, Iowa, Indiana, Illinois, Kentucky, Missouri, Nebraska, Ohio, Tennessee, Virginia, and Wisconsin (FWS 2004a). It has been largely reduced to a relatively few disjunct sites. The spectaclecase at some of the sites may no longer be capable of reproduction due to loss of fish hosts or due to adverse environmental conditions (e.g., hypolimnetic releases from reservoirs) (NatureServe 2004). In Alabama, the spectaclecase is known in Limestone and Morgan Counties. The spectaclecase is usually found in areas with a strong current. In medium-size rivers, it prefers coarse substrates such as cobble, gravel, or cracks in bedrock. In large rivers, substrates used are typically finer and include sand or mud. It may be associated with shoals, bars, and islands (NatureServe 2004). The spectaclecase is often found in small clusters of the same-aged individuals. Other than burrowing deeper into the substrate, adults are essentially sessile (NatureServe 2004). Fish hosts for the spectaclecase are unknown (Schulz and Marbain 1998). Live specimens of the spectaclecase have been collected in the main stem of the Tennessee River in Colbert, Lauderdale, Limestone, and Morgan Counties as recently as 2000. Recent collections in the mainstream of the Tennessee River have been made in the tailwaters downstream of dams. Relic specimens (i.e., present only as weathered shells) were collected in the Elk River, Limestone County, Alabama in 1998 and 1974 (Butler 2002).

The Cumberlandian combshell (*Epioblasma brevidens*) is Federally listed as endangered, within its entire range (FWS 1997b), except where proposed for establishment as a nonessential experimental population in the free-flowing reach of the Tennessee River from the base of Wilson Dam downstream to the backwaters of Pickwick Reservoir (about 19 km [12 mi]) and the lower 8 km (5 mi) of all tributaries to this reach in Colbert and Lauderdale Counties, Alabama (FWS 2001). A draft recovery plan has been prepared for the species (FWS 2003). It is known to occur in Alabama, Kentucky, Tennessee and Virginia (FWS 2004d). The Cumberlandian combshell is now restricted to populations in limited areas of five drainages, and some of these may no longer be reproducing. The species was eliminated from much of its historic range by impoundments. Existing populations are in decline because of pollution (especially from mining activities), impoundments, and siltation (FWS 1997b). It was last collected from Muscle Shoals (the area now incorporated within the upper reaches of Pickwick Reservoir through Wilson Reservoir and into Wheeler Reservoir) in 1925 (Garner 1997). The Cumberlandian combshell is typically associated with riffle and shoal areas in medium and large rivers in substrates of coarse sand to cobble. It has been apparently eliminated from the mainstems of the Tennessee and Cumberland Rivers (FWS 2004e). In Alabama, moribund specimens were found in the late 1990s in Bear Creek, a tributary of the Tennessee River (NatureServe 2004). Fish hosts for the Cumberlandian combshell include darters and sculpins (Schulz and Marbain 1998). Critical habitat has been designated for the species within the Tennessee and Cumberland River Basins, including a portion of Bear Creek that flows through Colbert County, Alabama, and Tishomingo County, Mississippi (FWS 2004e). One of the BFN transmission lines crosses Bear Creek in Tishomingo County, Mississippi, within the reach of designated critical habitat.

The pink mucket (*Lampsilis abrupta*) is Federally listed as endangered (FWS 1976). It is known to occur in Alabama, Arkansas, Illinois, Indiana, Kentucky, Louisiana, Missouri, Ohio, Pennsylvania, Tennessee, Virginia, and West Virginia (FWS 2004f). It seems to be surviving and reproducing in sections of river that have been altered by impoundments. However, its range has diminished (e.g., extirpated from Ohio, Pennsylvania, and Illinois) (NatureServe 2004). Within Alabama, the pink mucket occurs in Colbert, Lauderdale, Limestone, Madison, Marshall, and Morgan Counties (NatureServe 2004). Suitable hosts for the glochidia of the pink mucket include freshwater drum (*Aplodinotus grunniens*), largemouth bass, smallmouth bass, spotted bass, sauger, and walleye (Fuller 1974; Barnhart et al. 1997). The pink mucket inhabits areas of large rivers with swift currents, at depths ranging from 0.5 to 8.0 m (1.6 to 26.2 ft) and a mixed sand/gravel/cobble substrate (Barclay 2004). Therefore, it is unlikely that the pink mucket exists in Wheeler Reservoir in the areas near or downstream from BFN. They are generally collected in the tailwater areas downstream from the Tennessee River drainage dams (Barclay 2004). Sixteen individual pink muckets were collected near Hobbs Island (more than 64 km [40 mi] upstream of BFN) in 1998 (Yokely 1998). Past and ongoing threats to the pink mucket include habitat loss and modification from dams and dredging, water-quality degradation, and commercial overharvesting (NatureServe 2004). The zebra mussel would also pose a threat to the pink mucket in areas where they co-exist.

The slabside pearlymussel (*Lexingtonia dolabelloides*) is a candidate for Federal listing. Its historic range includes Alabama, Kentucky, Tennessee, and Virginia (FWS 2004b). Most surviving individuals are restricted to two or three populations, and the long-term viability of all extant occurrences is questionable (NatureServe 2004). It historically occurred in the Cumberland River, although it is now extirpated from the entire Cumberland River system. The slabside pearlymussel was more prevalent in the Tennessee River system. Historically, it was fairly common from Muscle Shoals (the area now incorporated within the upper reaches of Pickwick Reservoir through Wilson Reservoir and into Wheeler Reservoir) to the Tennessee River headwater tributaries in Virginia and the Duck River drainage. It was last collected from Muscle Shoals in 1963 (Garner 1997). Remaining populations occur in a number of tributary streams of the Tennessee River system, but not in the main stem of the river (NatureServe 2004). Bear Creek is the only one of these streams that is crossed by a BFN transmission line. Fish hosts for the slabside pearlymussel include the smallmouth bass and, possibly, various minnow species (Schulz and Marbain 1998). Threats to the species include channel alterations, impoundments, siltation, pollution, commercial clamming, and gravel and coal mining (NatureServe 2004). It is generally found in areas of moderate to swift current velocities with substrates ranging from coarse sand to heterogeneous assemblages for larger-sized particles (NatureServe 2004).

The rough pigtoe (*Pleurobema plenum*) is Federally listed as endangered (FWS 1976). It is known to occur in Alabama, Indiana, Kentucky, Pennsylvania, Tennessee, and Virginia (FWS 2004g), and it has a wide, but very fragmented, distribution that includes Colbert, Lauderdale, Limestone, and Morgan Counties in Alabama. Within the Tennessee River, the rough pigtoe is currently present in an undetermined number of miles downstream of Pickwick, Wilson, and Guntersville Dams (NatureServe 2004). The rough pigtoe occurs in medium to large rivers in sand, gravel, and cobble substrates in shoals, although it is occasionally found on flats and muddy sand (NatureServe 2004). It does not occur in the impounded sections of rivers (FWIE 1996). Therefore, it is unlikely that the rough pigtoe exists in Wheeler Reservoir in the areas near or downstream from BFN. One individual was collected near Hobbs Island (more than 64 km [40 mi] upstream of BFN) in 1998 (Yokely 1998). Possible host fish for the rough pigtoe are bluegill and rosefin shiner (*Lythrurus ardens*) (Schulz and Marbain 1998). The long-term viability of most populations is in jeopardy, particularly for those in large rivers where zebra mussels are established (NatureServe 2004). Threats to the rough pigtoe include impoundments, channelization, dredging, industrial and residential discharges, siltation, herbicide and fertilizer runoff, zebra mussels, loss of glochidial hosts, and natural predators (NatureServe 2004).

The slackwater darter (*Etheostoma boschungi*) is Federally listed as threatened (FWS 1977a). Critical habitat was also designated for the species (FWS 1977a, b). It is known to occur in Alabama and Tennessee (FWS 2004h). The slackwater darter occupies the following five tributaries of the Tennessee River: Buffalo River and upper Shoal Creek in Lawrence County, Tennessee; the Flint River in Madison County, Alabama; Swan Creek in Limestone County, Alabama; and Cypress Creek in Lauderdale County, Alabama (NatureServe 2004). Swan Creek is crossed by one of the BFN transmission lines. Critical habitat for the slackwater darter includes many of the permanent and intermittent streams that are tributaries to Cypress Creek in Lauderdale County, Alabama, and Wayne County, Tennessee (FWS 1977b). None of these streams are located near BFN transmission lines. The slackwater darter typically occurs in gravel-bottomed pools and sluggish areas of creeks and small rivers that are not more than 12 m (39 ft) wide and 2 m (6.6 ft) deep. They often inhabit slow waters beneath undercut banks or accumulations of leaf litter or detritus. Spawning occurs in very shallow (5 to 10 cm [2 to 4 in.]) clear, flowing seepage water characterized by the presence of rushes and sedges in fields and open woods. Threats to the species include habitat loss and degradation. The heavy use of groundwater dries seepage areas used for spawning (NatureServe 2004).

The Alabama cave shrimp (*Palaemonias alabamae*) is Federally listed as endangered (FWS 1988). It is known only from two caves in Madison County, Alabama (NatureServe 2004). Habitat for the cave shrimp is silt-bottom pools in caves (FWS 1990b). Degradation of habitat and groundwater contamination are the major threats to this species (FWS 1990b).

- **State-Listed Species**

In addition to the 31 Federally listed mussel species, an additional 22 mussel species are State-listed within one or more of the counties of concern in Alabama and Mississippi (Table 2-2). As for the Federally listed mussel species, the State-listed species have been primarily impacted by impoundments. Some of the species listed for Mississippi have also been affected by habitat modifications created by the Tennessee-Tombigbee Waterway. The mussel species have also been variously impacted by water-quality degradation (e.g., siltation and chemical contamination). Continued declines in some of these species could be expected in the future, which may lead to their becoming Federally listed species. Several of the species may be listed in one state or the other due to natural constraints in distribution (e.g., a mussel species may be primarily associated with either the Mobile River or the Tennessee River system). For example, the pink heelsplitter is considered imperiled in Mississippi, but is considered a commercial species in Alabama (Ahlstedt and McDonough 1992).

Three Alabama-listed troglobitic crayfish (Alabama cave crayfish [*Cambarus jonesi*], White Spring Cave crayfish [*C. veitchorum*], and phantom cave crayfish [*Procambarus pecki*]) occur in the project area. The Alabama cave crayfish is endemic to Alabama. It is known to occur in caves between Florence and Guntersville, Alabama (NatureServe 2004). The White Spring Cave crayfish is endemic to White Spring Cave in Limestone County, Alabama. It has a very small population size and a low reproductive potential (NatureServe 2004). The phantom cave crayfish is known from only three cave locations in Colbert, Lauderdale, and Morgan Counties, Alabama (NatureServe 2004). Degradation of habitat and groundwater contamination are the major threats to these species (NatureServe 2004).

Two Mississippi-listed crayfish species occur within several of the counties of concern. The Tombigbee riverlet crayfish (*Hobbseus petilus*) is considered imperiled in Itawamba and Lee Counties, while the crayfish *Procambarus ablusus* is considered rare or uncommon in Tishomingo County (MMNS 2002). The imperiled status of the Tombigbee riverlet crayfish results from its restricted range and potential habitat impacts related to the Tennessee-Tombigbee Waterway. There are no existing threats to *P. ablusus* (NatureServe 2004). Its status in Mississippi is based more on Tishomingo County being at the edge of the species range. The species is considered to be apparently secure within Tennessee (NatureServe 2004).

The spring pygmy sunfish (*Elassoma alabamae*) is known in several spring systems in Alabama. Its status has improved as a result of introductions and discoveries of additional populations (NatureServe 2004). It is currently known to occur in Limestone County, Alabama, in the Beaverdam Moss Spring complex (most of Moss Spring and its spring run to Beaverdam Creek, the areas within Beaverdam Swamp, and Lowe's Ditch) and in the Pryor Springs system. It was extirpated from Cave Spring in Lauderdale County, Alabama, because of habitat inundation by Pickwick Reservoir (NatureServe 2004). In Beaverdam Creek, the range of the spring pygmy sunfish extends downstream to the impounded section of Wheeler Reservoir (Floyd 1999). The species has been negatively impacted by impoundments and water-quality degradation from poor land-use practices (e.g., crop-dusting, vegetation control, and agricultural practices). They are also vulnerable to wetland alterations and chemical spills (NatureServe 2004). The spring pygmy sunfish occurs in areas of clear water with fine sand or mud substrates and abundant and thickly matted vegetation along the shoreline. It apparently uses different spring and swamp microhabitats at different times of the year (NatureServe 2004). Spawning occurs in March and April. Adults spawn at one year of age and die within a few days to months after spawning. The eggs are attached to aquatic vegetation above the substrate (NatureServe 2004).

The Tuskaloosa darter (*Etheostoma douglasi*) has a small range, but occurs in a number of areas in the upper Black Warrior system (Locust Fork and Sipsey Fork systems) in Alabama. It is moderately threatened by timber practices and coal mining, siltation, and proposed reservoirs on Locust Fork (NatureServe 2004). A portion of the Sipsey Fork system occurs in the southern portion of Lawrence County that is not crossed by the BFN transmission lines.

Fewer than 15 populations of the Tuscumbia darter (*Etheostoma tuscumbia*) are known to occur in springs and spring runs along the Tennessee River in Alabama. It is extirpated from Tennessee (NatureServe 2004). Threats to the Tuscumbia darter include changes in the water table, siltation, predation, and loss of aquatic vegetation (NatureServe 2004). Structures such as low dams that are larger than 1.2- to 1.5-m (4- to 5-ft) high pose a barrier to dispersal. Warm summer temperatures in waters surrounding springs are also believed to preclude dispersal (NatureServe 2004). It feeds on invertebrates such as amphipods, snails, and midge larvae with reduced feeding in winter (NatureServe 2004).

The paddlefish (*Polyodon spathula*) is widespread in rivers in the eastern and central United States. While populations are faring well in some areas, they are declining or of unknown trend over much of the range. Threats to the species include habitat alteration (e.g., dams and impoundments), pollution, siltation, and overharvesting. States stock paddlefish to compensate for destruction or unavailability of spawning habitat (NatureServe 2004). While notable increases in paddlefish have been documented in portions of the Tennessee, Cumberland, and Arkansas Rivers, they have all but disappeared from the Tennessee River in Alabama (NatureServe 2004).

The southern cavefish (*Typhlichthys subterraneus*) has a discontinuous range in subterranean waters of Alabama, Arkansas, Georgia, Indiana, Kentucky, Missouri, and Tennessee. The species is apparently stable, but individual populations are vulnerable to habitat alteration and pollution of groundwater (NatureServe 2004).

In addition to the fish species already discussed, 27 other fish species (10 minnows, 10 darters, three suckers, two madtoms, one sculpin, and one lamprey) are listed as species of special concern within one or more of the Mississippi counties within which BFN transmission line rights-of-way occur (Table 2-2). However, no fish species are listed for Lee County, and only the spotfin shiner (*Cyprinella spiloptera*) and steelcolor shiner (*C. whipplei*) are listed for Union County. Both species, plus the other 25 fish species, occur in Itawamba and/or Tishomingo Counties where they occur in the Tennessee and/or the Tennessee-Tombigbee Waterway systems. The frecklebelly madtom (*Noturus munitus*) has a discontinuous distribution (Page and Burr 1991), and within the Tennessee drainage is only known from an upper tributary above Wheeler Reservoir. Twenty-five of the fish species are at the edge of their natural distribution and are more common elsewhere. Water pollution, sedimentation, or habitat loss, modification, or fragmentation could have a localized impact on some of these species. Similarly, siltation, pollution, or habitat fragmentation (e.g., between adult habitat and spawning streams) account for the rare or uncommon status of the chestnut lamprey (*Ichthyomyzon castaneus*) within Itawamba County, Mississippi.

The eastern hellbender (*Cryptobranchus alleganiensis alleganiensis*) ranges widely within the central interior portion of the eastern United States (NatureServe 2004). Northern Alabama and extreme northeastern Mississippi are at the southeastern edge of the eastern hellbender's range (NYSDEC 2003). Within Alabama, the eastern hellbender occurs in Colbert, Franklin, Lauderdale, Limestone, Madison, Marshall, and Morgan Counties (NatureServe 2004). It has been collected in Bear Creek in Tishomingo County in Mississippi and the Tennessee River, and may also occur in Cedar Creek in Mississippi (Mayasich et al. 2003). While the species is apparently secure, populations have declined or been eliminated in many areas due to impoundments, sedimentation, water pollution, overharvesting, and heavy recreational use of habitat (NatureServe 2004). Degradation of habitat is the principal threat to the eastern hellbender. As it primarily "breathes" through its skin, the eastern hellbender requires cool, well-oxygenated, flowing water (NatureServe 2004). The hellbender inhabits rocky, clear creeks and rivers that usually have large rock shelters. They tend to avoid temperatures greater than 20°C (68°F). Males prepare nests beneath large flat rocks or submerged logs, and attend to the eggs. Crayfish are the primary prey, but they also eat other invertebrates and fishes (often scavenged) (NatureServe 2004).

The Tennessee cave salamander (*Gyrinophilus palleucus*) has a small range in Alabama, Tennessee, and Georgia. Threats to the species include flooding of caves because of dams, pollution, siltation, mining, and dumping (NatureServe 2004).

2.2.6 Terrestrial Resources

BFN is located within the Highland Rim section of the Interior Low Plateau Physiographic Province on the north shore of Wheeler Reservoir in Limestone County, Alabama. Botanically, the project site occurs within the Mississippian Plateau section of the Western Mesophytic Forest Region (EPA 2004). In this region of northern Alabama, native forest communities generally consist of mixed oak forests of varying composition in relation to topography and soils. Historically, upland forests in the project area were characterized by mixtures of southern red oak (*Quercus falcata*), black oak (*Q. velutina*), post oak (*Q. stellata*), and white oak (*Q. alba*) with dogwood (*Cornus florida*) commonly present in the understory. The clearing of forested lands for agriculture has converted many of these forest communities to early successional habitats, allowing representative native plant communities to become replaced by introduced plant species.

The BFN site is a 340-ha (840-ac) tract situated in an area where the land is used primarily for agriculture. The countryside includes open pasture lands, scattered farmsteads, few residents, and little industry within several miles. The south and west side of the plant site abuts Wheeler Reservoir. The shoreline is approximately 3772 m (12,375 ft) with 58 percent stabilized with riprap; the remaining 42 percent of the shoreline of the site is partially eroded and is composed of mixed upland forest vegetation. The stabilized shoreline is adjacent to BFN and is primarily vegetated by young (approximately 4- to 5-year-old) black willow (*Salix nigra*), common hackberry (*Celtis occidentalis*), sumac (*Rhus* spp.), and exotic species such as Chinese privet (*Ligustrum sinense*), Japanese honeysuckle (*Lonicera japonica*), and trumpet creeper (*Campsis radicans*). The remainder of the shoreline is just west of the facility and is a young mixed upland forest scattered with a few large specimens (approximately more than 80 years old) of oak and loblolly pine (*Pinus taeda*). Young plants associated with the upland forest include black locust (*Robinia pseudoacacia*), sweetgum (*Liquidambar styraciflua*), sassafras (*Sassafras albidum*), cottonwood (*Populus* spp.), elm (*Ulmus* spp.), common hackberry, and black cherry (*Prunus serotina*). Common understory vegetation in the forested area includes Chinese privet, spleenwort (*Asplenium* spp.), Virginia creeper (*Parthenocissus quinquefolia*), and poison ivy (*Toxicodendron radicans*).

Invasive exotic plant species are an issue in the area. TVA has identified 19 high priority invasive plant species in the area (TVA 2003a) with a special emphasis on Chinese privet, Japanese honeysuckle, Japanese knotweed (*Polygonum cuspidatum*), and Nepal grass (*Microstegium vimineum*). There are approximately 10 ha (25 ac) and 5 ha (12 ac) of National Wetlands Inventory and U.S. Army Corps of Engineers-classified wetlands, respectively, occurring within the BFN site. This includes forested wetlands, emergent (marsh) wetlands, and scrub-shrub/emergent wetlands (based on 1980s aerial photography). The wetland ecological communities identified on the BFN site are dominated by plant species that are common in the region. These include black willow, buttonbush *(Cephalanthus occidentalis)*, sedges *(Carex lupulina, C. vulpinoidea, Rhyncospora corniculata)*, rushes (*Juncus* spp.), water hemlock *(Conium maculatum)*, and smartweeds *(Polygonum* spp.). These wetlands occur in areas that have been previously disturbed by clearing and agriculture, and parts that are currently maintained by periodic mowing. These types of wetlands are on land that was previously used or is currently being used for agriculture. The dominant vegetation species occurring within them are common in the region.

The vegetation communities described above are not unusual for the area and provide no uncommon forms of wildlife habitat. Animal species commonly associated with upland communities include white-tailed deer (*Odocoileus virginianus*), cottontail rabbit (*Syvilagus floridanus*), Virginia opossum (*Didelphis virginiana*), hispid cotton rat (*Sigmodon hispidus*), song sparrow (*Melospiza melodia*), eastern bluebird (*Sialia sialis*), northern mockingbird (*Mimus polyglottus*), turkey vulture (*Cathartes aura*), tufted titmouse (*Baeolophus bicolor*), American toad (*Bufo americanus*), spring peeper (*Pseudacis crucifer*), black racer (*Coluber constrictor constrictor*), and eastern box turtle (*Terrapene carolina*) (TVA 2003a). Riparian communities can support a unique assemblage of wildlife including muskrat (*Ondatra zibethicus*), beaver (*Castor canadensis*), raccoon *(Procyon lotor)*, wood duck (*Aix sponsa*), belted kingfisher (*Ceryle alcyon*), barred owl (*Strix varia*), American woodcock (*Scolopax minor*), Carolina wren (*Thryothorus ludovicianus*), prothonotary warbler (*Protonotaria citrea*), eastern phoebe (*Sayornis phoebe*), bullfrog (*Rana catesbeiana*), green frog (*Rana clamitans*), eastern newt (*Notophthalmus viridescens*), southern two-lined salamander (*Eurycea cirrigera*), common snapping turtle (*Chelydra serpentina serpentina*), and northern water snake (*Nerodia sipedon*) (TVA 2003a). Some waterholes along Wheeler Reservoir are used by American alligators (*Alligator mississippiensis*) in the winter. Invasive terrestrial animals that are expected to occur in the project vicinity include European starling (*Sturnus vulgaris*), house sparrow (*Passer domesticus*), and rock dove (*Columba livia*).

Two wildlife management areas – Swan Creek State Wildlife Management Area and Mallard-Fox Creek State Wildlife Management Area – are within 5 km (3 mi) of the BFN site (TVA 2003a). The Swan Creek Wildlife Management Area includes 1232 ha (3045 ac) of land and 2357 ha (5825 ac) of water surrounded by numerous industrial facilities. The Mallard-Fox Creek State Wildlife Management Area encompasses approximately 593 ha (1483 ac), and is primarily used for small game hunting. The Round Island Recreation Area is located approximately 5.6 km (3.5 mi) upstream of BFN. The BFN-to-Maury, Alabama, transmission line right-of-way crosses the Duck River State Wildlife Management Area, the Duck River Unit 1 Proposed Designated Critical Habitat, and Elk River and Richland Creek, both of which are listed on the Nationwide Rivers Inventory. The BFN-to-Union, Mississippi, transmission line right-of-way crosses the John Bell Williams State Wildlife Management Area, the Natchez Trace National Parkway, the Tennessee-Tombigbee Waterway, and the Foxtrap Creek Ravine Potential National Natural Landmark.

Terrestrial species listed by the FWS that have the potential to occur in the vicinity of the BFN site or along the transmission line rights-of-way are presented in Table 2-3. State-listed species (excluding Federally listed species) that have the potential to occur in the vicinity of the BFN site or along the transmission line rights-of-way are presented in Table 2-4 for Alabama (ANHP 2003) and Table 2-5 for Mississippi (MMNS 2002). A review of the TVA Regional Natural Heritage database indicates that no Federally or State-listed species of animals or plants have been reported from areas within 5 km (3 mi) of the BFN (TVA 2003a). BFN transmission line

Table 2-3. Federally Listed Terrestrial Species Reported from Counties Associated with the Browns Ferry Nuclear Power Plant, Units 1, 2, and 3 Site and Its Transmission Line Rights-of-Way

Scientific Name	Common Name	Federal Status[a]
Birds		
Haliaeetus leucocephalus	bald eagle	T
Picoides borealis	red-cockaded woodpecker	E
Mammals		
Myotis grisescens	gray bat	E
Myotis sodalis	Indiana bat	E
Plants		
Apios priceana	Price's potato bean	T
Asplenium scolopendrium var. *americanum*	American hart's-tongue fern	T
Dalea foliosa	leafy prairie clover	E
Helianthus eggertii	Eggert's sunflower	T
Leavenworthia crassa	fleshy-fruited gladecress	C
Lesquerella lyrata	lyrate bladder-pod	T
Xyris tennesseensis	Tennessee yellow-eyed grass	E

(a) E = endangered, T = Threatened, C = Candidate, (FWS 2004a).

Table 2-4. Alabama State-Listed Terrestrial Species Reported from the Vicinity of Browns Ferry Nuclear Power Plant, Units 1, 2, and 3 and Associated Transmission Line Rights-of-Way

Scientific Name	Common Name	State Status[a]
Insects		
Batrisodes jonesi	beetle	NOST
Batrisodes specus	beetle	NOST
Batrisodes tumoris	beetle	NOST
Batrisodes valentinei	beetle	NOST
Pseudanophthalmus distinguens	ground beetle	NOST
Pseudanophthalmus fluviatilis	cave beetle	NOST
Pseudanophthalmus lodingi	ground beetle	NOST
Pseudosinella hirsuta	springtail	NOST
Pseudosinella spinosa	cave springtail	NOST
Rhadine caudata	ground beetle	NOST
Arachnids		
Nesticus jonesi	cave spring cave spider	P
Amphibians		
Aneides aeneus	green salamander	P
Reptiles		
Eumeces authracinus pluvialis	southern coal skink	NOST
Lampropeltis triangulum syspila	red milk snake	NOST
Birds		
Accipiter cooperii	Cooper's hawk	P
Thryomanes bewickii bewickii	Bewick's wren	P
Mammals		
Corynorhinus rafinesquii	eastern big-eared bat	P
Myotis austroriparium	southeastern bat	P
Myotis septentrionalis	northern long-eared bat	NOST
Plants		
Acorus calamus	sweetflag	NOST
Aplectrum hyemale	puttyroot	NOST
Asplenium ruta-muraria	wall-rue spleenwort	NOST
Astragalus tennesseensis	Tennessee milk-vetch	NOST
Boykinia aconitifolia	brook saxifrage	NOST

Table 2-4. (contd)

Scientific Name	Common Name	State Status[a]
Bryoxiphium norvegicum	sword moss	NOST
Cotinus obovatus	American smoke-tree	NOST
Cuscuta harperi	Harper's dodder	NOST
Cypripedium candidum	white lady-slipper	NOST
Cystopteris tennesseensis	Tennessee bladderfern	NOST
Dalea gattingeri	Gattinger prairie-clover	NOST
Delphinium alabamicum	Alabama larkspur	NOST
Delphinium exaltatum	tall larkspur	NOST
Dicentra cucullaria	Dutchman's breeches	NOST
Dodecatheon frenchii	French's shootingstar	NOST
Elodea canadensis	waterweed	NOST
Enemion biternatum	false rue-anemone	NOST
Equisetum arevense	common horsetail	NOST
Eriogonum longifolium var. *harperi*	Harper's umbrella-plant	NOST
Erythronium albidum	white trout-lily	NOST
Frasera caroliniensis	American columbo	NOST
Huperzia lucidula	shining clubmoss	NOST
Huperzia porophila	rock clubmoss	NOST
Hydrastis canadensis	goldenseal	NOST
Hymenophyllum tayloriae	gorge filmy fern	NOST
Isoetes butleri	Butler's quillwort	NOST
Jamesianthus alabamensis	Alabama warbonnet	NOST
Leavenworthia alabamica	Alabama glade-cress	NOST
Leavenworthia uniflora	Michaux leavenworthia	NOST
Lesquerella densipila	Duck River bladderpod	NOST
Linum sulcatum var. *harperi*	Harper's grooved-yellow flax	NOST
Listera australis	southern twayblade	NOST
Mirabilis albida	pale umbrella-wort	NOST
Monotropsis odorata var. *odorata*	sweet pinesap	NOST
Neobeckia aquatica	lake-cress	NOST
Neviusia alabamensis	Alabama snow-wreath	NOST
Onosmodium molle ssp. *molle*	soft false gromwell	NOST
Ophioglossum engelmannii	limestone adder's tongue	NOST
Oxalis grandis	great yellow wood-sorrel	NOST

Table 2-4. (contd)

Scientific Name	**Common Name**	**State Status**[a]
Pachysandra procumbens	Allegheny-spurge	NOST
Pediomelum subacaule	tuberous scurfpea	NOST
Phlox pulchra	Wherry's phlox	NOST
Plantago cordata	heartleaved plantain	NOST
Platanthera lacera	ragged fringed orchid	NOST
Schoenolirion croceum	sunnybell	NOST
Selaginella arenicola ssp. *riddellii*	spikemoss	NOST
Selaginella rupestris	spikemoss	NOST
Sida elliottii	Elliot sida	NOST
Silene rotundifolia	roundleaf catchfly	NOST
Silphium brachiatum	Cumberland rosinweed	NOST
Spiranthes magnicamporum	Great Plains ladies'-tresses	NOST
Stewartia ovata	mountain camellia	NOST
Talinum calcaricum	limestone fameflower	NOST
Talinum mengesii	fameflower	NOST
Thalictrum debile	southern meadow-rue	NOST
Thalictrum mirabile	little mountain meadow-rue	NOST
Trichomanes petersii	dwarf filmy-fern	NOST
Trichostomum crispulum	moss	NOST
Trillium flexipes	nodding trillium	NOST
Trillium pusillum var. 1	interior least trillium	NOST
Trillium recurvatum	prairie trillium	NOST
Trillium sessile	sessile trillium	NOST
Triosteum angustifolium	horse-gentian	NOST
Viola egglestonii	Eggleston's violet	NOST

(a) Status rankings developed by Alabama Natural Heritage Program. P = protected, NOST = no official status, but species are tracked by the Alabama Natural Heritage Program due to rarity in the state (ADCNR 2003).

Table 2-5. Mississippi State-Listed Terrestrial Species Reported from the Vicinity of the Browns Ferry Nuclear Power Plant, Units 1, 2, and 3 and Associated Transmission Line Rights-of-Way

Scientific Name	Common Name	State Status[a]
Amphibians		
Aneides aeneus	green salamander	S1
Eurycea lucifuga	cave salamander	S1
Gyrinophilus porphyriticus	spring salamander	S1
Hemidactylium scutatum	four-toed salamander	S1
Pseudacris brachyphona	mountain chorus frog	S3
Pseudotriton ruber	red salamander	S3
Reptiles		
Lampropeltis calligaster rhombomaculata	mole kingsnake	S2
Lampropeltis getula nigra	black kingsnake	S3
Regina septemvittata	queen snake	S3
Insects		
Ellipsaria lineaolata	butterfly	S3
Birds		
Accipiter striatus	sharp-shinned hawk	S1
Aimophila aestivalis	Bachman's sparrow	S3
Petrochelidon pyrrhonota	cliff swallow	S3
Mammals		
Myotis septendrionalis	northern myotis	S3
Peromyscus ploionotus	oldfield mouse	S2S3
Plants		
Anemone quinquefolia	wood anemone	S1S2
Antennaria solitaria	single-headed pussytoes	S3
Aplectrum hyemale	puttyroot	S1
Aquilegia canadensis	wild columbine	S1S2
Arabis canadensis	sicklepod	S2S3
Asarum canadense	Canada wild-ginger	S2S3
Asplenium pinnatifidum	lobed spleenwort	S1
Asplenium resiliens	black-stem spleenwort	S1
Asplenium rhizophyllum	walking-fern spleenwort	S1S2
Asplenium trichomanes	maidenhair spleenwort	S1
Astragalus canadensis	rattle-vetch	S2

Table 2-5. (contd)

Scientific Name	Common Name	State Status[a]
Aster ericoides	white heath aster	S2
Athyrium thelypterioides	silvery spleenwort	S2S3
Cacalia muehlenbergii	great Indian-plantain	S1
Callirhoe triangulata	clustered poppy-mallow	S1S2
Camassia scilloides	wild hyacinth	S2S3
Carex jamesii	Nebraska sedge	S1S2
Carex oligocarpa	eastern few-fruit sedge	S1
Carex picta	painted sedge	S2S3
Carex prasina	drooping sedge	S1
Carex seorsa	separated sedge	S1S2
Carex stricta	uptight sedge	S2
Carex virescens	ribbed sedge	S1
Carya laciniosa	big shellbark hickory	S2S3
Carya leiodermis	swamp hickory	S2S3
Cheilanthes lanosa	hairy lipfern	S2
Chelone glabra	white turtlehead	S3
Chelone lyonii	pink turtlehead	S1
Chelone obliqua	red turtlehead	SH
Chimaphila maculata	spotted wintergreen	S2
Cimifuga racemosa	black bugbane	S1S2
Cladrastis kentukea	yellowwood	S2
Clematis beadlei	vase-vine leather-flower	S1
Coreopsis auriculata	lobed tickseed	S2S3
Cypripedium pubescens	yellow lady's-slipper	SU
Decodon verticillatus	hairy swamp loosestrife	S2S3
Delphinium tricorne	dwarf larkspur	S2
Dentaria diphylla	pepper-root	S1S2
Dentaria heterophylla	slender toothwort	S2S3
Dicentra cucullaria	Dutchman's breeches	S1
Dirca palustris	eastern leatherwood	S2
Dodecatheon meadia	shooting star	S2
Erythronium albidum	white dog's tooth violet	S2
Erythronium americanum	yellow dog's tooth violet	S1S2
Erythronium rostratum	beaked dog's tooth violet	S1S2
Euonymus atropurpureus	burning bush	S2S3
Fraxinus quadrangulata	blue ash	S2
Gynmocladus dioicus	Kentucky coffee-tree	S2
Heuchera villosa var. *macrorhiza*	giant alumroot	S1

Table 2-5. (contd)

Scientific Name	Common Name	State Status[a]
Hexalectris spicata	crested coralroot	S2
Hexastylis shuttleworthii	large-flowered heartleaf	S1
Hybanthus concolor	green violet	S2
Hydrophyllum appendiculatum	appendaged waterleaf	S1
Hydrophyllum macrophyllum	large-leaf waterleaf	S1
Ilex montana	mountain holly	S3
Isoetes engelmannii	Appalachian quillwort	S1S2
Juglans cinerea	white walnut	S2
Lesquerella gracilis	spreading bladder-pod	S2
Ligusticum canadense	nondo lovage	S1S2
Luzula acuminata	hairy woodrush	S3
Melanthium virginicum	Virginia bunchflower	S2S3
Mertensia virginica	Virginia bluebells	S1S2
Muhlenbergia tenuiflora	slender muhly	S1S2
Nemastylis geminiflora	prairie-iris	S2
Neviusia alabamensis	Alabama snow-wreath	S1
Osmorhiza longistylis	smoother sweet-cicely	S3
Pachysandra procumbens	Allegheny-spurge	S3
Panax quinquefolius	American ginseng	S3
Pellaea atropurpurea	purple-stem cliff-brake	S1S2
Penstemon tenuiflorus	narrow flowered beard tongue	S2S3
Perideridia americana	eastern eulophus	S1S2
Phacelia bipinnatifida	fernleaf phacelia	S1
Philadelphus hirsutus	hairy mock-orange	S1
Pinus virginiana	Virginia pine	S2
Platanthera cristata	crested fringed orchid	S3
Platanthera integrilabia	white fringeless orchid	S1
Platanthera lacera	ragged fringed orchid	S1S2
Platanthera peramoena	purple fringeless orchid	S2S3
Polemonium reptans	Jacob's ladder	S2S3
Rhamnus lanceolata	lance-leaved buckthorn	S2
Rhododendron arborescens	smooth azalea	S1
Sabatia campestris	prairie pink	S2S3
Salvia urticifolia	nettle-leaf sage	S2S3
Sedum ternatum	wood stonecrop	S2
Solidago flaccidifolia	Appalachian goldenrod	S1S2
Solidago sphacelata	false goldenrod	S1S2
Spiraea tomentosa	hardhack spiraea	SH

Table 2-5. (contd)

Scientific Name	Common Name	State Status[a]
Spiranthes ovalis	lesser ladies-tresses	S2S3
Staphylea trifolia	American bladdernut	S3
Stellaria pubera	giant chickweed	S2S3
Stewartia ovata	mountain camellia	S1
Swertia caroliniensis	American colombo	S2S3
Tiarella cordifolia	heart-leaved foam-flower	S2
Tomanthera auriculata	earleaf false-foxglove	S1
Tradescantia ernestiana	Palmer's spiderwort	S1
Trautvetteria caroliniensis	Carolina tassel-rue	S1
Trichomanes boschianum	bristle-fern	S1
Trillium flexipes	drooping trillium	S1
Triosteum angustifolium	narrow-leaf fever root	S3
Triphora trianthophora	three birds orchid	S2S3
Viola pubescens var. *eriocarpon*	smooth yellow violet	S1S2

(a) Status rankings developed by the Natural Heritage Inventory; S1 = critically imperiled because of extreme rarity; S2 = Imperiled because of rarity; S3 = rare or uncommon; SH = historically extant; SU = status uncertain (MMNS 2002; MNHP 2002).

rights-of-way pass through Limestone, Morgan, Lawrence, Colbert, and Franklin Counties in Alabama and Tishomingo, Itawamba, Lee, and Union Counties in Mississippi.[a] Eleven Federally listed terrestrial species have been reported from these counties. There are 89 species listed for the State of Alabama and 116 species listed for Mississippi.[a]

The threatened bald eagle (*Haliaeetus leucocephalus*) has been reported in Franklin County, Alabama, and Itawamba and Tishomingo Counties, Mississippi. Bald eagles prefer habitat along coastlines, lakes, rivers, and other water bodies that provide their primary food source (i.e., fish and waterfowl) (NatureServe 2004). Eagles generally nest in tall trees or cliff faces near water and away from human disturbance. Bald eagles are known in the area around BFN, but there are no known nests within 5 km (3 mi) of the site. BFN transmission line rights-of-way are likely to be within foraging areas for this species.

The endangered red-cockaded woodpecker (*Picoides borealis*) has been reported in Lawrence County, Alabama. Red-cockaded woodpeckers inhabit older open pine forests, (generally at least 80 to 120 years old) (FWS 2004d). Hardwood forests or pine forests with a hardwood

(a) Prentiss County, Mississippi is not included. Species are accounted for in adjacent counties.

understory are usually avoided. There is no woodpecker habitat within 5 km (3 mi) of the BFN site, and it is unlikely that there is any suitable habitat along the BFN transmission line rights-of-way.

Gray bats (*Myotis grisescens*) are listed by the FWS as endangered and have been found in Colbert, Franklin, Lawrence, Limestone, and Morgan Counties, Alabama, and Tishomingo County, Mississippi. Gray bats are colonial and are restricted to cave or cave-like habitats (FWS 2004d). Gray bats roost and females form maternity colonies in caves located along rivers and reservoirs over which they feed. In the winter, gray bats congregate and hibernate in a limited number of caves across the southeast (FWS 2004d, i). Roosting and foraging habitat for gray bats is very limited on the BFN site. Water sources for the bats include lagoons, sedimentation ponds, and drainage canals. Although no suitable habitats for these species occur on the BFN site, gray bats likely forage along the Tennessee River, adjacent to the site. BFN transmission line rights-of-way are also likely to be within foraging areas for this species.

The endangered Indiana bat (*Myotis sodalis*) has been reported from Colbert, Lawrence, Limestone, and Morgan Counties, Alabama and Tishomingo County, Mississippi. Indiana bats are highly colonial and hibernate in caves during winter months but can be found in hollow trees and under loose tree bark during the summer, where they form small maternity colonies (FWS 2004d). Indiana bats forage for insects primarily in riparian and upland forests. Roosting and foraging habitat for Indiana bats is very limited on the BFN site. Water sources for the bats include lagoons, sedimentation ponds, drainage canals, and forested habitats are primarily small woodlots of poor quality. BFN transmission line rights-of-way are also likely to be within foraging areas for this species.

Price's potato bean (*Apios priceana*) is listed as threatened by the FWS and has been found in Lee County, Mississippi. This species is found in open mixed hardwood forests often on floodplains in or near riparian areas (NatureServe 2004). Although thought to be somewhat dependent on disturbances that maintain an early succession environment, it is also reported to be sensitive to some management activities such as logging, cattle grazing, and highway right-of-way maintenance. No populations of Price's potato bean are known to exist within 5 km (3 mi) of the BFN site, but suitable habitat could be found along the BFN transmission line rights-of-way.

American hart's-tongue fern (*Asplenium scolopendrium* var. *americanum*) is listed as threatened by the FWS and is known to occur in Morgan County, Alabama (FWS 2004d). In Alabama, this fern is found only around the openings to limestone caves and sinkholes. No populations have been recorded within 5 km (3 mi) of the BFN site; no suitable habitat has been found along the BFN transmission line rights-of-way.

Leafy prairie clover (*Dalea foliosa*) is listed as endangered by the FWS and is known to occur in Franklin, Lawrence, and Morgan Counties, Alabama (FWS 2004d). This species is found in association with cedar glades in northern Alabama and central Tennessee. No populations of leafy prairie clover are known to occur from within 5 km (3 mi) of the BFN site, and no suitable habitat could be found along the BFN transmission line rights-of-way.

Eggert's sunflower (*Helianthus eggertii*) is listed as threatened by the FWS and has been found in Colbert, Franklin, Lawrence, Limestone, and Morgan Counties, Alabama. This species is found in barren habitats within the Interior Plateau Ecoregion of Kentucky, Tennessee, and Alabama (NatureServe 2004). No populations are recorded within 5 km (3 mi) of the BFN site. Populations may occur along the BFN transmission line rights-of-way because the species is reported to respond favorably to management activities such as burning and mowing (NatureServe 2004).

Fleshy-fruited gladecress (*Leavenworthia crassa*) is a candidate species that has been found in Lawrence and Morgan Counties, Alabama. Reportedly endemic to Lawrence and Morgan Counties, this species inhabits limestone glades and has been identified in only six sites (NatureServe 2004). No populations have been recorded within 5 km (3 mi) of the BFN site, but suitable habitat could be found along the BFN transmission line rights-of-way.

The threatened lyrate bladder-pod (*Lesquerella lyrata*) has been reported in Colbert, Franklin, and Lawrence Counties, Alabama. The species in known in only two populations in Franklin and Colbert Counties (FWS 2004d). The plant is an annual in the mustard family and is found in disturbed glade habitats. No populations exist within 5 km (3 mi) of the BFN site, but suitable habitat could be found along the BFN transmission line rights-of-way.

The endangered Tennessee yellow-eyed grass (*Xyris tennesseensis*) is found in Franklin County, Alabama. This species is found in moist-to-wet, limestone-derived soils in open or lightly wooded sites (FWS 2004d). No populations are known to exist within 5 km (3 mi) of the BFN site, but suitable habitat could be found along the BFN transmission line rights-of-way.

2.2.7 Radiological Impacts

TVA has conducted a radiological environmental monitoring program (REMP) in the vicinity of BFN since 1968. Through this program, radiological impacts to workers, the public, and the environment are monitored, documented, and compared to the appropriate standards. The objectives of the REMP are described below:

- Provide representative measurements of radiation and radioactive materials in the exposure pathways and of the radionuclides that have the highest potential for radiation exposures to members of the public.

- Supplement the radiological effluent monitoring program by verifying that the measurable concentrations of radioactive materials and levels of radiation are not higher than expected on the basis of the effluent measurements and the modeling of the environmental exposure pathways.

Results of measurements of radiological releases and environmental monitoring are summarized in annual reports (TVA 2004c, g). The limits for all radiological releases are specified in the Browns Ferry ODCM, and these limits are designed to meet Federal standards and requirements (TVA 2004c). The REMP includes monitoring of the aquatic environment (fish and shoreline sediment), the atmospheric environment (airborne radioiodine, gross beta, and gamma), the terrestrial environment (crops, soil, milk), and direct radiation (TVA 2004g).

Review of historical data on releases and the resultant dose calculations indicated that the doses to maximally exposed individuals in the vicinity of the BFN site were a small fraction of the limits specified in EPA's environmental radiation standards 40 CFR Part 190 as required by 10 CFR 20.1301(d). Dose estimates are calculated for a hypothetical maximally exposed individual, based on monitored liquid and gaseous effluent release data, onsite meteorological data, local river flow data, and appropriate pathways identified in the ODCM (TVA 2004c).

The dose from all pathways during the period from 1999 to 2003 to a maximally exposed individual was less than 0.0035 mSv (0.35 mrem)/yr to the whole body or any organ other than the thyroid. To calculate the dose to the maximally exposed individual, the calculated doses from the liquid and gaseous effluent exposure pathways are summed. For the liquid effluent pathway the whole body dose was calculated to be less than 0.0013 mSv (0.13 mrem) per year. The liquid exposure pathways included drinking water, fish ingestion, and direct radiation from shoreline sediment during recreation such as boating. For the gaseous effluent pathways, the whole body dose was calculated to be less than 0.0022 mSv (0.22 mrem) per year; the gaseous exposure pathways included inhalation, ingestion of milk and crops, and direct radiation from the airborne radioactive material. The thyroid dose from all pathways was less than 0.0096 mSv (0.96 mrem)/yr (TVA 2000, 2001, 2002b, 2003c, 2004c).

These doses are typical of the annual dose for operation of BFN, Units 2 and 3 without the power uprates. As discussed earlier, operation at the combined total power level of 11,856 MW(t) during the license renewal term could increase doses by as much as a factor of 1.8 over these typical values. Historically, doses to members of the public from BFN are well below NRC and EPA limits and would continue to be well below NRC and EPA limits during operation at the combined total power level of 11,856 MW(t) during the license renewal term.

2.2.8 Socioeconomic Factors

The staff reviewed the TVA ER and information obtained from several county, city, and economic development staff during a site visit to Limestone and Morgan counties in the spring 2004. The following information describes the economy, population, and communities near BFN.

2.2.8.1 Housing

BFN employs approximately 1000 people on a full-time basis, with an additional 2475 contract employees who are primarily working on the restart of Unit 1 (TVA 2004h). About 300 contract employees who are not affiliated with the restart of Unit 1 support the non-outage operations at Units 2 and 3. Approximately 26 percent of these employees (both plant and contract) live in Lauderdale County, while an additional 21 percent live in Limestone County, 16 percent live in Madison County, and 14 percent live in Morgan County, with the remainder living in other locations (see Table 2-6). Although the employee residences are widely dispersed, the socioeconomic analysis primarily focuses on Lauderdale, Limestone, Madison, and Morgan Counties, because more than 75 percent of the BFN employees live in these counties, and Limestone County is where BFN is located (TVA 2004h).

There are presently more than 2000 temporary workers onsite who are working on the restart of Unit 1. In addition, the units are on a schedule to refuel in alternate years. During refueling, the number of employees increases by as many as 900 temporary workers for a period of 30 to 40 days. Most of the temporary employees appear to primarily reside in surrounding counties and commute to the plant rather than make use of temporary rental housing available in Limestone County (TVA 2003a). Local real estate agents in Athens also confirmed this trend despite the recent increase in employment at the plant, resulting from Unit 1 restart activities. The local real estate market has remained relatively unaffected and rental rates have not significantly increased.[a]

(a) Personal communication (discussion) with L. McBay and L. Smith, Century 21 Realtors, Athens, Alabama (March 31, 2004).

Table 2-6. Residence by County for Browns Ferry Nuclear Power Plant, Units 1, 2, and 3 Tennessee Valley Authority and Contract Employees

County	Tennessee Valley Authority Employees		Contract Employees		Total (Employees and Contractors)	
Colbert	71	6.9%	261	10.5%	332	9.5%
Cullman	4	0.4%	13	0.5%	17	0.5%
Franklin	13	1.3%	68	2.7%	81	2.3%
Giles, TN	5	0.5%	4	0.2%	9	0.3%
Jackson	11	1.1%	32	1.3%	43	1.2%
Lauderdale	306	29.6%	617	24.9%	923	26.3%
Lawrence, AL	18	1.8%	94	3.8%	112	3.2%
Lawrence, TN	21	2.0%	60	2.4%	81	2.3%
Limestone	251	24.3%	496	20.0%	747	21.3%
Madison	137	13.2%	419	16.9%	556	15.8%
Marshall, AL	8	0.8%	13	0.5%	21	0.6%
Morgan	172	16.6%	312	12.6%	484	13.8%
Wayne	0	0.0%	23	0.9%	23	0.7%
Other	18	1.7%	63	2.5%	81	2.3%
Total	1035		2475		3510	

Source: TVA 2004h.

Table 2-7 provides the number of housing units and housing unit vacancies for Lauderdale, Limestone, Madison, and Morgan counties for 1990 and 2000. Limestone County, where BFN is located, had 26,897 housing units in 2000, with a vacancy rate around 8 percent. Lauderdale County, in which the greatest number of TVA plant and contract employees reside, had 40,424 housing units and a vacancy rate of just over 10 percent. Madison and Morgan Counties, both of which have a larger population base and a relatively more diverse employment market, had vacancy rates in 2000 of 9 and 8 percent, respectively (USCB 2000). These counties are not subject to restrictive growth control measures that limit housing development (TVA 2003a).

Table 2-8 contains data on population, estimated population, and annual population growth rates for Lauderdale, Limestone, Madison, and Morgan Counties. All counties experienced positive population growth in the 1990s, with Limestone County's rate of increase exceeding 20 percent (TVA 2003a).

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

	1990	2000	% Increase
	LAUDERDALE COUNTY		
Housing Units	33,522	40,424	21%
Occupied Units	30,905	36,088	17%
Vacant Units	2,617	4,336	66%
	LIMESTONE COUNTY		
Housing Units	21,455	26,897	25%
Occupied Units	19,685	24,688	25%
Vacant Units	1,770	2,209	25%
	MADISON COUNTY		
Housing Units	97,855	120,288	23%
Occupied Units	91,208	109,955	21%
Vacant Units	6,647	10,333	55%
	MORGAN COUNTY		
Housing Units	40,419	47,388	17%
Occupied Units	37,799	43,602	15%
Vacant Units	2,620	3,786	45%

Sources: U.S. Census Bureau (USCB) 2000, 1990.

Table 2-8. Population Growth in Lauderdale, Limestone, Madison and Morgan Counties, Alabama – 1980 to 2025

	Lauderdale County		Limestone County		Madison County		Morgan County	
	Population	% Change	Population	% Change	Population	% Change	Population	% Change
1980	80,546	--	46,005	--	196,966	--	90,231	--
1990	79,661	(-1.1)	54,135	17.7	238,912	21.3	100,043	10.9
2000	87,966	10.4	65,676	21.3	276,700	15.8	111,064	11.0
2015	98,015*	11.4	81,747*	24.5	324,153*	17.1	124,358*	12.0
2025	103,176*	5.3	90,865*	11.2	349,713*	7.9	131,112*	5.4

-- = No data available.
* population estimated
Sources: TVA 2003a.

2.2.8.2 Public Services

Public services include water supply, education, and transportation.

- **Water Supply**

The City of Athens Water Services and the Limestone County Water Authority are the primary sources of potable water in Limestone County. The City of Athens Water Services draws water from the Elk River and currently has a Safe Yield from the River of 21.3 x 10^4 m^3/day (56 MGD) (TVA 2004i). Limestone County Water Authority draws water from the Elk River and four wells. Both of these water systems operate with excess capacity, and currently meet water demands for Unit 1 restart activities and normal BFN operations. As shown in Table 2-9, the average total daily water demand on the City of Athens system is about 2.5 x 10^4 m^3/day (6.5 MGD), which is less than half the permitted capacity of 5.1 x 10^4 m^3/day (13.5 MGD). Athens City Water Services has plans to upgrade its intake structure to accommodate an increased intake rate of 6.8 x 10^4 m^3/day (18 MGD) to ensure supply reliability. This system upgrade is scheduled for implementation during 2004. BFN typically uses 500 to 1000 m^3/day (0.13 to 0.26 MGD).

Table 2-9. Public Water Supply Systems in Limestone County, Alabama

Water System	Source	Permitted Capacity m^3/d (MGD)	Average Daily Demand m^3/d (MGD)	Peak Demand Per Day m^3/d (MGD)	Area Served
City of Athens Water Services	Elk River and wells	5.1 x 10^4 (13.5)	2.5 x 10^4 (6.5)	4.1 x 10^4 (10.7)	City of Athens/ Limestone County
Limestone County Water Authority	Elk River and wells	3.0 x 10^4 (8)	2.4 x 10^5 (6.25)	2.6 x 10^4 (6.75)	Limestone County

Source: TVA 2003a, 2004i

- **Transportation**

The BFN site is approximately 16 km (10 mi) southwest of Athens in northern Alabama in Limestone County and is located just south of U.S. Highway 72, which runs from South Pittsburg, Tennessee, west to Memphis, Tennessee. The site is directly accessible from County Road 25 (Shaw Road), which intersects U.S. Highway 72 approximately 10 km (6 mi) north of the site. County Road 25 (Nuclear Plant Road) also intersects U.S. Highway 31 approximately 14 km (9 mi) east of the site. U.S. Highway 31 intersects U.S. Highway 72 northeast of the site. Browns Ferry Road to County Road 25 just east of the site provides a more direct route to the site from Athens. U.S. Highways 72 and 31 are both high-quality, four-lane roads with adequate lane widths, alignments, turning lanes, and speed limits of 80 km/hr (50 mph) through Athens and increasing away from the city.

County Road 25 and Browns Ferry Road are medium-quality, two-lane roads with level alignment, some passing zones, and a speed limit of 72 km/hr (45 mph). There is direct accessibility to BFN off County Road 25. The large diamond intersection at one entrance allows for smooth turning movements into and out of the BFN site. Another access road into the plant commonly used by contractors uses a traffic light at the intersection with Nuclear Plant Road. BFN, which is the primary traffic generator in the vicinity of the site, currently averages a daily site non-outage population of approximately 3600 persons; of this total, 1300 is for the total Unit 2 and 3 operating workforce, and 2300 is for Unit 1 recovery. The operational population currently peaks at approximately 2200 persons during outages, which occur every 24 months (per unit) for approximately 2 months. Current truck deliveries are minimal (less than 10 per week) and include hydrogen delivery trucks, Calgon™ water chemistry trucks, and occasional diesel fuel deliveries during peak months. Rural residences located along the county roads that provide access to the site are also sources of traffic in the area (TVA 2003a).

Figure 2-5 shows a map of the local road network for the area. The latest available (1998) average daily traffic counts in proximity to the site indicate approximately 13,440 vehicles per day on U.S. Highway 72 north of the site and 16,260 vehicles per day on U.S. Highway 31 south of U.S. Highway 72. There are no available traffic counts on the county roads; however, TVA estimates approximately 1600 vehicles per day on Shaw Road, Browns Ferry Road, and Nuclear Plant Road.

BFN does not have direct rail service; however, a railway spur track with an unloading area is located off the CSX (Louisville and Nashville Railroad) mainline that runs north and south in Tanner, Alabama, approximately 13 km (8 mi) east of BFN. TVA leased this small parcel of land from CSX and used it for offloading during construction of BFN; however, TVA has not used the spur and unloading area for offloading and transporting materials to the plant since then. After offloading, heavy items were transported on heavy trucks via a "hardened" pathway to the site. This pathway included shallow fords through creek beds along the way. At the site, a short railroad spur runs into the turbine building for transport into the plant (TVA 2003a). The railroad spur track and unloading area may be used for future removal of dry cask spent fuel storage canisters from the site. There are no plans to use it for Unit 1 restart activities or regular plant operations.

Traffic on the Tennessee River near BFN includes both commercial and recreational vessels. The river channels and the locks at Guntersville Lock and Dam and at Wheeler Dam are more than adequate for handling river traffic. Both Guntersville Lock and Wheeler Lock are operating below their utilization capacity (TVA 2003a).

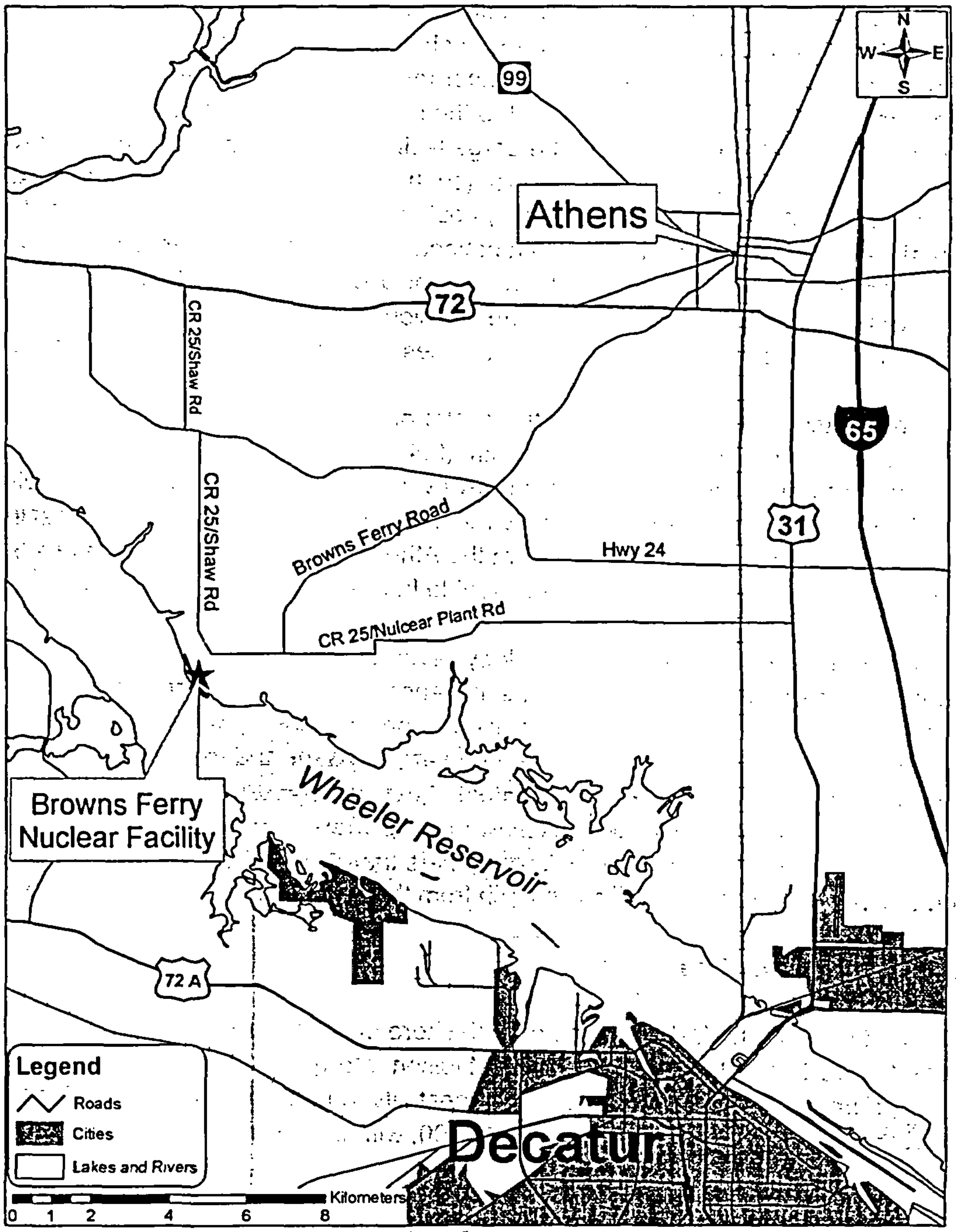

Figure 2-5. Local Road Network for Browns Ferry Nuclear Power Plant, Units 1, 2, and 3

BFN has a qualified barge facility near the northwest corner of the site. Currently it consists of barge tie points and a wide ramp going down into the water. The ramp was used during initial plant construction to transport very heavy loads such as reactor vessels. The barge facility is currently used several times per year, but a temporary crane has to be brought in to unload the barge each time. The roadbed from the plant to the barge facility is "hardened" for heavy loads. Future work is contemplated to upgrade the barge facility by stabilizing the riverbank and installing anchoring cells and a permanent dock (so that the facility will no longer require use of a temporary crane). An upgraded barge facility could eventually be used to facilitate transport of spent fuel canisters offsite for disposal in a national repository. The barge facility would likely be used for some heavy items during Unit 1 restart; however, its use for this purpose and the proposed facility upgrade is independent of the decision to restart Unit 1. Appropriate environmental analyses would be done if TVA decides to propose upgrading the barge facility.

Three pipelines pass within 8 km (5 mi) of the center of the BFN plant site. One pipeline that carries xylene runs north and south about 3.9 km (2.4 mi) east of the plant. The other two pipelines carry natural gas in a common right-of-way about 6.1 km (3.8 mi) south-southwest of the plant. The natural gas pipelines generally run east-west. The only pipeline crossing the BFN site boundary is a potable water line from the Athens Water District. There are no plans to install or connect to any pipelines in the foreseeable future.

BFN is connected to the TVA system network by seven 500-kV lines: one line to Madison substation; two lines to Trinity substation; one line each to the West Point, Maury, and Union substations; and one line to Limestone substation. Normal station power is from the unit station service transformers connected between the generator breaker and main transformer of each unit. Startup power is from the TVA 500-kV system network through the 500-kV to 20.7-kV main and 20.7 kV to 4.16-kV unit station service transformers. Auxiliary power is available through the two common station service transformers that are fed from two 161-kV lines supplying the 161-kV switchyard, one line each from the Athens and Trinity substations.

2.2.8.3 Offsite Land Use

BFN is located in northern Alabama on the north shore of Wheeler Reservoir in an unincorporated portion of Limestone County. Madison, Morgan, Lawrence, and Lauderdale Counties also are in the vicinity of BFN. The largest city in Limestone County is Athens, and the population in the county is approximately 67,000, with approximately 19,000 residing in Athens.

BFN is located in an agricultural area, surrounded by cropland principally planted with cotton. Limestone County is ranked first in Alabama for the most cotton grown. About 89,000 ha (220,000 ac) or 66.8 percent of the total acreage in Limestone County is used for agriculture (TVA 2003a). In addition, there are approximately 31,930 ha (78,900 ac) of forested land in the county, constituting approximately 23.9 percent of total county acreage. The majority of the forested land is located in the northern two-thirds of the county. Trends show that the amount of forested land has been declining since the early 1960s (TVA 2003a). The amount of land devoted to agriculture has been gradually increasing.

Only about 2 percent of Limestone County is urban development; however, the current trend in population growth will likely result in more land becoming urbanized (TVA 2003a). Population in Limestone County has been gradually increasing because of increased employment opportunities in the county as well as in nearby Huntsville and Decatur. It is expected that the majority of residential growth will occur around Athens and in the Elkmont Village area (TVA 2003a). Development of commercial property is rapidly occurring in the area of the intersection of U.S. Highway 72 and Interstate 65 and along the U.S. Highway 72 corridor to Huntsville.

2.2.8.4 Visual Aesthetics and Noise

- **Visual Aesthetics**

BFN is situated in an area where the land is used primarily for agriculture. Population densities are low, with no population centers of significance within 16 km (10 mi) of the plant. The site is surrounded to the north and east by rural countryside. It includes open pasture lands, scattered farmsteads, few residents, and little industry within several miles. The terrain is gently rolling with open views to higher elevations to the north. The south and west sides of the plant abut Wheeler Reservoir, which is a wide expanse of open river used for an array of recreational purposes. The reservoir in the vicinity of BFN is moderately used by recreational boaters and fishermen (TVA 2003a).

There are no homes within foreground viewing distance to the north and east. Adjacent to the site however, is a small residential development located to the northwest. Another residential development is located across Wheeler Reservoir to the southwest, and the Mallard Creek public use area is directly across the reservoir. These developments have at least partial views of the plant site. A berm, graded during the initial construction of the plant and containing approximately 2.5 million m^3 (3.3 million yd^3) of earth excavated to make cooling water channels, lies adjacent to the cooling tower complex and blocks views of the northern and eastern plant area (TVA 2003a).

Two wildlife management areas – Swan Creek State Wildlife Management Area and Mallard-Fox Creek State Wildlife Management Area – are within 5 km (3 mi) of the BFN site (TVA 2003a). The Swan Creek Wildlife Management Area includes 1232 ha (3045 ac) of land and 2357 ha (5825 ac) of water surrounded by numerous industrial facilities. The Mallard-Fox

Creek State Wildlife Management Area encompasses approximately 593 ha (1483 ac), and is primarily used for waterfowl and small game hunting. The Round Island Recreation Area is located approximately 5.6 km (3.5 mi) upstream of BFN (TVA 2003a).

- **Noise**

Several communities near BFN are exposed to noise from plant operations. The two areas considered to be most susceptible are the Paradise Shores and the Lakeview communities. Paradise Shores is located downstream and adjacent to the BFN site, while Lakeview is located across the river and about 2591 m (8500 ft) from the center of the cooling tower area (TVA 2002a). Upstream and adjacent to the site are two new subdivisions of waterfront homes, Pointe Westmoreland and Lookingbill. Given the distance and buildings and terrain features between BFN and its cooling tower area, Pointe Westmoreland and Lookingbill are not considered to be sensitive to the current noise environment. Given the growth that has occurred around BFN since it first became operational, the initial background noise estimates for both the Paradise Shores and Lakeview communities were not considered representative of present-day conditions.

In June 2001, TVA conducted a new background noise survey (TVA 2002a). For the Paradise Shores community, the 15-hour daytime (7:00 a.m. to 10:00 p.m.) average noise value was 45.7 decibels, while the nighttime (10:00 p.m. to 7:00 a.m.) average was 43.1 decibels. Similar data for the Lakeview community for the same time periods was 44.1 and 38.7 decibels. The predominant noise sources were traffic, lawn mowers, home air-conditioners, and children's activities. At night, insects, frogs, air-conditioners, and traffic were the dominating noises (TVA 2002a). Lakeview has posted traffic restrictions that reduced traffic, thus reducing the recorded background noise values.

In July 2001, a daytime noise survey was conducted while the three cooling towers closest to Paradise Shores were operating. Measurements taken at the same locations used for the background noise survey indicated a total noise level of 45.8 decibels, while the calculated total noise level value for this location was 46.4 decibels, based on noise measurements taken from another location closer to the cooling towers. If the other two operating cooling towers were used, the estimated background noise level would increase by less than 1 decibel. For six cooling towers (assumes the replacement and operation of the sixth cooling tower), the additional total noise level would be 1 to 2 decibels greater than the levels measured during the July 2001 survey. On the day of the testing, noise from the existing five operating cooling towers was not detected in the Lakeview community.

for acceptable noise level for residential areas before noise reduction measures would be considered (TVA 2002a). While the measured noise levels obtained both for the background and during operation of the five cooling towers were discrete measurements, that information can be used to calculate the average annual day/night level. TVA estimated these values to be 50 decibels for Paradise Shores and 46 decibels for Lakeview (TVA 2002a). Therefore, the current estimated noise levels for both communities is below the recommended EPA level. However, this does not preclude the potential for annoyance and complaints from some members of either the Paradise Shores or Lakeview communities because of disturbances of communication, relaxation, and concentration.

2.2.8.5 Demography

- **Resident Population Within 80 km (50 mi)**

Population within 80 km (50 mi) of BFN was estimated (TVA 2003a). An estimated 164,936 people live within 32 km (20 mi) of BFN, and 872,478 live within 80 km (50 mi) (TVA 2003a). The largest population centers within a portion of the 16-km (10-mi) radius are Athens (located in Limestone County with a population 18,967) and Decatur (located in Morgan County with a population of 53,929) (USCB 2000).

Between 1990 and 2000, the population of Lauderdale County grew by 10 percent, Limestone County population grew by 21 percent, Madison County grew by 16 percent, and Morgan County grew by 11 percent. All the population growth of these counties, which surround the plant, were equal to or greater than the growth of the State of Alabama between these same years (10 percent). As a group, these four counties have been growing faster than the State of Alabama. Projections indicate that the growth rate in all four of these counties will exceed 10 percent between 2000 and 2015. The fastest growth, however, is limited to Limestone and Madison counties, which constitute the Huntsville metropolitan area (TVA 2003a).

- **Workforce**

The economy of Limestone County is more closely linked to BFN activities then are the economies of Lauderdale, Madison, and Morgan Counties, because TVA is one of the largest sources of employment for Limestone County residents and contributes a greater share to the county's revenue relative to the share contributed by other neighboring counties.

The largest single employer in Limestone County is Delphi Saginaw Steering Systems, which has approximately 2600 employees. The next largest employers include TVA and the County Board of Education, each of which employs approximately 1200 people throughout the year.

Other major employers in the county include Target Distribution (retail distribution), Federal Mogul Sealing Systems (production of automotive gaskets), Steelcase, Inc., (production of office furniture), and ConAgra Poultry (poultry processing) (Athens-Limestone Chamber of Commerce 2004).

The number of jobs in Limestone County has more than doubled since 1970, reaching a total of 32,068 jobs in 2001 (Table 2-10). The 2001 level is 17.9 percent higher than the 1990 level. During this same time period, the population grew by 23.6 percent, suggesting that Limestone County has become more of a bedroom community to Huntsville as its growth has continued to spread toward the west. With the exception of Colbert and Lawrence Counties, the employment market for the surrounding counties listed in Table 2-10 has been strong during the past three decades relative to State and U.S. growth rates. Based on TVA forecasts of employment for the TVA Power Service Area, employment in Limestone County is expected to be around 41,000 in 2015 and about 53,000 in 2035, which is a 1.5 percent growth per year for the next 30 years (TVA 2003a). Limestone County is more dependent on manufacturing, government, and farm employment than other neighboring counties, as is presented in Table 2-11. The region around BFN has an industrial distribution similar to that of the state as a whole, although it is slightly more dependent on manufacturing. The state, as well as the region surrounding BFN, is more dependent on manufacturing and less on trade and service employment than is the nation as a whole.

Table 2-10. Number of Jobs by County in the Vicinity of Browns Ferry Nuclear Power Plant, Units 1, 2, and 3

County	1970	1980	1990	2001	Average % Change 1970-2001	% Change, 1990-2001
Colbert	25,045	29,775	28,594	28,292	0.4%	(-1.1%)
Lauderdale	20,518	29,126	36,579	43,171	3.6%	18.0%
Lawrence	7,289	8,905	11,445	11,766	2.0%	2.8
Limestone	14,056	18,300	27,188	32,068	4.1%	17.9%
Madison	93,110	108,507	165,710	194,841	3.5%	17.6%
Morgan	34,144	42,699	54,151	64,473	2.9%	19.1%
Alabama (x 1000)	1,413	1,736	2,062	2,410	2.3%	16.9%
United States (x 1000)	91,282	114,231	139,427	167,536	2.7%	20.2%

Source: TVA 2003a

Table 2-11. Major Employment Sectors in Counties Surrounding Browns Ferry Nuclear Power Plant, Units 1, 2, and 3 and in Alabama – 2001

Employment Sector	Colbert	Lauderdale	Lawrence	Limestone	Madison	Morgan	Alabama
Trade and Services	12,391	21,197	4,165	13,180	103,266	28,626	1,151,833
Manufacturing	4,272	6,087	1,883	6,381	27,278	13,797	334,947
Agriculture	849	2,159	1,953	2,149	3,117	1,612	84,339
Government	5,885	7,382	1,753	5,836	37,604	7,930	383,141
Other	4,895	6,346	2,012	4,522	23,576	12,508	455,433
Total Jobs	**28,292**	**43,171**	**11,766**	**32,068**	**194,841**	**64,473**	**2,409,693**
Unemployment (Rate)	2,082 (8.2%)	3,260 (8.0%)	1,115 (6.6%)	1,299 (4.1%)	4,880 (3.4%)	3,083 (5.4%)	112,004 (5.3%)

Source: TVA 2003a; U.S. Bureau of Labor Statistics (BLS 2004).

- **Transient Populations**

There appears to be very little seasonal fluctuation in local populations around BFN caused by transient populations moving through the area. Because migratory workers travel and can spend a significant amount of time in an area without being actual residents, they may be unavailable for census takers to count. If this occurs, these workers would be "under-represented" in U.S. Census Bureau (USCB) population counts. Although migrant workers are commonly found in rural agriculturally productive areas and a significant portion of Limestone County is made up of agricultural land, the farming in this area is less labor-intensive than other regions because of the types of crops that are raised (primarily cotton and soy beans) and the lack of irrigation requirements. There appear to be no significant concentrations of migrant workers in areas surrounding BFN (TVA 2003a).[a]

- **Taxes**

Property taxes are used to fund schools, police and fire protection, road maintenance, and other municipal services. Property taxes may be levied by counties, cities, towns, villages, school districts, and special districts. BFN is located in Limestone County, which generates most of its tax revenues through *ad valorem* taxes, which are taxes levied on the value of real

(a) Personal Communication (discussion) with M. Jordan and A. Stover, Community Development Department, Decatur, Alabama (March 31, 2004).

estate. The commercial and industrial sectors generate relatively more of the tax revenues in Limestone County than the residential sector.[a]

Although TVA is a nonprofit entity, which is not subject to conventional state and local taxation, it makes payments in lieu of taxes to states in which its power operations are carried on and in which it has acquired properties previously subject to State and local taxation in accordance with federal law, Section 13 of the TVA Act, 16 U.S.C. §831l. Under Section 13, TVA pays 5 percent of its gross power revenues to such states and counties (TVA 2004h).

TVA makes tax-equivalent payments to eight states, including Alabama. The State of Alabama then allocates its tax-equivalent payments from TVA in accordance with Title 40 "Revenue and Taxation," Chapter 28 "Distribution of Payments Made In Lieu of Taxes," Sections 40-28-1 through 40-28-4. Alabama distributes 75 percent of the TVA tax-equivalent payments to the 16 TVA-served counties based on a formula from TVA's book value of power property and sales in each of these counties. These counties then share a portion of their payment with cities, the school systems, hospitals, etc., within their boundaries. The remainder of the tax-equivalent payments are either retained for the State's general fund or are distributed to counties not served by TVA. During FY 2003, the State of Alabama allocated $15 million to the general fund, $58 million to TVA-served counties, and nearly $4 million to counties not served by TVA (TVA 2004h).

TVA tax-equivalent payments that are distributed to Limestone County, the City of Athens, and school districts within Limestone County are included in Table 2-12. Because of the series of tax payment formulas and distribution policies, the total amount of the TVA tax-equivalent payment listed in the third column of Table 2-12 is not solely attributable to the existence and operation of BFN. The TVA allocation paid to Limestone County is however largely attributed to TVA's fixed assets. An estimated portion of the tax-equivalent payment to the local jurisdictions that could reasonably be attributed to the existence and operation of BFN in Limestone County is provided in Table 2-12, Column 5.

In fiscal year 2003, Limestone County received just over $4.5 million from the State as redistribution of TVA's tax-equivalent payment. Approximately $2 million of this payment to Limestone County could be attributed to the presence of BFN in the county. Tax-equivalent payments for BFN that were retained by Limestone County average about 8 percent of the total

(a) Personal Communication (discussion) with M. Cole, D. Seibert, T. Hill, P. Ball, E. Ezzell, Limestone County Commission (March 31, 2004).

Table 2-12. Limestone County Distribution of Tax-Equivalent Payments Made by Tennessee Valley Authority in Fiscal Year 2003

Fund	Total Fund Revenue ($)	Tax Equivalent Payment by TVA ($)	% of Total Revenues	Estimated TVA Payment Attributable to BFN[a] ($)	% of Total Revenue
Limestone County General Fund	6,372,000	1,110,276	17%	488,521	8%
Limestone Hospital Fund	1,471,000	221,955	15%	97,660	7%
Limestone Public Buildings, Roads and Bridges	1,850,000	443,536	24%	195,156	11%
City of Athens (less utilities)	17,073,000	884,817	5%	389,320	2%
Athens City School District	23,946,000	545,406	2%	239,979	1%
Limestone County School District	49,547,000	1,157,867	2%	509,462	1%
Other (e.g., libraries and other towns)	NA	166,361	NA	73,199	NA

(a) *It is estimated that 44 percent of the TVA tax-equivalent payment is attributable to BFN; thus, all distributions were adjusted proportionately to estimate the BFN portion.*
NA = Not Available
Source: LCC 2004; NCES 2004; and TVA 2004h, i.

revenue taken in by the county (excluding funding that passes directly through to school districts, towns, and cities). The distribution of these payments to various county funds (e.g., general fund, building fund, hospital), school districts, and local municipalities is included in Table 2-12. BFN accounted for a smaller proportion of the City of Athens' total revenue (only 2.0 percent) and even less for the local school districts (one percent) during this same period. Although Morgan County also relies on the significant tax-equivalent payments from TVA (approximately $10 million, $2 million of which is retained by the county) (MCC 2004), the amount directly attributable to BFN operations and asset value is far less than the share contributed to Limestone County revenues (TVA 2004h).

2.2.9 Historic and Archaeological Resources

The area around BFN is rich in prehistoric and historic resources. Recent literature provided adequate background information for the area. Consequently, only a brief summary is provided here. Prehistoric and historic period overviews for Alabama are provided by U.S. National Park Service (NPS 2004), Hudson (1999), and Walthall (1980).

2.2.9.1 Prehistoric Period

Archaeological research has indicated that prehistoric Native American occupation of the region around BFN occurred from the Paleo-Indian period (about 10,000 to 8000 B.C.) to the Mississippian period (about A.D. 900 to 1500). Archaeological periods are based on changing settlement and land-use patterns and artifact styles. In Alabama, prehistoric chronology is divided into five broad time periods: Paleo-Indian, Archaic, Gulf Formational, Woodland, and Mississippian.

The prehistoric periods were marked by initial reliance on big game hunting for subsistence, followed by increased use of smaller game animals and plant foods in the Archaic period, more sedentary villages, and an increased reliance on cultivated crops. Through the Mississippian period, the Native American population occupied larger base camps in the river valleys, with subsistence based on agriculture, hunting and gathering, and intergroup trade. The late prehistoric period is primarily identified by the introduction of European trade goods.

2.2.9.2 Native American Historic Period

Prior to the early 18th Century, most of Alabama was home to Native Americans belonging to a southeastern alliance known as the Creek Confederacy. Today's Creek Nation, also known as the Muskogee, were the major tribe in that alliance. The Confederacy consisted of separate and independent tribes that gradually became, over a long period of time, a single political organization. Throughout most of its history, however, the Confederacy was a dynamic institution, constantly changing in size as tribes, for whatever reason, entered or left the alliance.

At the time of historic European contact, the ancestors of the modern Creek Indians lived in a number of small distinct Mississippian-related societies in Alabama and Georgia. The dominant group, sharing a common language or dialects, was the Muskogee. The Muskogee consisted of 12 bands including the Kasihta, Coweta, Coossa, Abihka, Wakokai, Eufaula, Hilibi, Atasi, Kolomi, Tukabahchee, Pakana, and Okchai. The bands situated to the north along the Coosa, Tallapoosa, and Alabama Rivers became known as the Upper Creek, while those along the Chattahoochee and Flint Rivers collectively became known as the Lower Creek.

In the early 1800s, a population of Creek Indians and other groups (such as the Yamassee) were still present in Alabama. However, in 1830 the U.S. Congress passed the Indian Removal Act. Within a couple of years from this date, virtually the entire expanse of Alabama was devoid of Indian settlements.

2.2.9.3 Euro-American Historic Period

The Alabama territory was first explored by the Spanish in 1540. Their immediate objective was to create settlements along the Gulf of Mexico. Entering Pensacola Bay, they failed to establish a permanent settlement, but explored parts of Alabama. The first settlement was built in 1720 in the Mobile area by the French under the command of Baptiste le Moyne Bienville, who was a colonizer and the governor of Louisiana for France. The Alabama territory was later ceded to Great Britain in 1763 after the French and Indian Wars.

After the American Revolution in 1783, the Alabama territory came under the possession of the United States. The defeat of the Creek Indians by Andrew Jackson in 1814 spurred settlement and Alabama became a territory in 1817. Alabama was admitted to the Union in 1819. Late in 1819, the Missouri Territory embraced all of the Louisiana Purchase and the question was raised as to the legal status of slavery in Missouri and the rest of the territory west of the Mississippi. This debate led to the beginning of the Civil War. Alabama was one of several southern states that seceded from the Union on January 11, 1861. The Confederate government was organized at Montgomery on February 4, 1861. After the Civil War in 1868, Alabama was readmitted to the Union. Both World Wars stimulated industrialization and crop diversification in the State of Alabama.

TVA began major construction on BFN in 1967. Unit 1 began commercial operation in August 1974, Unit 2 in 1975, and Unit 3 in 1977. BFN was TVA's first nuclear power plant.

2.2.9.4 Historic and Archaeological Resources at BFN

Much of the BFN site has been disturbed by construction of the nuclear power plant facilities and related infrastructure, including roads, parking lots, and the cooling towers. Some previous disturbance has also occurred along the transmission line rights-of-way. However, there are a few small areas on the site that remain undeveloped. Intact archaeological sites may be present within these undeveloped areas.

The final environmental impact statement for the construction of BFN (TVA 1972) listed one site on the National Register of Historic Places, which is the TVA Wilson Dam located 31 km (19 mi) downstream from BFN. Prior to construction, TVA relocated the Cox Cemetery, an action which involved moving more than 50 graves. Complete records of the grave relocation activities were filed with the Alabama Historical Commission.

TVA has an extensive cultural resource program that works to protect historic resources, as required by Federal law. Staff is responsible for the identification, evaluation, and protection of cultural resources on TVA lands and land affected by TVA actions (TVA 2004j). The majority of undisturbed land at BFN was surveyed in 2001 as part of the review for license renewal. The survey identified two historic properties. The first property identified was a prehistoric archaeological site (1Li535) with an Early-to-Middle Woodland period occupation. The site is considered potentially eligible for listing in the National Register of Historic Places (TVA 2002a). The second historic property identified was the Cox Cemetery. This cemetery was relocated during the initial construction of BFN. No historic structures were identified during the historic structures survey.

Cultural resources location information is protected by the Archaeological Resources Protection Act of 1979 and by 36 CFR Part 800. Therefore, no maps, photos, or figures of historic properties are provided in this SEIS.

2.2.10 Related Federal Project Activities and Consultations

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

TVA, a Federal corporation wholly owned by the U.S. Government, is a Federal agency subject to the requirements of the National Environmental Policy Act of 1969 (NEPA). In compliance with NEPA, TVA prepared an SEIS to provide the public and TVA decisionmakers with an assessment of the environmental impacts of extending the operating life of the BFN nuclear units (TVA 2002a). This NRC SEIS draws upon the content of the TVA SEIS, but was prepared by NRC staff independently.

BFN is located on the north bank of Wheeler Reservoir on the Tennessee River. The reservoir is created by Wheeler Dam, which is approximately 32 km (20 mi) downriver from the plant. Wheeler Dam was constructed and is operated by TVA for flood control, power generation, and navigation.

The Mallard Creek Recreation Area is located directly across the Tennessee River from BFN. This is a TVA developed and operated area. It includes developed areas for camping, picnicking, swimming, and boat launching. Approximately 5.6 km (3.5 mi) upstream of the plant is Round Island Recreation Area, also developed and operated by TVA. It also features facilities for camping, swimming, picnicking, and boat launching. The reservoir in the vicinity of the plant site is moderately used by recreational boaters and fishermen. Wheeler National Wildlife Refuge, operated by FWS, is located upstream from BFN. It is one of the southern-most wintering areas for ducks and geese in the southeastern United States.

After reviewing the Federal activities in the vicinity of the BFN site, the staff determined that there were no Federal project activities that would make it desirable for another Federal agency to become a cooperating agency for preparation of the SEIS.

NRC is required under Section 102(C) of NEPA 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 in the subject matter of the SEIS. During the course of preparing this SEIS, NRC consulted with TVA, FWS, and the National Marine Fisheries Service (NOAA Fisheries). Consultation correspondence with these agencies is included in Appendix E.

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."

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

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

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

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

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

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3.0 Environmental Impacts of Refurbishment

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

(1) The environmental impacts associated with the issue have been determined to apply either to all plants or, for some issues, to plants having a specific type of cooling system or other specified plant or site characteristics.

(2) A single significance level (i.e., SMALL, MODERATE, or LARGE) has been assigned to the impacts (except for collective 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 in this supplemental environmental impact statement unless new and significant information is identified.

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

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

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

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

Table 3-1. Category 1 Issues for Refurbishment Evaluation

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
GROUNDWATER USE AND QUALITY	
Impacts of refurbishment on groundwater use and quality	3.4.2
LAND USE	
Onsite land use	3.2
HUMAN HEALTH	
Radiation exposures to the public during refurbishment	3.8.1
Occupational radiation exposures during refurbishment	3.8.2
SOCIOECONOMICS	
Public services: public safety, social services, and tourism and recreation	3.7.4; 3.7.4.3; 3.7.4.4; 3.7.4.6
Aesthetic impacts (refurbishment)	3.7.8

The potential environmental effects of refurbishment actions would be identified, and the analysis would be summarized within this section, if such actions were planned. The Tennessee Valley Authority (TVA) indicated that it has performed an evaluation of structures and components pursuant to Title 10 of the Code of Federal Regulations (CFR) 54.21 to identify activities that are necessary to continue operation of Browns Ferry Nuclear Plant, Units 1, 2, and 3 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 (TVA 2003).

However, TVA stated that the replacement of these components and the additional inspection activities are within the bounds of normal plant component replacement and inspections (TVA 2003). Therefore, they are not expected to affect the environment outside the bounds of plant operations as evaluated in TVA's final environmental statement (TVA 1972). In addition, TVA's evaluation of structures and components as required by 10 CFR 54.21 did not identify any major plant refurbishment activities or modifications necessary to support the continued

Table 3-2. Category 2 Issues for Refurbishment Evaluation

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.

operation of Browns Ferry Nuclear Plant, Units 1, 2, and 3 beyond the end of the existing operating licenses. Therefore, refurbishment is not considered in this supplemental environmental impact statement.

TVA is in the process of restarting Browns Ferry Nuclear Plant, Unit 1, and used the term "refurbishment" within the Environmental Report (TVA 2003) when discussing some of the impacts of restart. The staff determined that all of the activities associated with the restart of Unit 1 can be, and are being, conducted within the scope of the existing operating license as reviewed previously (TVA 1972, 2002). Therefore, these activities are not considered refurbishment for the purposes of license renewal and are not being evaluated within the scope of the license renewal application.

3.1 References

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

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

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4.0 Environmental Impacts of Operation

Environmental issues associated with operation of a nuclear power plant during the license 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 offsite radiological impacts from the fuel cycle and from high-level waste and spent fuel disposal).

(3) Mitigation of adverse impacts associated with the issue has been considered in the analysis, and it has been determined that additional plant-specific mitigation measures are likely not to be sufficiently beneficial to warrant implementation.

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

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

This chapter addresses the issues related to operation during the 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 the Browns Ferry Nuclear Plant, Units 1, 2, and 3 (BFN). Section 4.1 addresses issues applicable to the BFN cooling system. Section 4.2 addresses issues related to transmission lines and onsite land use. Section 4.3 addresses the radiological impacts of normal operation, and Section 4.4 addresses issues related to the socioeconomic impacts of normal operation during the license renewal term. Section 4.5 addresses issues related to groundwater use and quality, while Section 4.6 discusses the impacts of license renewal-term operations on threatened and endangered species. Section 4.7 addresses potential new information that was raised during the scoping period, and Section 4.8 discusses

(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.

cumulative impacts. The results of the evaluation of environmental issues related to operation during the license renewal term are summarized in Section 4.9. Finally, Section 4.10 lists the references for Chapter 4. Category 1 and Category 2 issues that are not applicable because they are related to plant design features or site characteristics not found at BFN are listed in Appendix F.

4.1 Cooling System

Resumption of three-unit operation after restart of Unit 1 will require upgrading the cooling tower system by constructing a 20-cell cooling tower on the foundation of the original cooling tower number four, and increasing the water intake flow rates by approximately 11 percent above those of past three-unit operation (TVA 2003b). The facility would be operated to ensure that the maximum discharge water temperature and the temperature increase between the intake and discharge points remain within approved regulatory limits. Use of cooling towers would increase and, on rare occasions when the cooling towers are unable to meet thermal limits, the facility would be derated to remain in compliance. Although significant impacts are not anticipated, Tennessee Valley Authority (TVA) will also confirm expected levels of impingement and entrainment resulting from increased intake water flow rates by monitoring during current two-unit operation and following resumption of three-unit operations (TVA 2003b).

Category 1 issues in Table B-1 of 10 CFR Part 51, Subpart A, Appendix B, that are applicable to cooling system operation for BFN during the license renewal term, are listed in Table 4-1 (NRC 1996). TVA stated in its Environmental Report (ER) that no new information existed for the issues that would invalidate the GEIS conclusions (TVA 2003b). Additionally, the staff has not identified any new and significant information during its independent review of the ER (TVA 2003b), the staff's site visit, the scoping process, or its evaluation of other available information, such as operation at a combined total power level of 11,856 megawatts-thermal (MW[t]). Therefore, the staff concludes that there are no impacts related to these issues beyond those discussed in the GEIS. For all of the issues, the staff concluded in the GEIS that the impacts are SMALL, and additional plant-specific mitigation measures are not likely to be sufficiently beneficial to be warranted.

Table 4-1. Category 1 Issues Applicable to the Operation of the Browns Ferry Nuclear Power Plant, Units 1, 2, and 3 Cooling System During the License Renewal Term

ISSUE 10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Sections
SURFACE WATER QUALITY, HYDROLOGY, AND USE (FOR ALL PLANTS)	
Altered current patterns at intake and discharge structures	4.2.1.2.1; 4.3.2.2; 4.4.2
Altered thermal stratification of lakes	4.2.1.2.3; 4.4.4.2
Temperature effects on sediment transport capacity	4.2.1.2.3; 4.4.2.2
Scouring caused by discharged cooling water	4.2.1.2.3; 4.4.2.2
Eutrophication	4.2.1.2.3; 4.4.2.2
Discharge of chlorine or other biocides	4.2.1.2.4; 4.4.2.2
Discharge of sanitary wastes and minor chemical spills	4.2.1.2.4; 4.4.2.2
Discharge of other metals in wastewater	4.2.1.2.4; 4.3.2.2; 4.4.2.2
Water use conflicts (plants with once-through cooling systems)	4.2.1.3
AQUATIC ECOLOGY (FOR ALL PLANTS)	
Accumulation of contaminants in sediments or biota	4.2.1.2.4; 4.3.3; 4.4.3; 4.4.2.2
Entrainment of phytoplankton and zooplankton	4.2.2.1.1; 4.3.3; 4.4.3
Cold shock	4.2.2.1.5; 4.3.3; 4.4.3
Thermal plume barrier to migrating fish	4.2.2.1.6; 4.4.3
Distribution of aquatic organisms	4.2.2.1.6; 4.4.3
Premature emergence of aquatic insects	4.2.2.1.7; 4.4.3
Gas supersaturation (gas bubble disease)	4.2.2.1.8; 4.4.3
Low dissolved oxygen in the discharge	4.2.2.1.9; 4.3.3; 4.4.3
Losses from predation, parasitism, and disease among organisms exposed to sublethal stresses	4.2.2.1.10; 4.4.3
Stimulation of nuisance organisms	4.2.2.1.11; 4.4.3

Table 4-1. (contd)

ISSUE 10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Sections
Terrestrial Resources	
Cooling tower impacts on crops and ornamental vegetation	4.3.4
Cooling tower impacts on native plants	4.3.5.1
Bird collisions with cooling towers	4.3.5.2
Human Health	
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 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 TVA ER, the scoping process, the staff's site visit, or its evaluation of other available information, such as operation at a combined total power level of 11,856 MW(t). Therefore, the staff concludes that there are no impacts of altered current patterns during the license renewal term beyond those discussed in the GEIS.

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

> 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 TVA ER, the scoping process, the staff's site visit, or its evaluation of other available information, such as operation at a combined total power level of 11,856 MW(t). Therefore, the staff concludes that there are no impacts of altered thermal stratification of lakes beyond those discussed in the GEIS.

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

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

The staff has not identified any new and significant information during its independent review of the TVA ER, the scoping process, the staff's site visit, or its evaluation of other available information, such as operation at a combined total power level of 11,856 MW(t). Therefore, the staff concludes that there are no impacts of temperature on sediment transport capacity during the license renewal term beyond those discussed in the GEIS.

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

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

The staff has not identified any new and significant information during its independent review of the TVA ER, the scoping process, the staff's site visit, or its evaluation of other available information, such as operation at a combined total power level of 11,856 MW(t). Therefore, the staff concludes that there are no impacts of scouring during the license renewal term beyond those discussed in the GEIS.

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

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

The staff has not identified any new and significant information during its independent review of the TVA ER, the scoping process, the staff's site visit, or its evaluation of other available information, such as operation at a combined total power level of 11,856 MW(t). Therefore, the staff concludes that there are no impacts of eutrophication during the license renewal term beyond those discussed in the GEIS.

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

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

The staff has not identified any new and significant information during its independent review of the TVA ER, the scoping process, the staff's site visit, its evaluation of other available information, such as the National Pollutant Discharge Elimination System (NPDES) permit for BFN, Discharge Monitoring Reports (DMRs), discussion with the NPDES compliance office, and operation at a combined total power level of 11,856 MW(t). Therefore, the staff concludes that there are no impacts of discharge of chlorine or other biocides during the license renewal term beyond those discussed in the GEIS.

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

  Effects are readily controlled through NPDES permit and periodic modifications, 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 TVA ER, the scoping process, the staff's site visit, or its evaluation of other available information, such as the NPDES permit for BFN, DMRs, discussion with the NPDES compliance office, and operation at a combined total power level of 11,856 MW(t). Therefore, the staff concludes that there are no impacts of discharges of sanitary wastes and minor chemical spills during the license renewal term beyond those discussed in the GEIS.

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

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

The staff has not identified any new and significant information during its independent review of the TVA ER, the scoping process, the staff's site visit, or its evaluation of other available information, such as the NPDES permit for BFN, DMRs, discussion with the NPDES compliance office, and operation at a combined total power level of 11,856 MW(t). Therefore, the staff concludes that there are no impacts of discharges of other metals in waste water during the license renewal term beyond those discussed in the GEIS.

- Water-use conflicts (plants with once-through cooling systems). Based on information in the GEIS, the Commission found that

  > These conflicts have not been found to be a problem at operating nuclear power plants with once-through heat dissipation systems.

The staff has not identified any new and significant information during its independent review of the TVA ER, the scoping process, the staff's site visit, or its evaluation of other available information, such as operation at a combined total power level of 11,856 MW(t). Therefore, the staff concludes that there are no water-use conflicts during the license renewal term beyond those discussed in the GEIS.

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

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

The staff has not identified any new and significant information during its independent review of the TVA ER, the scoping process, the staff's site visit, or its evaluation of other available information, such as operation at a combined total power level of 11,856 MW(t). Therefore, the staff concludes that there are no impacts of accumulation of contaminants in sediments or biota during the license renewal term beyond those discussed in the GEIS.

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

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

The staff has not identified any new and significant information during its independent review of the TVA ER, the scoping process, the staff's site visit, review of monitoring programs, or its evaluation of other available information, such as operation at a combined total power level of 11,856 MW(t). Therefore, the staff concludes that there are no impacts of entrainment of phytoplankton and zooplankton during the license renewal term beyond those discussed in the GEIS.

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

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

The staff has not identified any new and significant information during its independent review of the TVA ER, the scoping process, the staff's site visit, or its evaluation of other available information, such as operation at a combined total power level of 11,856 MW(t). Therefore, the staff concludes that there are no impacts of cold shock during the license renewal term beyond those discussed in the GEIS.

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

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

The staff has not identified any new and significant information during its independent review of the TVA ER, the scoping process, the staff's site visit, or its evaluation of other available information, such as operation at a combined total power level of 11,856 MW(t). Therefore, the staff concludes that there are no impacts of thermal plumes to migrating fish during the license renewal term beyond those discussed in the GEIS.

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

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

The staff has not identified any new and significant information during its independent review of the TVA ER, the scoping process, the staff's site visit, its review of monitoring programs, or its evaluation of other available information, such as operation at a combined total power level of 11,856 MW(t). Therefore, the staff concludes that there are no impacts on the distribution of aquatic organisms during the license renewal term beyond those discussed in the GEIS.

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

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

The staff has not identified any new and significant information during its independent review of the TVA ER, the scoping process, the staff's site visit, or its evaluation of other available information, such as operation at a combined total power level of 11,856 MW(t). Therefore, the staff concludes that there are no impacts of premature emergence during the license renewal term beyond those discussed in the GEIS.

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

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

The staff has not identified any new and significant information during its independent review of the TVA ER, the scoping process, the staff's site visit, or its evaluation of other available information, such as operation at a combined total power level of 11,856 MW(t). Therefore, the staff concludes that there are no impacts of gas supersaturation during the license renewal term beyond those discussed in the GEIS.

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

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

The staff has not identified any new and significant information during its independent review of the TVA ER, the scoping process, the staff's site visit, its review of monitoring programs, or its evaluation of other available information, such as operation at a combined total power level of

11,856 MW(t). Therefore, the staff concludes that there are no impacts of low dissolved oxygen during the license renewal term beyond those discussed in the GEIS.

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

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

The staff has not identified any new and significant information during its independent review of the TVA ER, the scoping process, the staff's site visit, or its evaluation of other available information, such as operation at a combined total power level of 11,856 MW(t). Therefore, the staff concludes that there are no impacts of losses from predation, parasitism, and disease among organisms exposed to sublethal stresses during the license renewal term beyond those discussed in the GEIS.

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

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

The staff has not identified any new and significant information during its independent review of the TVA ER, the scoping process, the staff's site visit, or its evaluation of other available information, such as operation at a combined total power level of 11,856 MW(t). Therefore, the staff concludes that there are no impacts of stimulation of nuisance organisms during the license renewal term beyond those discussed in the GEIS.

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

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

The staff has not identified any new and significant information during its independent review of the TVA ER, the scoping process, the staff's site visit, or its evaluation of other available information, such as operation at a combined total power level of 11,856 MW(t). Therefore, the staff concludes that there are no cooling tower impacts on crops and ornamental vegetation during the license renewal term beyond those discussed in the GEIS.

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

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

The staff has not identified any new and significant information during its independent review of the TVA ER, the scoping process, the staff's site visit, or its evaluation of other available information, such as operation at a combined total power level of 11,856 MW(t). Therefore, the staff concludes that there are no cooling tower impacts on native plants during the license renewal term beyond those discussed in the GEIS.

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

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

The staff has not identified any new and significant information during its independent review of the TVA ER, the scoping process, the staff's site visit, or its evaluation of other available information, such as operation at a combined total power level of 11,856 MW(t). Therefore, the staff concludes that there are no impacts of bird collisions with cooling towers during the license renewal term beyond those discussed in the GEIS.

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

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

The staff has not identified any new and significant information during its independent review of the TVA ER, the scoping process, the staff's site visit, or its evaluation of other available information, such as operation at a combined total power level of 11,856 MW(t). Therefore, the staff concludes that there are no impacts of microbiological organisms on occupational health during the license renewal term beyond those discussed in the GEIS.

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

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

The staff has not identified any new and significant information during its independent review of the TVA ER, the scoping process, the staff's site visit, or its evaluation of other available information, such as operation at a combined total power level of 11,856 MW(t). Therefore, the staff concludes that there are no impacts of noise during the license renewal term beyond those discussed in the GEIS.

The Category 2 issues related to cooling system operation during the license renewal term that are applicable to BFN Units 1, 2, and 3 are listed in Table 4-2 and discussed in Sections 4.1.1, through 4.1.5.

Table 4-2. Category 2 Issues Applicable to the Operation of the Browns Ferry Nuclear Power Plant, Units 1, 2, and 3 Cooling System During the License Renewal Term

ISSUE 10 CFR Part 51, Subpart A, Appendix B, Table B	GEIS Sections	10 CFR 51.53(c)(3)(ii) Subparagraph	SEIS Section
WATER USE			
Water use conflicts (plants with cooling ponds or cooling towers using makeup water from a small river with low flow)	4.3.2.1; 4.4.2.1	B	4.1.1
AQUATIC ECOLOGY (FOR PLANTS WITH ONCE-THROUGH AND 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; 4.3.3; 4.4.3	B	4.1.3
Heat shock	4.2.2.1.4; 4.4.3	B	4.1.4
HUMAN HEALTH			
Microbiological organisms (public health)(plants using lakes or canals, or cooling towers or cooling ponds that discharge into a small river)	4.3.6	G	4.1.5

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

The Tennessee River average annual flow at BFN for 1976 through 2002 was 4.16×10^{10} m^3/yr (1.47×10^{12} ft^3/yr). This annual flow is less than the 9×10^{10} m^3/yr (3.15×10^{12} ft^3/yr) criterion stated by the U.S. Nuclear Regulatory Commission (NRC) in 10 CFR 51.53(c)(3)(ii)(A) as the value below which "an assessment of the impact of the proposed action on the flow of the river and related impacts on instream and riparian ecological communities must be provided" (NRC 1996).

NRC made water use and water availability issues a Category 2 issue because two factors may cause them to become important for some nuclear power plants that use cooling towers (NRC 1996). First, the relatively small rates of cooling water withdrawal and discharge allows some power plants with cooling towers to be located on small bodies of water that are susceptible to droughts or competing water uses. Second, closed-cycle cooling systems evaporate cooling water, and this consumptive water loss may represent a substantial proportion of the flow in small rivers. Loss of a substantial portion of flow from a small stream as a result of evaporative losses from a cooling tower will reduce the amount of habitat for fish and aquatic invertebrates. Off-stream water uses, such as power plant consumption, must be regulated to ensure that important in-stream uses, such as habitat for aquatic organisms, boating, sport fishing, and waste assimilation, are not compromised.

BFN normally operates in open mode using once-through cooling. Modeling predicts that, on average, BFN will operate in the open mode 93 percent of the time (TVA 2003b). Cooling towers are not used during open mode operations and consumptive water use is reduced.

For three units operating at a combined total power level of 11,856 MW(t), modeling shows the cooling towers would only be used on average 7 percent of the time in what is called "helper mode" (TVA 2003b). During these times, the total BFN intake water flow for three-unit operation of 12 million m^3/d (3171 MGD) or 139 m^3/s (4907 cfs) can be a significant fraction of the river flow past the plant (the lowest average flow for severe consecutive days with a 10-year recurrence [7Q10] of 250 m^3/s [8700 cfs] in the NPDES permit rationale). However, even when operating in helper mode, consumptive water use is negligible and is expected to remain so throughout the license renewal term.

As discussed more fully in Section 2.2.2, cooling tower consumptive water loss from evaporation and drift is not expected to exceed 2.3 m^3/s (82 cfs) (Hopping 2004), which is less than one percent of the 7Q10, even under worst-case conditions (three-unit operation at 120 original licensed thermal power [OLTP] with unfavorable meteorology). For a two-unit operation cooling tower use is even less frequent with modeling predicting tower use, on average, only 5 percent of the time (TVA 2003b).

Consumptive and off-stream water use has not resulted in significant use conflicts because of the large volume of reservoir water available, the high river flow rate, and the return of most of the water withdrawn (TVA 2003b). Regulatory control of withdrawal rates and NPDES permit limits for return water quality also mitigate potential conflicts. Potential trade-offs can occur with in-stream water uses (e.g., in-stream use conflicts among aquatic life, waste assimilation, navigation, power generation, flood control, and lake levels). These potential conflicts are addressed by historic operating procedures, legal requirements, and regulatory procedures.

The staff independently reviewed the TVA ER and visited the site. The staff determined that water-use conflicts would be SMALL, and further mitigation measures are not warranted.

4.1.2 Entrainment of Fish and Shellfish in Early Life Stages

For power plants with once-through cooling systems, entrainment of fish and shellfish in early life stages into cooling water systems is considered a Category 2 issue, requiring a site-specific assessment before license renewal. To perform this evaluation, the staff reviewed the TVA ER and other TVA environmentally related documents, visited the BFN site, and reviewed the applicant's State of Alabama NPDES Permit AL0022080, which was issued on December 29, 2000, became effective on February 1, 2001, and will remain in force until January 31, 2006 (ADEM 2000).

Section 316(b) of the Federal Water Pollution Control Act of 1972 (FWPCA) (also referred to as the Clean Water Act) requires that the location, design, construction, and capacity of cooling water intake structures reflect the best technology available for minimizing adverse environmental impacts. Entrainment of fish and shellfish into the cooling water system is a potential adverse environmental impact that can be minimized by use of the best available technology.

On July 9, 2004, the U.S. Environmental Protection Agency (EPA) published a final rule in the *Federal Register* (69 FR 41575) (EPA 2004) addressing cooling water intake structures at existing power plants where flow levels exceed a minimum threshold value of 190,000 m^3/d (50 MGD). The rule is Phase II in EPA's development of 316(b) regulations that establish national requirements applicable to the location, design, construction, and capacity of cooling water intake structures at existing facilities that exceed the threshold value for water withdrawals. The national requirements, which are implemented through NPDES permits, minimize the adverse environmental impacts associated with the continued use of the intake systems. Licensees are required to demonstrate compliance with the Phase II performance standards at the time of renewal of their NPDES permit. Licensees may be required as part of the NPDES renewal to alter the intake structure, redesign the cooling system, modify station operation, or take other mitigative measures as a result of this regulation. The new performance standards are designed to significantly reduce entrainment losses due to plant operation. Any required site-specific mitigation would result in less impact from entrainment during the license renewal term.

For all three units operating at a combined total power level of 11,856 MW(t), the total BFN intake water flow would be 139 m^3/s (2.2 million gpm), which can be a significant fraction of the river flow past the plant, especially during the lowest average flow for 7 consecutive days that can have a recurrence of 10 years (7Q10 low-flow value), of 246 m^3/s (3.9 million gpm) (Section 2.2.2). This intake flow represents an 11 percent increase over the original 100 percent power level of 124.9 m^3/s (1.98 million gpm) (Buchanan 1980).

The critical time of year for approaching the maximum river water temperature limits specified in the BFN NPDES Permit (ADEM 2000), and therefore requiring the use of cooling towers or plant derates, is July and August. The average flow in Wheeler Reservoir at BFN during these months is 965 m^3/s (15.3 million gpm) during July and August (TVA 2003b). During these same months the daily average flow exceeds the 7Q10 low-flow value 98.6 percent of the time in July and 98.8 percent of the time in August.

Characterization of the ichthyoplankton of Wheeler Reservoir was initiated prior to startup of BFN, and continued during the initial years of operations (1974 through 1979). From 80 to 98 percent of the larval fish populations were composed of clupeids (e.g., threadfin shad [*Dorosoma petenense*] and gizzard shad [*D. cepedianum*]). Fish larvae entrainment during the initial 6 years of operation ranged from 1.0 to 9.0 percent of the total number of larval fish in the reservoir passing by the plant (Table 4-3). During this same period, the mean hydraulic entrainment (portion of the river flow passing through the plant) varied from 3.0 to 13.3 percent (TVA 1978a; Buchanan 1980). During all years, percent entrainment of larval fish was less than hydraulic entrainment (Table 4-3). In addition to shad, other fish comprising greater than

Table 4-3. Calculated Entrainment of Fish Eggs and Larvae at Browns Ferry Nuclear Power Plant, Units 1, 2, and 3 – 1974 to 1979

Year	Fish Egg Entrainment Percent (Number)	Larval Fish Entrainment Percent (Number)	Percent Mean Hydraulic Entrainment
1974	13.3 (459 million)	1.0 (125 million)	3.0
1975	1.3 (50 million)	3.3 (770 million)	4.4
1976	3.8 (143 million)	6.3 (1.3 billion)	8.4
1977	2.7 (149 million)	9.0 (3.7 billion)	12.0
1978	3.6 (50 million)	5.4 (2.92 billion)	13.3
1979	8.1 (188 million)	4.5 (1.34 billion)	9.0

Sources: Buchanan 1980; TVA 1978a.

1 percent of the total number of entrained larvae included suckers, minnows, freshwater drum (*Aplodinotus grunniens*), and white and yellow basses (*Morone chrysops* and *M. mississippiensis*) (TVA 1978a). The three fish families with the highest estimated entrainment (i.e., percent loss of larvae passing BFN) during three-unit operation at BFN in 1977 were Clupeidae (12.1 percent), Catostomidae (4.5 percent), and Sciaenidae (6.1 percent) (TVA 2002).

Taxa that exhibited increases in larval entrainment percentage over the period of study (1974 through 1977, which coincided with an increase from one- to three-unit operation) included those known to be widely distributed in the water column and essentially planktonic (e.g., Clupeidae, Moronidae, Cyprinidae, and Percidae). Those not exhibiting this trend included fishes that have nest-inhabiting or parental-care characteristics in early life (e.g., Ictaluridae and Centrarchidae) and are thus unlikely to be as planktonic or uniformly distributed in the water column (TVA 1978a). Fish entrainment was generally lower than hydraulic entrainment (the amount of river flow that passes through the plant) because fish larvae are not truly planktonic except at very early stages (TVA 1978a).

Fish egg entrainment during the initial 6 years of operation ranged from 1.3 to 13.3 percent of the total number of eggs in the reservoir passing by the plant. During 1974, the percent egg entrainment was much higher than hydraulic entrainment. During 1979, the percent egg entrainment was similar to hydraulic entrainment, and from 1975 through 1978, percent egg entrainment was much lower than hydraulic entrainment (Table 4-3). The only two commonly occurring species in Wheeler Reservoir that have buoyant or semibuoyant eggs are freshwater drum and mooneye (*Hiodon tergisus*), although the skipjack herring (*Alosa chrysochloris*) may also have buoyant eggs (TVA 1972). It was speculated that conditions were favorable in 1974 for spawning freshwater drum to be attracted to or near the plant intake resulting in the release of large numbers of eggs into the cooling water source (TVA 1978a). A similar speculation accounts for the large percentage of catfish larvae that were entrained in 1975 (TVA 1978a).

Under the original operating mode of 100 percent power, entrained organisms were subject to a 13.9°C (25°F) temperature rise (TVA 2003b). Under 120 percent power this increase in temperature could be as high as 15.9°C (28.7°F) (Hopping 2004). Total duration of cooling system passage is estimated at 7 to 11 minutes, with 5 to 9 minutes spent in heated waters (TVA 2003b). When discharge temperatures do not exceed 37.8°C (100°F), some entrainment survival would be expected (LaJeone and Monzingo 2000). Under a very conservative scenario, total mortality of all entrained ichthyoplankton occurs. Three-unit operation at 120 percent power would increase intake flow rates by approximately 11 percent (TVA 2003b). Therefore, the amount of entrainment would be expected to increase, but the percent increase would be expected to be lower than the hydraulic entrainment increase.

Flow studies conducted at BFN have indicated that most of the water hydraulically entrained by the plant comes from the right side of the main river channel. This pelagic area contains significantly lower densities of drifting fish larvae than found in the overbank areas. Higher densities of fish eggs (mostly freshwater drum) are transported in the channel portion of the river, but entrainment of freshwater drum eggs and larvae have not resulted in noticeable decreases in abundance of this species, nor is it expected under return to three-unit operation at increased operational rates (TVA 2003b). There are no specific or unique spawning or nursery areas or migration routes for any fish species located upstream of BFN that would make eggs or larvae of these species unusually susceptible to entrainment (TVA 2003b). No obvious declines in these fish species have been noticed based on collection of adults in Wheeler Reservoir (TVA 2003b). Because ichthyoplankton in Wheeler Reservoir are produced upstream and downstream of BFN, it was concluded that entrainment would not add significantly to expected natural mortality of fish eggs and larvae in the reservoir (Buchanan 1980).

The staff reviewed the available information in the TVA ER (TVA 2003b) and in other BFN documents related to the FWPCA 316(b) permitting process. Based on the results of past entrainment studies and the operating history of the BFN intake structure, the staff concludes that the potential impacts of entrainment of fish and shellfish in the early life stages into the cooling water intake system are SMALL, and it is not likely that further mitigation will be warranted. Nevertheless, TVA will evaluate levels of entrainment by monitoring under current two-unit operation and following the return of three-unit operation. Analysis of current and future entrainment data collected at BFN will use modeling techniques designed to extrapolate from the lost production of eggs and larvae of forage species (e.g., clupeids) to more effectively assess overall potential entrainment impacts (TVA 2003b). TVA's Vital Signs Monitoring Program would also continue to assess aquatic communities in Wheeler Reservoir. If it is determined that increased entrainment is resulting in unacceptable environmental impacts, TVA would assess technologies, operational measures, and restoration measures that could be undertaken to remedy the impacts, and institute appropriate mitigation measures in consultation with appropriate Federal and State of Alabama agencies (TVA 2003b).

4.1.3 Impingement of Fish and Shellfish

For plants with once-through cooling systems, impingement of fish and shellfish on debris screens of cooling water system intakes is considered a Category 2 issue, which requires a site-specific assessment before license renewal. To perform this evaluation, the staff reviewed the TVA ER and other TVA environmentally related documents, visited the BFN site, and reviewed TVA's State of Alabama NPDES Permit AL0022080, issued on December 29, 2000, which became effective on February 1, 2001, and will remain in force until January 31, 2006 (ADEM 2000).

Section 316(b) of the FWPCA requires the location, design, construction, and capacity of cooling-water intake structures to reflect the best technology available for minimizing adverse environmental impacts. Impingement of fish and shellfish on the debris screens of the cooling water intake system is a potential adverse environmental impact that can be minimized by use of the best available technology.

On July 9, 2004, EPA published a final rule in the *Federal Register* (69 FR 41575) (EPA 2004) addressing cooling water intake structures at existing power plants whose flow levels exceed a minimum threshold value of 190,000 m^3/d (50 MGD). The rule is Phase II in EPA's development of 316(b) regulations that establish national requirements applicable to the location, design, construction, and capacity of cooling water intake structures at existing facilities that exceed the threshold value for water withdrawals. The national requirements, which are implemented through NPDES permits, minimize the adverse environmental impacts associated with the continued use of the intake systems. Licensees are required to demonstrate compliance with the Phase II performance standards at the time of renewal of their NPDES permit. Licensees may be required as part of the NPDES renewal to alter the intake structure, redesign the cooling system, modify station operation, or take other mitigative measures as a result of this regulation. The new performance standards are designed to significantly reduce impingement losses due to plant operation. Any required site-specific mitigation would result in less impact from impingement during the license renewal term.

During the initial years of plant operation (1974 through 1977), 72 species of fish were collected in impingement samples (TVA 1978a). Four species comprised 95.8 percent of the impinged fish: threadfin shad (76.5 percent), gizzard shad (12.3 percent), freshwater drum (4.3 percent), and skipjack herring (2.7 percent). Each of the remaining 68 species comprised less than 1.0 percent of the total fish impinged; many less than 0.01 percent. Forty-two of the species were impinged at rates estimated to be one fish or less per day (TVA 1978a). Juvenile fish occurred more often than adults in impingement samples. This is attributed to (1) the greater relative abundance of these age classes, (2) juvenile fish of some species may concentrate in the shoreline areas, and (3) juveniles are weaker swimmers than adults (TVA 1978a).

Table 4-4 provides the impingement information for the most prevalent species during initial years of BFN operation (1974 to 1977). Overall, there was a positive relationship between the level of plant operation and impingement. However, for several species (e.g., spotted sucker [*Minytrema melanops*], silver chub [*Macrhybopsis storeriana*], white crappie [*Pomoxis annularis*], and sauger [*Stizostedion canadense*]) impingement levels may have reflected year class variation of the species within the reservoir rather than the level of plant operation (TVA 1978a). Nuclear generating stations are typically operated as baseload facilities and daily changes in the operational mode are minimal. Also, there is usually only a minor variation in

Table 4-4. Calculated Total Number and Percent of Total Impingement for the Most Prevalent Fish Species Impinged at Browns Ferry Nuclear Power Plant, Units 1, 2, and 3 – 1974 to 1977

Common Name (Scientific Name)	March 1974 - March 1975	March 1975 - March 1976	Sept 1976 - Aug 1977
skipjack herring (*Alosa chrysochloris*)	220,964 (4.2 %)	98,751 (3.7 %)	110,487 (1.7 %)
gizzard shad (*Dorosoma cepedianum*)	188,300[(a)] (3.5 %)	343,312 (12.8 %)	1,353,913 (20.3 %)
threadfin shad (*Dorosoma petenense*)	4,552,208[(a)] (86.5 %)	1,909,492 (71.0 %)	4,635,290 (69.5 %)
channel catfish (*Ictalurus punctatus*)	21,716 (0.4 %)	11,435 (0.4 %)	24,719 (0.4 %)
white bass (*Morone chrysops*)	14,126 (0.3 %)	13,408 (0.5 %)	50,681 (0.8 %)
yellow bass (*Morone mississippiensis*)	14,453 (0.3 %)	29,936 (1.1 %)	67,005 (1.0 %)
green sunfish (*Lepomis cyanellus*)	10,154 (0.2 %)	3115 (0.1 %)	39,210 (0.6 %)
bluegill (*Lepomis macrochirus*)	17,556 (0.3 %)	9423 (0.4 %)	84,977 (1.3 %)
redear sunfish (*Lepomis microlophus*)	7910 (0.2 %)	2561 (0.1 %)	27,625 (0.4 %)
freshwater drum (*Aplodinotus grunniens*)	179,501 3.4 %)	233,902 (8.7 %)	215,783 (3.2 %)
Total number impinged (Number of species impinged)	5,263,546 (51 species)	2,688,498 (52 species)	6,673,488 (61 species)

(a) The 48,937 individuals identified as only *Dorosoma* spp. were proportionally split between gizzard and threadfin shad.
Source: TVA 1978a.

cooling water use between years as long as all units are operating at normal levels. Therefore, when there are dramatic fluctuations in impingement collections from week to week or from year to year, they generally reflect prevailing conditions in the river and changes in the fish community (Bowzer and Lippincott 2000).

The number of fish impinged between 1974 and 1977 were compared to the estimated standing stock of fish within Wheeler Reservoir (TVA 1978a). For the species listed in Table 4-4, the percent standing stock impinged between September 1976 and August 1977 were skipjack herring, 5.39 percent; gizzard shad, 0.40 percent; threadfin shad, 0.66 percent; channel catfish

(*Ictalurus punctatus*), 1.35 percent; white bass, 5.56 percent; yellow bass, 11.72 percent; green sunfish (*Lepomis cyanellus*), 3.49 percent; bluegill (*L. macrochirus*), 0.04 percent; redear sunfish (*Lepomis microlophus*) 0.21 percent; and freshwater drum, 3.32 percent (TVA 1978a). The estimated number of fish that occur in Wheeler Reservoir was based on densities of fish collected in three coves. The coves are located in Second Creek near the Wheeler Dam (1.1 ha [2.7 ac] in area and 1.8 m [5.9 ft] deep), a cove at Lawrence County Park (1.4 ha [3.5 ac] in area and 1.3 m [4.3 ft] deep), and a cove on Elk River (0.6 ha [1.5 ac] in area and 1.4 m deep [4.6 ft]) (TVA 1978b).

No major or significant spawning areas, nursery grounds, feeding areas, wintering areas, or migration routes are located near BFN that would result in an increased potential for impingement (Baxter and Buchanan 1998; TVA 2003b). The intake channel at BFN is 150 m (492 ft), long from the skimmer wall to the pumping station. At normal maximum pool, the water depth along a 6.1-m (20.0-ft)-wide area in the middle of the intake channel is 10.1 m (33.1 ft). From there the sides of the channel slope at a 3-to-1 ratio. Directly in front of the pumping station the bottom slopes down an additional 1.5 m (4.9 ft) to the bottom of the intake opening, resulting in a maximum depth of 11.6 m (38.1 ft) at the intake screen at normal maximum pool (TVA 1978a). Fish have free access to the intake channel and can reside within this area without necessarily succumbing to impingement.

During original operations, the intake screens were cleaned either on a regular basis (e.g., at shift changes or daily) or when a pressure differential value is exceeded across the screens due to fouling. The often long impingement time, in addition to exposure to high-pressure spray system during the cleaning process, essentially resulted in a 100 percent mortality of impinged fish (TVA 1978a). The intake screens are now continuously backwashed as they are rotated, resulting in impingement losses of less than 100 percent. However, the survival rate has not been determined.

The paddlefish (*Polyodon spathula*) is the only State-listed fish species that has been collected in impingement samples (TVA 1978a). An estimated 168 specimens were collected between March 1974 and March 1975; 15 between March 1975 and March 1976; and 14 specimens between September 1976 and August 1977. They comprised less than 0.01 percent of the number of fish impinged in those years (TVA 1978a).

During the course of preparing this supplemental environmental impact statement (SEIS), the staff considered mitigation measures for the continued operation of BFN. Based on the assessment, the staff expects that the measures in place at BFN (e.g., shoreline intake, escape passages, and a fish return system) provide mitigation for impacts related to impingement, and no new mitigation measures are warranted. There have been no measurable changes to the fish community of Wheeler Reservoir related to the BFN, and no indications that impingement has had a destabilizing impact on fish populations (TVA 2003b). The direct and indirect effects associated with the modification of the Tennessee River through creation of reservoirs has had the greatest influence on fish populations (see Section 2.2.5).

The staff reviewed the available information in the TVA ER (TVA 2003b), other BFN documents related to the FWPCA 316(b) permitting process, and TVA's Vital Signs Monitoring Program evaluations and other documents related to the fish community of Wheeler Reservoir. Based on the results of past impingement studies and the operating history of BFN intake structure, the staff concludes that the potential impacts of impingement of fish and shellfish are SMALL, and it is not likely that further mitigation will be warranted. Nevertheless, the TVA will evaluate the levels of impingement by monitoring under current two-unit operation and following the return of three-unit operation at 120 percent power level, which will increase intake flow rates by approximately 11 percent over those of past three-unit operation (TVA 2003b). Modeling techniques are currently being refined, which will allow more realistic analysis of the effects of impingement and allow extrapolation of impingement losses to production foregone for forage fish. These techniques or similar modeling techniques will be employed to analyze future impingement data from BFN to better quantify long-term, far-field effects of impingement to the reservoir fish community (TVA 2003b). TVA's Vital Signs Monitoring Program would also continue to assess aquatic communities in Wheeler Reservoir. If it is determined that increased impingement is resulting in unacceptable environmental impacts, TVA would assess technologies, operational measures, and restoration measures that could be undertaken to remedy the impacts, and institute appropriate mitigation measures in consultation with appropriate Federal and State of Alabama agencies (TVA 2003b).

4.1.4 Heat Shock

For plants with once-through cooling systems, the effects of heat shock are listed as a Category 2 issue and require plant-specific evaluation before license renewal. The staff made impacts on fish and shellfish resources resulting from heat shock 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). Information to be considered includes (1) the type of cooling system (whether once-through or cooling pond) and (2) evidence of a FWPCA Section 316(a) variance or equivalent State documentation. To perform this evaluation, the staff reviewed the TVA ER and other TVA environmentally related documents, visited the BFN site, reviewed the facility's thermal variance monitoring and 316(a) studies, and reviewed the applicant's State of Alabama NPDES Permit No. AL0022080, which was issued on December 29, 2000, became effective on February 1, 2001, and will remain in force until January 31, 2006 (ADEM 2000).

BFN has a once-through heat dissipation system. Water is discharged back to the river through submerged diffusers located on the river bottom and oriented perpendicular to the river flow. The diffusers for each unit have 7800 5-cm (2-in.)-diameter ports located on the downstream-facing portion of the diffuser pipe and angled to force the heated effluent up into the water column (TVA 2003a). BFN also currently has five mechanical draft cooling towers, with a sixth to be added, which can be operated to assist in heat dissipation (helper mode) primarily during summer (July and August) hot-weather periods (TVA 2003b). BFN has been able to operate at full power in the open-cycle mode while still meeting state water temperature standards under most river flow and temperature conditions. Under the original three-unit operation at 100 percent power levels, BFN used river water at the rate of 124.9 m^3/s (1.98 million gpm) and condenser cooling water was warmed a maximum of 13.9°C (25°F) above ambient temperature before being discharged to the river (Buchanan 1990). Under three-unit operation at a combined total power level of 11,856 MW(t), BFN would use river water at the rate of 139 m^3/s (2.20 million gpm) (an 11 percent increase). The maximum temperature increases above ambient temperature would be 15.9°C (28.7°F) under open mode for each unit's diffuser. Under helper mode, the diffuser discharge temperature would be 10.7°C (19.3°F) above ambient temperature for Unit 1 and 3.8°C (6.8°F) above ambient temperature for both Units 2 and 3 (Hopping 2004).

Based on results of a supplemental 316(a) demonstration for alternative thermal discharge limits for BFN (TVA 1983), the thermal limitations that have been in place for BFN since 1984 are a maximum 1-hour average of 33.9°C (93°F), a maximum 24-hour average of 32.2°C (90°F), and a maximum 24-hour average temperature increase of 5.6°C (10°F) over ambient conditions. This varies from the more stringent thermal criteria established in 1972 of a maximum temperature at the edge of the mixing zone of 30°C (86°F) and a maximum temperature increase of 2.8°C (5°F) (TVA 1983). These limitations are applied at the edges of a mixing zone with the following dimensions: (1) a maximum length of 730 m (2400 ft) downstream of the diffusers, (2) a maximum width of 600 m (2000 ft), and (3) a maximum length of 46 m (150 ft) upstream of the diffusers to the top of the diffuser pipes and extends to the bottom downstream of the diffusers (TVA 2003b). Annual ambient maximum temperatures in Wheeler Reservoir rarely exceed 31.7°C (89°F) in the main channel, but often exceed this temperature in the shallow areas of embayments and coves (TVA 2002). If the upstream 24-hour temperature exceeds 32.2°C (90°F), the 24-hour downstream temperature may equal, but not exceed, the upstream value. This type of operation is acceptable until the 1-hour average limit of 33.9°C (93°F) is obtained (TVA 2003b).

The BFN discharge diffusers are located such that fish would not become entrapped in areas of elevated temperatures. Acute thermal impacts to aquatic organisms (e.g., immediate death or disability) are unlikely (TVA 2003b). However, larval fish that pass through the mixing zone may be stunned by exposure to elevated temperatures, making them more susceptible to predation (TVA 1972). No heat-related fish kills have been reported for BFN. Thermal discharges related to the operation of BFN affect a relatively small area of Wheeler Reservoir. The required thermal mixing zone does not exceed a surface area of 47.3 ha (117 ac). This is less than 0.2 percent of the surface area of Wheeler Reservoir.

Maximum temperatures at the edge of the thermal mixing zone do not exceed the upper thermal limits for species such as bluegill; black crappie (Pomoxis nigromaculatus); white crappie; largemouth (*Micropterus salmoides*), and smallmouth (*M. dolomieu*) bass; channel catfish; and golden shiner (*Notemigonus crysoleucas*) (TVA 2002). For example, the upper temperature avoided by fish acclimated to 30°C (86°F) were 35°C (95°F) for spotfin shiner (*Cyprinella spiloptera*), 35°C (95°F) for bluegill, 33°C (91.4°F) for green sunfish, 33°C (91.4°F) for smallmouth bass, 34.0°C (93.2°F) for spotted bass (*Micropterus punctulatus*), and 35°C (93.2°F) for channel catfish (Cherry et al. 1975). However, the thermal tolerance of some species such as yellow perch (*Perca flavescens*), white sucker (*Catostomus commersoni*), walleye (*Stizostedion vitreum*), sauger, and emerald shiner (*Notropis atherinoides*) could be exceeded during annual extreme water temperatures (TVA 2002). Nevertheless, species such as sauger are reported to disperse throughout the reservoir and are not found in the vicinity of the BFN during extreme ambient water temperatures (Baxter and Buchanan 1998).

Although individual fish may occasionally be found in thermal effluents at lethal temperatures, populations as a whole avoid such conditions (Talmage and Opresko 1981). The thermal preference for relatively large numbers of species common to Wheeler Reservoir (e.g., shad, bass, crappie, sunfish, freshwater drum, and some minnows) have been found to be in the range of 28 to 32°C (82.4 to 89.6°F); while some fish such as gar, carp, catfish, and minnows have been observed in thermal effluents in summer that range from 32 to 36°C (89.6 to 96.8°F) (Talmage and Opresko 1981). Young fish generally have a higher thermal preference and greater tolerance to elevated temperatures than older fish (Talmage and Opresko 1981). Therefore, although younger fish may not be as capable of avoiding the thermal plume as older fish, they may not experience thermal shock during passage through the plume.

Thermal releases from BFN have not had a significant impact on the aquatic community of Wheeler Reservoir (TVA 1983; Baxter and Buchanan 1998; Buchanan 1990; Lowery and Poppe 1992). From 1985 through 1992, a biological monitoring program was conducted to evaluate the effects of thermal discharges from BFN on phytoplankton and on total standing stocks and selected fish species in Wheeler Reservoir. Algal surveys were conducted in 1989 (during plant shutdown) and in 1991 (during plant operation). The only consistent observation was that the planktonic community varied on a daily basis regardless of location and habitat type. There was no indication that operation of BFN, even with the revised thermal limits, had influenced the phytoplankton community in Wheeler Reservoir (Lowery and Poppe 1992). Special attention was focused on sauger and yellow perch for BFN thermal variance studies because these cool water species would be more susceptible to elevated water temperatures than would most of the warmwater fish species that occur in the reservoir. Survey results indicated that BFN had no adverse impact on the reproductive success of either species nor on the movement of sauger past BFN (Baxter and Buchanan 1998). The tailwaters of Guntersville Dam are the primary spawning location for sauger in Wheeler Reservoir (Buchanan 1990) and, therefore, are not influenced by thermal discharges from BFN. Overfishing for sauger in

Wheeler Reservoir and drought conditions (e.g., low flows and decreased turbidity) in the Tennessee Valley from 1985 through 1988 had adverse impacts on sauger spawning success (Maceina et al. 1998; Baxter and Buchanan 1998).

Currently, TVA operates cooling towers at BFN only when the water temperature of discharges approaches and presents the potential for exceeding the NPDES thermal limit. When this situation occurs, not all cooling towers are necessarily placed in service. To maximize the net generation of the plant, only those towers necessary to keep the water temperature below the thermal limits are operated. Thus, as long as derating is part of the operational strategy for maintaining the NPDES limits, there is no significant difference in the hottest average thermal discharge for any of the cooling tower options. Additionally, TVA is working toward improving its methods of predicting water temperatures in Wheeler Reservoir and optimizing the operation of the cooling system provided at BFN. Computer simulations indicate that the combination of using existing cooling towers, the addition of a new cooling tower, and derating the plant, when necessary, would allow compliance with the current NPDES permit when all three units are operating at 120 percent of OLTP power (TVA 2003b). In-stream temperatures at the end of the mixing zone would remain within NPDES-permitted limits; thus, heat shock impacts would not be expected (TVA 2003b). To maintain temperatures within thermal limitation requirements, BFN would use its cooling towers, on average, about 5.3 percent of the time, and derating would be required approximately 0.1 percent of the time when Units 2 and 3 were operating at 120 percent power levels. When all three units were operating at 120 percent power levels, on average the cooling towers would be required about 7.2 percent of the time, and derating would occur approximately 0.29 percent of the time (TVA 2003b).

The staff reviewed the available information, including that provided by TVA, the staff's site visit, the State of Alabama NPDES permit, the thermal variance monitoring and 316(a) studies, and other public sources. The staff evaluated the potential impacts to aquatic resources caused by heat shock when all three are operating at 120 percent power levels. Discharge temperatures would remain within the NPDES limits; thus, heat shock impacts are not anticipated (TVA 2003b). It is the staff's conclusion that the potential impacts to fish and shellfish due to heat shock during the license renewal term are SMALL and further mitigation measures are not warranted.

4.1.5 Microbiological Organisms (Public Health)

The effects of microbiological organisms on human health are listed as a Category 2 issue and require plant-specific evaluation before license renewal. The average annual flow of Wheeler Reservoir near the BFN site is 4.16×10^{10} m^3/yr (1.47×10^{12} ft^3/yr), which is less than the 9×10^{10} m^3/yr (3.15×10^{12} ft^3/yr) threshold value in 10 CFR 51.53(c)(3)(ii)(G) for thermal discharge to a small river. Thus, the effects of its discharge on microbiological organisms must be addressed for BFN.

The Category 2 designation is based on the magnitude of the potential public-health impacts associated with thermal enhancement of the enteric pathogens *Salmonella* spp. and *Shigella* spp., the bacterium *Pseudomonas aeruginos*, thermophilic fungi, a number of species from the Genus *Legionella*, and pathogenic strains of the free-living amoebae *Naegleria* spp. and *Acanthamoeba* spp. (NRC 1996). The BFN diffuser discharge temperatures would not exceed 44.4°C (112°F) under three-unit operation at 120 percent power level. Because two units can be run at slightly higher ambient river temperatures, the maximum diffuser discharge temperature would be 44.61°C (112.3°F) with just Units 2 and 3 in operation at 120 percent power level (Hopping 2004). Except under rare, extreme ambient water temperatures, the discharge temperatures at the edge of the thermal discharge plume would not exceed the maximum 1-hour average of 33.9°C (93°F) or the maximum 24-hour average of 32.2°C (90°F). The annual ambient maximum temperature in Wheeler Reservoir seldom exceeds 31.7°C (89°F).

Thermophilic microorganisms can have optimum growth temperatures of 50°C (122°F) or more, a maximum temperature tolerance of up to 70°C (158°F), and a minimum tolerance of about 20°C (68°F) (Deacon 2004). However, thermal preferences and tolerances vary among the various microorganisms and environmental conditions. *P. aeruginosa* has an optimum temperature for growth of 37°C (98.6°F) and can tolerate a temperature as high as 42°C (107.6°F) (Todar 2002). A water temperature range of 32.2 to 40.6°C (90 to 105°F) provide ideal conditions for *Legionella* spp. bacterial growth (CDC 2004). *Salmonella* spp. can thrive at temperatures between 4.4 to 60°C (40 to 140°F) (Kendall 2003), whereas *Acanthamoeba* spp. and *Naegleria* spp. were not found to colonize hot water systems of 40°C (104°F) or higher (Rohr et al. 1998).

Based on maximum temperatures at the diffusers and the edge of the permitted thermal plume, coupled with the dilution provided by Wheeler Reservoir and the short period of time for water to pass through the cooling system (i.e., 7 to 11 minutes, with 5 to 9 minutes of this spent in heated water), the thermophilic microorganisms are not expected to cause any appreciable public health risk (TVA 2003b). The Alabama Department of Public Health (Lofgrén 2003) agreed that there is no significant threat to the public from thermophilic microorganisms attributable to operation of BFN (see Appendix E). Disinfection of the BFN sewage treatment plant effluent and NPDES permit requirements to monitor fecal coliforms in this effluent (ADEM 2000) further reduces the potential for the heated discharge to be a seed source or inoculant for pathogenic microorganisms.

The staff independently reviewed the TVA ER (TVA 2003b), visited the BFN site, and reviewed TVA's State of Alabama NPDES Permit AL0022080 (ADEM 2000). Based on its review of this information, coupled with the fact that BFN operations and cooling systems are not expected to change significantly over the license renewal term, the staff concludes that the potential impacts to public health from microbiological organisms resulting from the BFN cooling-water discharges are SMALL. Therefore, additional mitigation is not warranted.

4.2 Transmission Lines

BFN is connected into the TVA system network by seven 500-kV lines via the 500-kV switchyard. One line is to the Madison substation; two lines are to the Trinity substation; one line each is to the West Point, Maury, and Union, Mississippi substations, and one line is to the Limestone 500-kV substation (TVA 2003b). In addition, there are two 161-kV lines, one to the Athens substation and one to the Trinity substation. All lines occupy portions of four rights-of-way: one to Maury substation, one to the Trinity substation, one to the Athens substation, and one to the Union, Mississippi, substation. There are portions of transmission lines within these rights-of-way that were not constructed specifically to connect BFN to the TVA power system. However, for the sake of simplicity and a comprehensive analysis, the entire right-of-way is included in this assessment. The 260 km (160 mi) of transmission line rights-of-way cross 10 counties in Alabama and Mississippi.

Continued maintenance activities on the transmission line rights-of-way used to connect BFN to the electric power grid will be required whether or not the proposed action is adopted. The TVA Transmission and Power Supply-Transmission Operations and Maintenance organization conducts maintenance activities on transmission lines and rights-of-way in the TVA system. These activities include, but are not restricted to, maintenance of vegetation in each right-of-way, replacement of poles or towers, installation of lightning arresters and counterpoise, and upgrading of existing equipment. Regular maintenance activities are conducted on a 3-to-5-year cycle (Muncy et al. 1999).

Transmission line maintenance activities are reviewed for potential resource issues by technical specialists in the TVA Regional Natural Heritage and Cultural Resources programs (Muncy et al. 1999). A 1.6-km (1.0-mi) buffer area is reviewed for the presence of terrestrial species, while a 16.1-km (10-mi) buffer area is used for aquatic species (TVA 2003b). The TVA Regional Natural Heritage program maintains a database of some 27,000-plus occurrence records for protected plants, animals, caves, National Wetland Inventory wetlands, cultural resources, and areas of management concern for the entire TVA Power Service Area. TVA also conducts fieldwork to inventory and protect threatened and endangered species and environmentally sensitive areas on public lands that it administers. Activities carried out by project staff members include monitoring species populations, educating the public, and managing and maintaining habitats (including caves) at TVA-managed sites.

Transmission line rights-of-way are regularly surveyed and video taped from helicopters. Video tapes can be used to search for sensitive habitat types before field crews are dispatched. Access routes and restrictions for maintenance activities are determined based on knowledge of the species or resources to be protected. Areas identified as sensitive are placed in different classes depending on the nature of the species or resources. In the most restricted areas (Class 2), vehicles and equipment are restricted from the site when habitat/sensitive resources are present, and all vegetation clearing is done by hand. In Class 1 sensitive areas, hand or mechanical clearing and herbicide use for vegetation control on transmission line rights-of-way is allowed. There is no broadcast application of herbicides in Class 1 sensitive areas. Herbicide application is carefully controlled, and personnel are trained, licensed, and follow manufacturer's guidelines, EPA guidance, and State regulations.

The streamside management zone is maintained to slow and spread surface water flow, to trap and filter suspended particulates before they reach the stream channel, protect stream bank integrity, and protect stream water temperature.

Category 1 issues in 10 CFR Part 51, Subpart A, Appendix B, Table B-1 that are applicable to transmission lines from BFN are listed in Table 4-5. The staff has not identified any new and significant information during its independent review of the TVA ER, the scoping process, the staff's site visit, consultation with the U.S. Fish and Wildlife Service (FWS) and the Alabama Division of Wildlife and Freshwater Fisheries (ADWFF), or its evaluation of other available information, such as operation at a combined total power level of 11,856 MW(t). 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.

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

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

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

  The staff has not identified any new and significant information during its independent review of the TVA ER, the scoping process, the staff's site visit, consultation with the FWS and ADWFF, or its evaluation of other available information, such as operation at a combined total power level of 11,856 MW(t). Therefore, the staff concludes that there are no impacts of transmission line rights-of-way maintenance during the license renewal term beyond those discussed in the GEIS.

Table 4-5. Category 1 Issues Applicable to the Browns Ferry Nuclear Power Plant, Units 1, 2, and 3 Transmission Lines During the License Renewal Term

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

- 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 TVA ER, the scoping process, the staff's site visit, consultation with the FWS and ADWFF, or its evaluation of other available information, such as operation at a combined total power level of 11,856 MW(t). Therefore, the staff concludes that there are no impacts of bird collisions with power lines during the license renewal term beyond those discussed in the GEIS.

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

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

  The staff has not identified any new and significant information during its independent review of the TVA ER, the scoping process, the staff's site visit, consultation with the FWS and ADWFF, or its evaluation of other available information, such as operation at a combined total power level of 11,856 MW(t). Therefore, the staff concludes that there are no impacts of electromagnetic fields on flora and fauna during the license renewal term beyond those discussed in the GEIS.

- Flood plains 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 TVA ER, the scoping process, the staff's site visit, consultation with the FWS and ADWFF, or its evaluation of other available information, such as operation at a combined total power level of 11,856 MW(t). Therefore, the staff concludes that there are no impacts of transmission line rights-of-way on flood plains and wetlands during the license renewal term beyond those discussed in the GEIS.

- Air-quality effects of transmission lines. Based on 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 TVA ER, the scoping process, the staff's site visit, or its evaluation of other available information, such as operation at a combined total power level of 11,856 MW(t). Therefore, the staff concludes that there are no air-quality impacts of transmission lines during the license renewal term beyond those discussed in the GEIS.

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

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

  The staff has not identified any new and significant information during its independent review of the TVA ER, the scoping process, the staff's site visit, or its evaluation of other available information, such as operation at a combined total power level of 11,856 MW(t). Therefore, the staff concludes that there are no onsite land-use impacts during the license renewal term beyond those discussed in the GEIS.

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

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

  The staff has not identified any new and significant information during its independent review of the TVA ER, the scoping process, the staff's site visit, or its evaluation of other available information, such as operation at a combined total power level of 11,856 MW(t). Therefore, the staff concludes that there are no impacts of power line rights-of-way on land use during the license renewal term beyond those discussed in the GEIS.

Category 2 and uncategorized issues in 10 CFR Part 51, Subpart A, Appendix B, Table B-1, that are applicable to transmission lines from BFN are listed in Table 4-6, and are discussed in Sections 4.2.1 and 4.2.2.

Table 4-6. Category 2 and Uncategorized Issues Applicable to the Browns Ferry Nuclear Power Plant, Units 1, 2, and 3 Transmission Lines During the License Renewal Term

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

4.2.1 Electromagnetic Fields – Acute Effects

In the GEIS (NRC 1996), the staff found that without a review of the conformance of each nuclear plant transmission line with National Electrical Safety Code (NESC) (IEEE 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), an 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 standard of 5 mA for preventing electric shock from induced currents.

The BFN site is connected to the TVA power system via seven 500-kV lines and two 161-kV lines. A study was completed by TVA to evaluate the transmission system against current NESC requirements (IEEE 2002). That study included evaluation of both the vertical clearance requirements and potential for shock from steady-state current caused by electrostatic effects for the largest equipment under the lines that could be short-circuited to ground. Drawings for each transmission line were reviewed and wire elevations were noted for road crossings under each line. Two types of roadways that passed under the lines were evaluated: (1) unpaved roadways where harvesting equipment might travel and (2) paved roadways (city, county, State, and Federal). The reference vehicles evaluated for electromagnetic field effects included a standard trailer, a cotton harvester, and an automobile. The electromagnetic field calculations were made using Version 3.1 of ENVIRO, which is a module of the Electric Power Research Institute (EPRI) electromagnetic field workstation. Steady-state current calculations were then made using procedures outlined in the EPRI Transmission Line Reference Book. The staff reviewed this study by the applicant, and concludes that the maximum steady-state current is less than the 2002 NESC standard of 5 mA. Therefore, the applicant completed the assessment required by 10 CFR 51.53. The staff concludes that the impact of the potential shock is SMALL, and additional mitigation measures are not warranted.

4.2.2 Electromagnetic Fields – Chronic Effects

In the GEIS, the chronic effects of 60-Hz electromagnetic fields from power lines were not designated as Category 1 or 2, and will not be 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). A NIEHS report (NIEHS 1999) contains the following conclusion:

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

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

4.3 Radiological Impacts of Normal Operations

Category 1 issues in 10 CFR Part 51, Subpart A, Appendix B, Table B-1, that are applicable to BFN in regard to radiological impacts are listed in Table 4-7. TVA stated in its ER (TVA 2003b) that it is not aware of any new and significant information associated with renewal of the BFN operating licenses (OLs).

The staff has not identified any new and significant information during its independent review of the TVA ER, the scoping process, the staff's site visit, or its evaluation of other available information, such as operation at a combined total power level of 11,856 MW(t). Therefore, the staff concludes that there are no impacts related to these issues beyond those discussed in the GEIS. For these issues, the staff concluded in the GEIS that the impacts are SMALL, and additional plant-specific mitigation measures are not likely to be sufficiently beneficial to be warranted.

Table 4-7. Category 1 Issues Applicable to Radiological Impacts of Normal Operations During the License Renewal Term

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

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

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

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

  The staff has not identified any new and significant information during its independent review of the TVA ER, the scoping process, the staff's site visit, or its evaluation of other available information, such as operation at a combined total power level of 11,856 MW(t). Any increases in radioactive effluents associated with plant operation at a combined total power level of 11,856 MW(t) for an additional 20 years would result in radiation doses to the public that would remain well within regulatory limits. These doses are not expected to result in health impacts to individuals or populations near the plant. Therefore, the staff concludes that there are no impacts of radiation exposures to the public during the license renewal term beyond those discussed in the GEIS.

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

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

  The staff has not identified any new and significant information during its independent review of the TVA ER, the scoping process, the staff's site visit, or its evaluation of other available information, such as operation at a combined total power level of 11,856 MW(t). Additional staff will be required to operate BFN at a combined total power level of 11,856 MW(t); however, the doses to individual plant workers would remain within regulatory limits. Therefore, the staff concludes that there are no impacts of occupational radiation exposures during the license renewal term beyond those discussed in the GEIS.

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

4.4 Socioeconomic Impacts of Plant Operations During the License Renewal Term

Category 1 issues in 10 CFR Part 51, Subpart A, Appendix B, Table B-1, that are applicable to socioeconomic impacts during the license renewal term are listed in Table 4-8. In its ER (TVA 2003b), TVA stated that it is not aware of any new and significant information associated with the license renewal of the BFN OLs. The staff has not identified any new and significant information during its independent review of the ER, the scoping process, the staff's site visit, or its evaluation of other available information, such as operation at a combined total power level of 11,856 MW(t).

Therefore, the staff concludes that there are no impacts related to these issues beyond those discussed in the GEIS (NRC 1996). For these issues, the staff concluded in the GEIS that the impacts are SMALL, and additional plant-specific mitigation measures are not likely to be sufficiently beneficial to be warranted.

Table 4-8. Category 1 Issues Applicable to Socioeconomics During the License Renewal Term

ISSUE—10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Section
SOCIOECONOMIC	
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

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

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

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

  The staff has not identified any new and significant information during its independent review of the TVA ER, the scoping process, the staff's site visit, or its evaluation of other available information, such as operation at a combined total power level of 11,856 MW(t). Therefore, the staff concludes that there are no impacts on public safety, social services, and tourism and recreation during the license renewal term beyond those discussed in the GEIS.

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

  Only impacts of small significance are expected.

  The staff has not identified any new and significant information during its independent review of the TVA ER, the scoping process, the staff's site visit, or its evaluation of other available information, such as operation at a combined total power level of 11,856 MW(t). Therefore, the staff concludes that there are no impacts on education during the license renewal term beyond those discussed in the GEIS.

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

  No significant impacts are expected during the license renewal term.

The staff has not identified any new and significant information during its independent review of the TVA ER, the scoping process, the staff's site visit, or its evaluation of other available information, such as operation at a combined total power level of 11,856 MW(t). Therefore, the staff concludes that there are no aesthetic impacts during the license renewal term beyond those discussed in the GEIS.

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

    No significant impacts are expected during the license renewal term.

    The staff has not identified any new and significant information during its independent review of the TVA ER, the scoping process, the staff's site visit, or its evaluation of other available information, such as operation at a combined total power level of 11,856 MW(t). Therefore, the staff concludes that there are no aesthetic impacts of transmission lines during the license renewal term beyond those discussed in the GEIS.

Table 4-9 lists the Category 2 socioeconomic issues that require plant-specific analysis and environmental justice, which was not addressed in the GEIS. These issues are discussed in Sections 4.4.1 through 4.4.6.

Table 4-9. Environmental Justice and GEIS Category 2 Issues Applicable to Socioeconomics During the License Renewal Term

ISSUE—10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Section	10 CFR 51.53(c)(3)(ii) Subparagraph	SEIS Section
	SOCIOECONOMIC		
Housing impacts	4.7.1	I	4.4.1
Public services: public utilities	4.7.3.5	I	4.4.2
Offsite land use (license renewal term)	4.7.4	I	4.4.3
Public services: transportation	4.7.3.2	J	4.4.4
Historic and archaeological resources	4.7.7	K	4.4.5
Environmental justice[a]	Not addressed	Not addressed	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 the licensee's ER and the staff's environmental impact statement (EIS).

4.4.1 Housing Impacts

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

In determining housing impacts, TVA chose to follow Appendix C of the GEIS (NRC 1996), which presents a population characterization method that is based on two factors, "sparseness" and "proximity." Sparseness measures population density within 32 km (20 mi) of the site, and proximity measures population density and city size within 80 km (50 mi). Each factor has categories of density and size (NRC 1996, Table C.1), and a matrix is used to rank the population category as low, medium, or high (NRC 1996, Figure C.1).

In 2000, the population living within 32 km (20 mi) of BFN was estimated to be approximately 164,936 (TVA 2003b). This total converts to a population density of about 52 persons/km^2 (136 persons/mi^2) living within a 32-km (20-mi) radius of BFN. This concentration falls into the GEIS sparseness Category 4 (i.e., having greater than or equal to 46 persons/km^2 [120 persons/mi^2]).

An estimated 872,478 people live within 80 km (50 mi) of the BFN site (TVA 2003b), equating to a population density of around 43 persons/km^2 (112 persons/mi^2). In addition, the City of Huntsville, which has a population of 158,216, is located about 48 km (30 miles) to the east of the site (TVA 2003b). Applying the GEIS proximity measures (NRC 1996), BFN is classified as Category 3 (i.e., having one or more cities with 100,000 or more persons and less than 73 persons/km^2 [190 persons/mi^2] within 80 km [50 mi] of the site). According to the GEIS, these sparseness and proximity scores identify the BFN nuclear units as being located in a high-population area.

10 CFR Part 51, Subpart A, Appendix B, Table B-1, states that impacts on housing availability are expected to be of SMALL significance at plants located in a high-population area where growth-control measures are not in effect. The BFN site is located in a high-population area. There are no restrictive growth-control measures that would limit housing development in Limestone County or any of its neighboring counties (Lawrence, Lauderdale, Madison, or Morgan Counties) (TVA 2003b).

SMALL impacts result when no discernible change in housing availability occurs, changes in rental rates and housing values are similar to those occurring statewide, and no housing construction or conversion is required to meet new demand (NRC 1996). The GEIS assumes that an additional staff of 60 permanent per-unit workers might be needed during the license renewal term to perform routine maintenance and other activities.

TVA plans no refurbishment activities as part of the license renewal process; therefore, employment will not change significantly in the area as a result of the license renewal of the plant. Activities related to the replacement of a cooling tower are outside the scope of license renewal because they are related to current operations and the restart of Unit 1.

The staff reviewed the available information relative to housing impacts and TVA's conclusions. Based on this review, including interviews with local real estate agents, the staff concludes that the impact on housing during the license renewal term would be SMALL, and additional mitigation is not warranted.

4.4.2 Public Services: Public Utilities

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

Analysis of impacts on the public water supply system considered both plant demand and plant-related population growth. Section 2.2.2 describes the BFN-permitted withdrawal rate and actual use of water. TVA plans no refurbishment activities at BFN so plant demand would not change beyond current demands (TVA 2004a).

For the sake of evaluation, the staff uses the employment projections for Unit 1 operation (150 new jobs), and an overall population increase of approximately 374 as a result of those jobs.[a] The plant-related population increase would require an additional 72 to 102 m^3/d (0.019 to 0.027 MGD) of water. This amount is within the total residual capacity of the water treatment plants serving BFN (Table 2-9). Thus, the staff concludes that the impact of increased water use resulting from the potential increase in employment is SMALL, and mitigation is not warranted.

4.4.3 Offsite Land Use

Offsite land use during the license renewal term is a Category 2 issue. Table B-1 of 10 CFR Part 51, Subpart A, Appendix B, notes that "significant changes in land use may be associated with population and tax revenue changes resulting from license renewal."

(a) Calculated by assuming that the average number of persons per household is 2.49 in the state of Alabama (150 jobs x 2.49 = 373.5) (USCB 2000).

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.

The current OLs for Units 1, 2, and 3 expire in 2013, 2014, and 2016, respectively. Unit 1 is currently not operating; however, TVA projects that operation will resume in 2007 (TVA 2003b). When Unit 1 resumes operation, the total permanent employment at the BFN site is expected to increase by 150 workers (TVA 2003b). TVA determined that no additional plant workers will be required during the license renewal term (TVA 2003b). Section 3.7.5 of the GEIS states that if plant-related population growth is less than 5 percent of the study area's total population, offsite land use changes would be small, especially if the study area has established patterns of residential and commercial development, a population density of at least 23 persons/km^2 (60 persons/mi^2), and at least one urban area with a population of 100,000 or more within 80 km (50 mi). For BFN, there is no expected population growth as a result of renewal of the three OLs. Consequently, the staff concludes that population changes resulting from license renewal are likely to result in minimal change to the land-use pattern in the area.

Tax revenue can affect land use because it enables local jurisdictions to be able 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 (10 to 20 percent) relative to the community's total revenue, new tax-driven, land-use changes would be moderate. This is most likely to be true where the community has no pre-established patterns of development (i.e., land-use plans or controls) or has not provided adequate public services to support and guide development in the past, especially infrastructure that would allow industrial development. If the plant's tax payments are projected to be a dominant source of the community's total revenue, new tax-driven, land-use changes would be large. This impact would be especially true where the community has no pre-established pattern of development or has not provided adequate public services to support and guide development in the past.

TVA makes tax-equivalent payments to the State of Alabama and local governments in eight states. These payments are redistributed by the state to the counties that are served by TVA power. See Section 2.2.8.5 for a discussion on the distribution of tax-equivalent payments to affected counties. A certain amount of this revenue is used for development and infrastructure within local communities. The portion of revenue in Limestone County and its subdivisons that is attributable to TVA payments for BFN is shown in Table 2-12. It is not expected that the percentages shown in Table 2-12 will vary significantly in the future (TVA 2003b). Consequently, the staff concludes that tax-driven, land-use impacts resulting from license renewal are likely to be minimal. Overall, changes in land use associated with population and tax revenue changes resulting from renewal of the BFN OLs are likely to be SMALL.

4.4.4 Public Services: Transportation

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

As noted in Section 2.2.8.2, BFN is approximately 16 km (10 mi) southwest of Athens in Limestone County and is located just south of U.S. Highway 72. The site is directly accessible from County Road 25. One portion of County Road 25 (Shaw Road) serves as a primary north-south corridor in the vicinity of the plant and intersects U.S. Highway 31 approximately 14.4 km (9 mi) east of the site. Browns Ferry Road, which intersects County Road 25 just east of the site, runs northeast from BFN and provides a direct route to BFN from Athens. The latest available 1998 average daily traffic counts in proximity to BFN indicate approximately 13,440 vehicles per day on U.S. Highway 72 north of the site and 16,260 vehicles per day on U.S. Highway 31 south of U.S. Highway 72. There are no available traffic counts on the county roads; however, TVA estimates approximately 1600 vehicles per day on Shaw Road, Browns Ferry Road, and Nuclear Plant Road. BFN is currently a primary source of traffic on these county roads (TVA 2003b).

The GEIS assumes that an additional 60 permanent workers per unit might be needed during the license renewal term to perform routine maintenance and other activities. This bounding scenario of 120 additional staff (60 workers each at Units 2 and 3) plus an additional 150 staff for operation of Unit 1 represents approximately 2 percent of the traffic volume on U.S. Highways 72 and 31. The total average daily traffic on Shaw Road, Nuclear Plant Road, and Browns Ferry Road would increase from approximately 1600 to 1870 (assuming no carpooling), which represents a 17 percent increase in average daily traffic.

To alleviate peak congestion and degradation of county roads in the vicinity of BFN, TVA identified specific site mitigation measures to improve the local roadway during peak periods. These mitigation measures include flexible working hours to reduce peak hours, delayed shift changes, restrictions for trucks traveling during peak hours, roadway improvements, which would include lane widening, realignment and lane addition, and repaving (TVA 2003b).

The staff reviewed the available information, including that provided by TVA, the scoping process, the staff's site visit, discussions with other agencies, and other public sources. Using this information, the staff evaluated the potential impacts to transportation service resulting from operation of BFN. It is the staff's conclusion that the potential impacts to transportation service degradation during the license renewal term are SMALL, considering that no additional staff are expected for renewal refurbishment activities. During the course of preparing this SEIS, the staff considered mitigation measures for the continued operation of BFN. When continued operation for an additional 20 years is considered as a whole, all the specific effects on the environment (whether or not "significant") were considered. Based on this assessment, the staff expects that the measures identified by BFN provide mitigation for all impacts related to transportation, and no new mitigation measures are warranted.

4.4.5 Historic and Archaeological Resources

The National Historic Preservation Act of 1966 (NHPA), as amended, requires Federal agencies to take into account the effects of their undertakings on historic properties. The historic preservation review process mandated by Section 106 of NHPA is outlined in regulations issued by the Advisory Council on Historic Preservation at 36 CFR Part 800. Operation of a nuclear power plant during the license renewal term could affect historic properties that may be located at the site. Therefore, in accordance with NHPA, NRC must make a reasonable effort to identify historic properties in the areas of potential effects. If no historic properties are present or affected, NRC is required to notify the State Historic Preservation Officer (SHPO) before proceeding. If it is determined that historic properties are present, NRC is required to assess and resolve possible adverse effects of the undertaking.

In 1972, TVA consulted with the Alabama Historical Commission for the construction of BFN as required by NHPA. In a letter dated March 16, 1972, the Alabama Historical Commission concluded that in the area of BFN nothing was found that would be adversely affected by the addition of the plant (AHC 1972). The original construction of the plant required the relocation of the Cox Cemetery. It was the opinion of the SHPO that the relocation of the cemetery occurred with considerable care.

In 2002, TVA prepared an SEIS for renewal of the BFN OLs (TVA 2002). In addition to the SEIS, TVA consulted with the Alabama SHPO regarding renewal of the BFN OLs. On April 24, 2002, the Alabama SHPO concurred with TVA that the project activities associated with license renewal at BFN would have no effect on significant cultural resources provided that site 1Li535 and the Cox Cemetery were avoided (SHPO 2002).

The NRC sent a letter to the Alabama SHPO, dated March 8, 2004 (NRC 2004b), and stated that in accordance with 36 CFR 800.8, the SEIS would include analyses of potential impacts to historic and archaeological resources. In the context of the NHPA, the NRC staff determined that the area of potential effect for a license renewal action is the area at the power plant site and its immediate environs, which may be impacted by post-license renewal land-disturbing operation or by projected refurbishment activities associated with the proposed action.

Seventeen Native American Tribes were sent letters on March 23, 2004, providing them with an opportunity to provide input regarding cultural resource issues in the vicinity of BFN and inviting them to participate in the National Environmental Policy Act of 1969 (NEPA) process. Several Federal and State agencies were contacted to identify tribes that may have a potential interest in the lands at BFN including the Alabama SHPO, the Advisory Council on Historic Preservation, the Bureau of Indian Affairs, the Alabama Department of Transportation, and the U.S. Forest Service. The Tribes contacted were the Poarch Creek Indians, Miccosukee Indian Tribe, Seminole Indian Tribe, Coushatta Indian Tribe, Jena Band of Choctaw Indians, Mississippi Band of Choctaw Indians, Eastern Band of Cherokee Indians, Alabama-Coushatta Tribe of Texas, Alabama-Quassarte Tribal Town, Cherokee Nation of Oklahoma, Chickasaw Nation, Choctaw Nation of Oklahoma, Kialegee Tribal Town, Muscogee (Creek) Nation, Seminole Nation of Oklahoma, Thlopthlocco Tribal Town, and United Keetoowah Band of Cherokee Indians. An example of one of the letters sent to the Tribes is included in Appendix E.

Operation of BFN, as planned under the application for license renewal, would protect undiscovered historic or archaeological resources on the site because the undeveloped natural landscape and vegetation would remain undisturbed, and access to the site would remain restricted.

TVA operating procedures take into account the inadvertent discovery of historic and archaeological remains at BFN. However, care should be taken during normal operational and maintenance conditions to ensure that historic resources are not inadvertently impacted. These activities may include not only operation of BFN itself but also land management-related actions such as recreation, wildlife habitat enhancement, and maintaining/upgrading BFN access roads through the site and on transmission line rights-of-way.

TVA recently conducted a study to determine if changes in the operating policies for TVA's reservoirs would produce greater overall public value. TVA prepared a programmatic EIS for the Reservoirs Operation Study (TVA 2004b). Consultations with seven SHPOs, including the Alabama Historical Commission, and other consulting parties under the requirements of

Section 106 of NHPA, have resulted in agreement(s) stipulating the actions TVA will take to avoid or reduce the adverse effects of the selected alternative on historic properties. The factors that were analyzed by TVA include shoreline erosion, exposure by elevation fluctuations, land development, and visual impacts. The agreement(s) developed can be found in the programmatic EIS for the Reservoirs Operation Study (TVA 2004b).

Based on the staff's archaeological and historic resources analysis and the consultation that has occurred, TVA's commitment that 1Li535 and the Cox Cemetery will be avoided, and the fact that operation will continue within the bounds of station operations as evaluated in the final EIS (TVA 1972), the staff concludes that the potential impacts on historic and archaeological resources are expected to be SMALL, and mitigation is not warranted.

4.4.6 Environmental Justice

Environmental justice refers to a Federal policy that requires Federal agencies to identify and address, as appropriate, disproportionately high and adverse human health or environmental effects of its actions on minority[(a)] or low-income populations. The memorandum accompanying Executive Order 12898 (59 FR 7629) directs Federal executive branch agencies to consider environmental justice under NEPA. The Commission's "Policy Statement on the Treatment of Environmental Justice Matters in NRC Regulatory and Licensing Actions" contains guidance and information for addressing environmental justice (69 FR 52040). Although the Executive Order is not mandatory for independent agencies, NRC has voluntarily committed to undertake environmental justice reviews. Specific guidance is provided in NRC Office of Nuclear Reactor Regulation Office Instruction LIC-203, Rev. 1 "Procedural Guidance for Preparing Environmental Assessments and Considering Environmental Issues" (NRC 2004b).

The staff examined the geographic distribution of minority and low-income populations within 80 km (50 mi) of the BFN site, employing the 2000 census (USCB 2000) for minority and low-income populations. The populations within an 80-km (50-mi) radius of BFN encompassed all or parts of 19 counties. The staff supplemented its analysis through the scoping process and by field inquiries to county planning departments, social service agencies, and local real estate agents.

For purposes of the staff's review, a minority population is defined to exist if the percentage of each minority, or aggregated minority category within the census tract or block group[(b)]

(a) The NRC Guidance for performing environmental justice reviews defines "minority" as American Indian or Alaskan Native, Asian or Pacific Islander, Black not of Hispanic Origin, or Hispanic (NRC 2004b).

(b) A census block group is a combination of census blocks, which are statistical subdivisions of a census tract. A census block is the smallest geographic entity for which the U.S. Census Bureau (USCB) potentially affected by the license renewal of BFN, exceeds the corresponding percentage of minorities in the entire state by 20 percent, or if the corresponding percentage of minorities within the census tract or block group is at least 50 percent. A low-income population is defined to exist if the percentage of low-income population within a census tract or block group exceeds the corresponding percentage of low-income population in the entire state by 20 percent, or if the corresponding percentage of low-income population within a census tract or block group is at least 50 percent. The minority population in the State of Alabama makes up 30 percent of the population and the low-income population makes up 16 percent of the total population in the state. The minority population in the State of Tennessee makes up 20 percent of the population and the low-income population makes up 14 percent of the total population in the state.

TVA used 2000 census data for identifying minority and low-income populations within the 80-km (50-mi) radius of the BFN site. TVA also followed the convention of employing census tracts within the 80-km (50-mi) radius of BFN (TVA 2003b), and the staff confirmed these results by examining the minority and low-income populations by census block group within the 80-km (50-mi) radius of the site. If the census tract or block group minority or low-income percentage exceeded the state by 20 percent then the census tract or block group was counted (TVA 2003b). Using this convention, the 80-km (50-mi) radius includes 74 census block groups for minority populations and 27 census block groups for low-income populations. Figure 4-1 shows the distribution of minority populations within the 80-km (50-mi) radius. The shaded areas in Figure 4-1 indicate census block groups where the aggregate percentage of minorities is at least 20 percentage points above the percentage of minorities in the States of Alabama and Tennessee or greater than 50 percent.

Minority population concentrations are present in eight counties within the 80-km (50-mi) radius of the BFN site. Minority populations are primarily concentrated in the urban center of Huntsville. Madison County contains 43 of the 74 block groups containing significant minority populations. The next greatest concentration of minority populations lives in Colbert and Morgan counties, which each have six block groups with significant minority populations. Lauderdale and Lawrence, Alabama each have five minority block groups. Limestone County, where BFN is located, has four minority block groups. The minority block groups in Morgan County are predominantly composed of black/African-American concentrations and are within the 16-km (10-mi) radius evacuation zone of BFN (USCB 2000; CDD 2004).

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

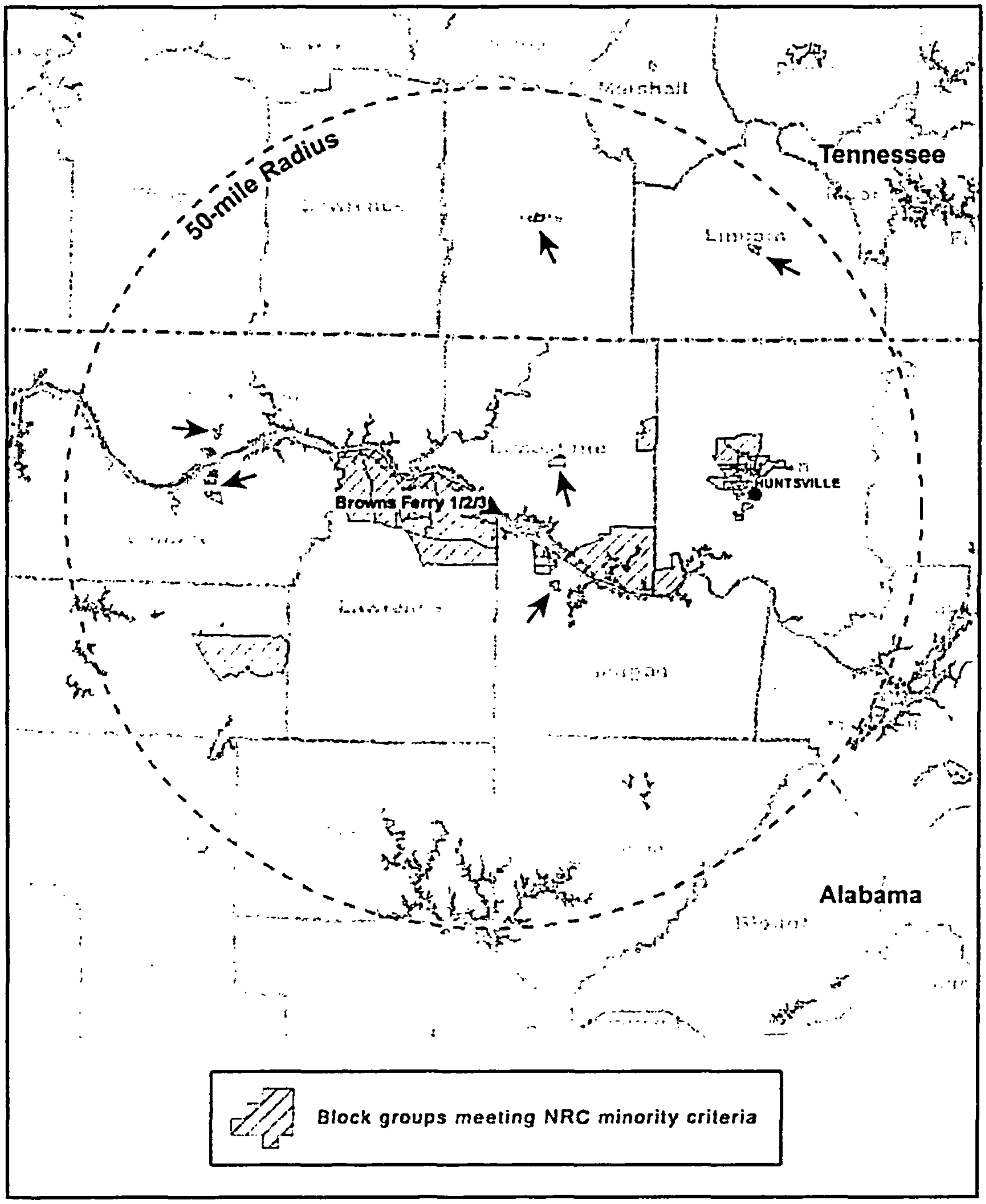

Figure 4-1. Geographic Distribution of Minority Populations (shaded areas) Within 80 km (50 mi) of Browns Ferry Nuclear Power Plant, Units 1, 2, and 3 Based on 2000 Census Block Group Data

Data from the 2000 census characterize low-income populations within the 80-km (50-mi) radius of the BFN site (USCB 2000). Applying the NRC criterion of "more than 20 percent greater" than the state average or "greater than 50 percent," the census block groups containing low-income populations were identified. Figure 4-2 shows the locations of the low-income populations within an 80-km (50-mi) radius of the BFN site. The low-income populations are concentrated around the urban center of Huntsville, where 11 of the 27 low-income block groups are found. Lauderdale County has seven additional low-income block groups, while Colbert County has four block groups. Franklin, Morgan, and Winston counties in Alabama, and Lawrence and Lincoln counties in Tennessee only have 1 low-income block group each.

With the locations of minority and low-income populations identified, the staff proceeded to evaluate whether any of the environmental impacts of the proposed action could affect these populations in a disproportionately high and adverse manner. Based on staff guidance (NRC 2004b), air, land, and water resources within about 80 km (50 mi) of the BFN site were examined. Within that area, a few potential environmental impacts could affect human populations; all of these impacts were considered minimal for the general population.

The environmental impacts associated with BFN license renewal that could affect human populations are discussed in each associated section. The staff found no unusual resource dependencies or practices such as subsistence agriculture, hunting, or fishing through which minority and/or low-income populations could be disproportionately highly and adversely affected. In addition, the staff did not identify any location-dependent disproportionately high and adverse impacts affecting these minority and low-income populations. The staff concludes that offsite impacts from BFN to minority and low-income populations are SMALL, and no special mitigation actions are warranted.

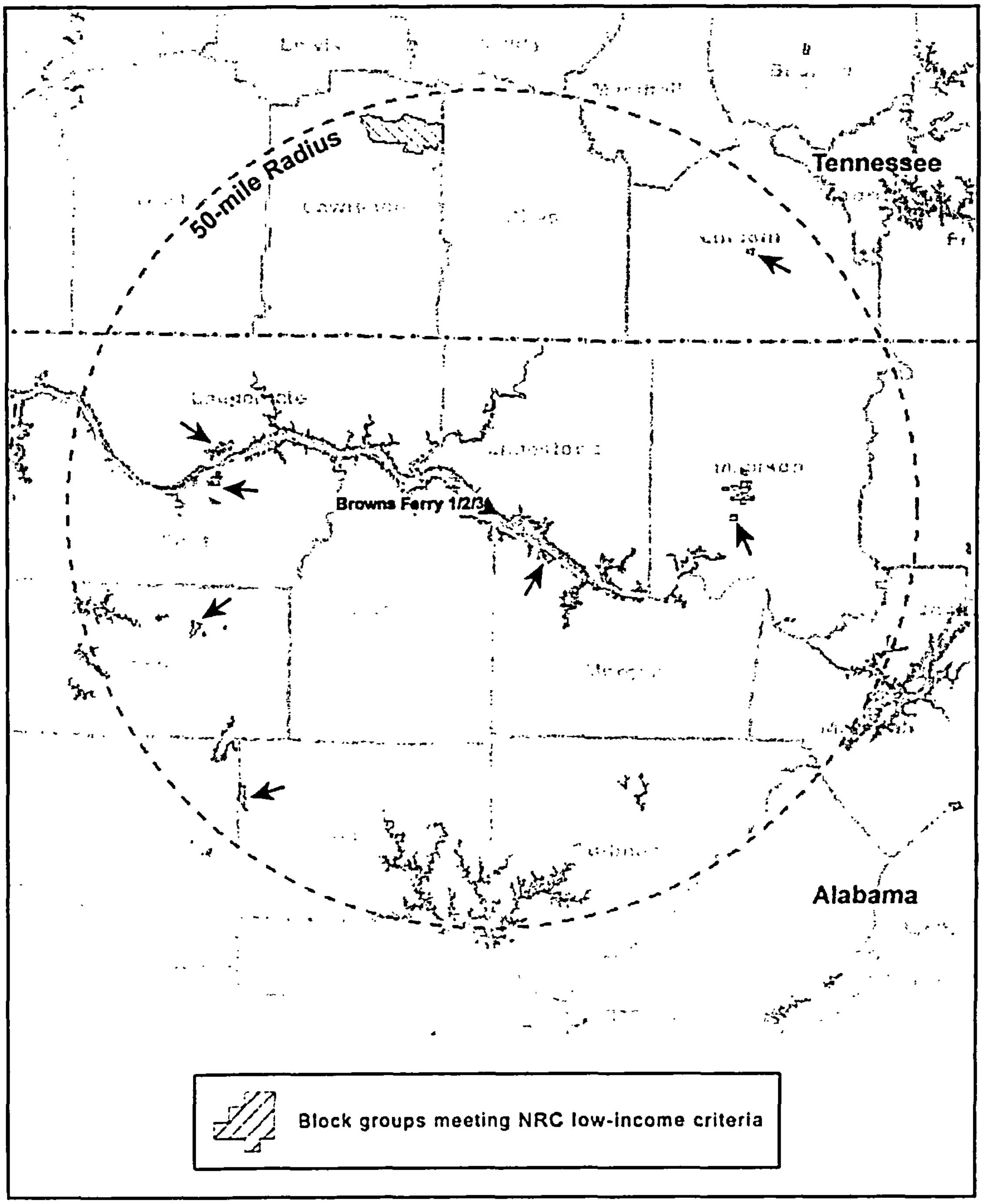

Figure 4-2. Geographic Distribution of Low-Income Populations (shaded areas) Within 80 km (50 mi) of Browns Ferry Nuclear Power Plant, Units 1, 2, and 3 Based on 2000 Census Block Group Data

4.5 Groundwater Use and Quality

The Category 1 issues related to groundwater use conflicts during the license renewal term that are applicable to BFN are discussed in the section that follows, and are listed in Table 4-10.

Table 4-10. Category 1 Issues Applicable to Groundwater Use Conflicts of Browns Ferry Nuclear Power Plant, Units 1, 2, and 3 During the License Renewal Term

ISSUE 10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Sections
(FOR POTABLE AND SERVICE WATER PLANTS USING < 100 GPM)	
Groundwater use conflicts (potable and service water plants that use <100 gpm)	4.8.1.1

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

  > Groundwater use conflicts related to potable and service water plants using <100 gpm 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.

BFN does not withdraw groundwater for potable or service water use. The staff has not identified any new and significant information during its independent review of the TVA ER, the scoping process, the staff's site visit, or its evaluation of other available information, such as operation at a combined total power level of 11,856 MW(t). Therefore, the staff concludes that there are no impacts of groundwater use conflicts related to potable and service water plants using less than 6.3 L/sec (100 gpm) during the license renewal term beyond those discussed in the GEIS.

The Category 2 issues related to groundwater-use conflicts during the license renewal term that are applicable to BFN are listed in Table 4-11 and are discussed in Section 4.5.1.

Table 4-11. Category 2 Issue Applicable to Groundwater Use Conflicts of Browns Ferry Nuclear Power Plant, Units 1, 2, and 3 During the License Renewal Term

ISSUE 10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Sections	10 CFR 51.53(c)(3)(ii) Subparagraph	SEIS Section
AQUATIC ECOLOGY			
(FOR PLANTS WITH COOLING TOWERS WITHDRAWING MAKEUP WATER FROM A SMALL RIVER)			
Groundwater use conflicts (plants using cooling towers and withdrawing makeup water from a small river)	4.8.1.3	B	4.5.1

4.5.1 Groundwater Use Conflicts (plants using cooling towers and withdrawing make-up water from a small river)

For plants using makeup water from a small river, potential use conflicts is a Category 2 issue, which requires a site-specific assessment prior to license renewal. The Tennessee River average annual flow at BFN for the period from 1976 through 2002 was 1320 m^3/s (46,606 ft^3/s) or 4.16×10^{10} m^3/yr (1.47×10^{12} ft^3/yr). This is less than the 9×10^{10} m^3/yr (3.15×10^{12} ft^3/yr) criterion stated by NRC in 10 CFR 51.53(c)(3)(ii)(A) as the value beneath which an assessment of the impact of the proposed action must be provided.

NRC has determined that indirect groundwater-use conflicts can result from surface water withdrawal from a small river (NRC 1996). It is a potentially important concern that has been designated a Category 2 issue. Rivers often supply alluvial aquifers, and large-scale withdrawals of makeup water for evaporative loss could impact an alluvial aquifer during periods of low flow. This does not occur at BFN as described below.

BFN uses cooling towers and withdraws makeup water from the Tennessee River; however, there are no existing or proposed offsite or onsite groundwater supply wells. Rights to "use" of groundwater at BFN were acquired by ownership of property overlying aquifers. There are no future water rights to groundwater underlying BFN (including Native American tribal rights).

Although shallow groundwater at BFN can occur within unconsolidated terrace deposits of alluvial origin, the terrace deposits are not recognized as an aquifer at the site. This is primarily because of the limited permeability and spatial extent of the terrace deposits. Therefore, groundwater-use conflicts associated with surface water withdrawals are small and may only occur during low flow conditions, which may affect aquifer recharge.

A total of 18 environmental monitoring wells have been installed at the BFN site since 1980, and groundwater level measurements were monitored on a monthly basis through 1989. The water levels in those wells have fluctuated throughout the year; however, there is no decreasing trend (Julian 2004). This indicates that site surface water consumption had not indirectly lowered groundwater levels or created conflicts through 1989.

The water levels in Wheeler Reservoir throughout 2003 and for the period from 1991 to 1997 were consistent with those from 1972 to 1990 (Julian 2004). This indicates that reservoir levels have had consistent annual profiles since routine site groundwater monitoring ceased in 1989. Furthermore, because the lake levels have not dropped since 1991, site surface water consumption has not indirectly lowered groundwater levels or created groundwater conflicts since site monitoring ceased in 1989.

An offsite well survey was conducted in May 1995 to identify groundwater supplies within a 3.2-km (2-mi) radius of the BFN site (TVA 1999). The closest known public groundwater supply (Limestone County Water System, Well G-1) resides approximately 3.2 km (2 mi) north of BFN (Bohac 2004). There is no groundwater use by BFN, and site dewatering wells have been inactive since the 1980s. All wells at the site are used for environmental monitoring purposes only.

The staff independently reviewed the TVA ER (TVA 2003b) and visited the site. Also, the potential for water-use conflicts was reviewed directly with respect to surface water withdrawals in Section 4.1.1 and was found to be SMALL. Because no groundwater is used at the plant, and the terrace deposits are characterized by limited permeability, the indirect use of groundwater by surface water withdrawal is even more remote. Surface water withdrawals for cooling system makeup water is not expected to affect groundwater levels. Therefore, the staff concludes that groundwater use conflicts would be SMALL.

4.6 Threatened or Endangered Species

Threatened or endangered species are listed as a Category 2 issue in 10 CFR Part 51, Subpart A, Appendix B, Table B-1. This issue is listed in Table 4-12.

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 plant during the license renewal term. The presence of threatened or endangered species in the vicinity of the BFN site is discussed in Sections 2.2.5 and 2.2.6. On March 4, 2004, the staff contacted the FWS to request information on threatened and endangered species and the impacts of license renewal (NRC 2004c). In response, on May 19, 2004, the FWS provided additional information regarding Federally listed species that have been observed or may occur in the vicinity of the BFN site and its associated transmission lines, as well as the concerns that the FWS have regarding those species (Goldman 2004). On October 25, 2004 the staff sent (NRC 2004d) a biological assessment (BA) (see Appendix E) to the FWS for concurrence.

Table 4-12. Category 2 Issue Applicable to Threatened or Endangered Species in the Vicinity of Browns Ferry Nuclear Power Plant, Units 1, 2, and 3 During the License Renewal Term

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

4.6.1 Aquatic Species

As described in Section 2.2.5, there are 38 Federally listed aquatic species (including three candidate species) that occur or historically have occurred in either Wheeler Reservoir or its tributaries or in other streams, rivers, or caves within the counties of Alabama and Mississippi through which the BFN transmission lines pass. The species that occur in Wheeler Reservoir and its tributaries are not impacted by plant operations. During BFN's thermal variance monitoring (1985 to 1998) and current Vital Signs Monitoring Programs, no threatened or endangered aquatic species were found within the area that would be affected by operational changes at BFN (TVA 2003b). Additionally, cooling water intake and discharge are closely monitored under the NPDES program, and permit limits are reviewed on a regular basis by State regulatory agencies to ensure the protection of aquatic biota.

A number of listed species occur in the counties crossed by the BFN transmission lines; however, this does not imply that they occur under or near the transmission lines. The TVA Regional Natural Heritage Program keeps track of Federally and State-protected species. Aquatic animal occurrence records are maintained and updated by TVA staff on a regular basis. Each proposed transmission line vegetation management project is reviewed for the known or likely occurrence of protected aquatic species in streams in or adjacent to the transmission line rights-of-way. A 16-km (10-mi) buffer area around the transmission line being reviewed is examined to determine the likely occurrence of protected aquatic animals. Once an occurrence is located, appropriate class restrictions are applied (see Section 4.2). Furthermore, best management practices, outlined by Muncy et al. (1999), are employed to protect listed species and their habitats while carrying out vegetation management activities along the transmission lines (TVA 2003b).

The staff concluded in its BA (NRC 2004d) that continued operation of BFN, including return to three-unit operation at a total combined power level of 11,856 MW(t) and the associated transmission line rights-of-way maintenance activities during the license renewal term, will have no effect, or is not likely to adversely affect any Federally listed aquatic species, nor will it adversely impact any designated critical habitat. Thus, the staff concludes that the impact on threatened or endangered aquatic species from an additional 20 years of operation would be SMALL, and additional mitigation is not warranted.

4.6.2 Terrestrial Species

No Federally listed species are known to occur within 5 km (3 mi) of the BFN site (TVA 2003b). Although no Federally or State-listed species have been reported from areas within 5 km (3 mi) of BFN, a total of 11 Federally listed species have been identified from counties traversed by transmission line rights-of-way along with over 200 State-listed species. Federally listed species reported to occur from Limestone, Morgan, Lawrence, Colbert, and Franklin counties in Alabama and Tishomingo, Itawamba, Lee, and Union Counties in Mississippi are the bald eagle, red-cockaded woodpecker, gray bat, Indiana bat, Price's potato-bean, American hart's tongue fern, leafy prairie clover, Eggert's sunflower, fleshy-fruited gladecress, lyrate bladder-pod, and the Tennessee yellow-eyed grass.

Habitat for some of the Federally listed species and some of the State-listed species could be found within or traversed by BFN transmission line rights-of-way. Two wildlife management areas occur within 5 km (3 mi) of the BFN site – Swan Creek State Wildlife Management Area and Mallard-Fox Creek State Wildlife Management Area (TVA 2003b). Approximately 5.6 km (3.5 mi) upstream of BFN is the Round Island Recreation Area. The BFN-to-Maury, Alabama, transmission line right-of-way is near the Philadelphia Glade and the Swan Creek State Wildlife Management Area. The BFN-to-Union, Mississippi, transmission line right-of-way crosses the John Bell Williams State Wildlife Management Area, the Natchez Trace National Parkway, the Tennessee-Tombigbee Waterway, the Foxtrap Creek Ravine Potential National Natural Landmark, the Canal Section Wildlife Management Area, East Fork Tombigbee Macrosite, Bear Creek Unit 2 proposed critical habitat, and is near the Lake Lamar Bruce State Fishing Area. The BFN-to-Trinity and BFN to Athens transmission line rights-of-way do not cross any natural areas. The BFN-to-Trinity transmission right-of-way does pass near the Mallard-Fox Creek State Wildlife Management Area.

TVA monitors and tracks populations of Federally and State-sensitive terrestrial species on the BFN site and within transmission line rights-of-way. In addition, TVA works with appropriate Federal and State agencies to develop and establish guidelines and safeguards for their contract personnel to follow to protect threatened and endangered species and their habitats during maintenance of transmission line rights-of-way (Muncy et al. 1999).

The staff concluded in its BA (NRC 2004d) that continued operation of BFN, including return to three-unit operation at a total combined power level of 11,856 MW(t) and the associated transmission line rights-of-way maintenance activities during the license renewal term, will have no effect, or is not likely to adversely affect any Federally listed terrestrial species, nor will it adversely impact any designated critical habitat. Thus, the staff concludes that the impact on threatened or endangered terrestrial species from an additional 20 years of operation would be SMALL, and additional mitigation is not warranted.

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

The GEIS assesses 92 environmental issues. Sixty-nine of these issues were found to be Category 1 issues, and are identified in 10 CFR Part 51 as not requiring additional plant-specific analysis in the absence of new and significant information. The staff 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 TVA is in compliance with applicable environmental standards and requirements for BFN. The staff has not identified any environmental issues that are both new and significant.

The staff identified one potential area that required further analysis. Category 1 issues were established by the GEIS after a review of data from existing operating nuclear plants. The analysis established an envelope of impact for each of the Category 1 issues that were based on the impacts that were identified at nuclear power plants throughout the United States at the time the GEIS was prepared. TVA has applied for extended power uprate (EPU) for the three BFN units. These EPUs would eventually increase thermal power levels from the initially licensed levels of 3293 MW(t)/unit to 3952 MW(t)/unit. This represents a total power increase of 20 percent. Once the uprate has been achieved, BFN will have a combined total power level of 11,856 MW(t), and will become the largest nuclear power plant in the United States.

For this reason, the staff determined that there is a potential that, at the uprated power level, BFN may no longer be within the envelope of impacts defined by the GEIS, as amended, for some Category 1 issues. If the potential impacts are beyond the defined envelope, the generic conclusions concerning these Category 1 issues may no longer be valid, and the power uprate could therefore represent new and significant information regarding some of the Category 1 issues. Category 2 issues are not a concern in this regard because all applicable Category 2 issues are evaluated on a site-specific basis for each facility undergoing license renewal.

To address this concern, the staff examined each of the 54 Category 1 issues applicable to BFN and determined that 34 of the Category 1 issues could be influenced by the station thermal power level. The staff then evaluated each of the 34 issues to determine if increasing the unit power level above the levels considered during the development of the GEIS would affect the specific generic conclusions. After evaluating all 34 issues the staff determined that the generic conclusions reached in the GEIS are still valid and that no additional analysis or evaluation of these issues is necessary. The 34 issues evaluated are listed in Tables 4-13 through 4-17. An explanation of why the GEIS conclusion is still valid for the uprated BFN site is provided following each table.

- Altered current patterns at intake and discharge structures

Any localized effects on current patterns would have been manifest during the initial stages of three-unit operation and would have been mitigated, if necessary, at that time. Three-unit operation at BFN, at the combined total power level of 11,856 WM (t) expected during the license renewal term, uses existing intake and discharge structures, and although re-tubing the condensers, upgrading other systems, and improving flow calibrations have increased the flow

Table 4-13. Cooling System-Related Category 1 Issues that are Potentially Affected by Proposed Extended Power Uprates at Browns Ferry Nuclear Power Plant, Units 1, 2, and 3

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	4.2.1.2.3; 4.4.4.2
Temperature effects on sediment transport capacity	4.2.1.2.3; 4.4.2.2
Scouring caused by discharged cooling water	4.2.1.2.3; 4.4.2.2
Eutrophication	4.2.1.2.3; 4.4.2.2
Discharge of chlorine or other biocides	4.2.1.2.4; 4.4.2.2
Discharge of other metals in wastewater	4.2.1.2.4; 4.3.2.2; 4.4.2.2
Water use conflicts (plants with once-through cooling systems)	4.2.1.3
AQUATIC ECOLOGY (for all plants)	
Accumulation of contaminants in sediments or biota	4.2.1.2.4; 4.3.3; 4.4.3; 4.4.2.2
Entrainment of phytoplankton and zooplankton	4.2.2.1.1; 4.3.3; 4.4.3
Cold shock	4.2.2.1.5; 4.3.3; 4.4.3
Thermal plume barrier to migrating fish	4.2.2.1.6; 4.4.3
Distribution of aquatic organisms	4.2.2.1.6; 4.4.3
Low dissolved oxygen in the discharge	4.2.2.1.9; 4.3.3; 4.4.3
SURFACE WATER QUALITY, HYDROLOGY, AND USE (FOR ALL PLANTS)	
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
Premature emergence of aquatic insects	4.2.2.1.7; 4.4.3
TERRESTRIAL RESOURCES	
Cooling tower impacts on crops and ornamental vegetation	4.3.4
Cooling tower impacts on native plants	4.3.5.1
HUMAN HEALTH	
Microbiological organisms (occupational health)	4.3.6
Noise	4.3.7

rate compared to the original three-unit operation, no increase in the total flow rate is expected as a result of the EPU operation (TVA 2002). Total intake flow is expected to be a maximum of 139 m^3/s (4907 cfs) or 12 million m^3/d (3171 MGD) (TVA 2003b). The staff concludes that the cooling system operation on current patterns is within the envelope of impacts considered in the GEIS as a Category 1 issue.

- Altered thermal stratification of lakes

TVA has modeled temperature stratification in Wheeler Reservoir with near- and far-field modeling. Three-unit operation at BFN, at the combined total power level of 11,856 MW(t) expected during the license renewal term, will increase the water discharge temperature (Hopping 2004) and presumably would affect the thermal stratification; however, discharge temperatures will not exceed temperature limits set by the NPDES permit. The licensee will be required to operate within the limits of the NPDES permit during the license renewal term. The limits impose the most severe restrictions in the late summer when thermal stratification is most pronounced at the reservoir. The staff concludes that the effect of the cooling system operation on altered thermal stratification is within the envelope of impacts considered in the GEIS as a Category 1 issue.

- Temperature effects on sediment transport capacity

Three-unit operation at BFN, at the combined total power level of 11,856 MW(t) expected during the license renewal term, will increase the water discharge temperature and theoretically could decrease viscosity and change the sediment transport capacity within the Tennessee River. The difference in the discharge temperature is not significant relative to changing the viscosity of the water, and the area of the reservoir affected by elevated temperature is small. This would not result in a detectable change in sediment transport capacity. The staff concludes that the effect of the cooling system operation on temperature effects on sediment transport capacity is within the envelope of impacts considered in the GEIS as a Category 1 issue.

- Scouring caused by discharged cooling water

Three-unit operation at BFN, even at the combined total power level of 11,856 MW(t) expected during the license renewal term, uses existing intake and discharge structures and "no changes are expected to the individual unit flow rates as a result of EPU" (TVA 2002). Total intake flow is expected to be a maximum of 139 m^3/s (4907 cfs) or 12 million m^3/d (3171 MGD) (TVA 2003b). The staff concludes that the effect of the cooling system operation on scouring is within the envelope of impacts considered in the GEIS as a Category 1 issue.

- Eutrophication

Three-unit operation at BFN, at the combined total power level of 11,856 MW(t) expected during the license renewal term, will increase water discharge temperature, but all discharges will continue to be within the thermal limits established in the NPDES permit. The licensee will be required to operate within the limits of the NPDES permit during the license renewal term. The limits impose the most severe restrictions in the late summer when thermal stratification is most pronounced in the reservoir. The staff concludes that the effect of the cooling system operation on eutrophication is within the envelope of impacts considered in the GEIS as a Category 1 issue.

- Discharge of chlorine or other biocides

BFN uses some biocides in parts of the service water system, but currently does not use chlorine or other biocides in the cooling water system. Therefore, resumption of three-unit operation at BFN, even at the 120 percent EPU expected during the license renewal term, is not likely to alter the quantity of biocides released from the station. Based on the need to stay within NPDES limits, no additional mitigation measures to reduce the discharge of biocides are necessary during the license renewal term. The effect of the cooling system operation on discharge of biocides is within the envelope of impacts considered in the GEIS as a Category 1 issue.

- Discharge of other metals in waste water

Three-unit operation at BFN at the combined total power level of 11,856 MW(t) expected during the license renewal term uses existing intake and discharge structures and "no changes are expected to the individual unit flow rates as a result of EPU" (TVA 2002). Total intake flow is expected to be a maximum of 139 m^3/s (4907 cfs) or 12 million m^3/d (3171 MGD) (TVA 2003b). Discharges of heavy metals are controlled under the NPDES permitting system administered by the State of Alabama. The current NPDES permit restricts the discharge of heavy metals. Furthermore, the main condensers of all three units will be re-tubed with stainless steel prior to the license renewal term. The staff concludes that the effect of the cooling system operation on discharge of metals in waste water is within the envelope of impacts considered in the GEIS as a Category 1 issue.

- Water-use conflicts (plants with once-through cooling systems)

Three-unit operation at BFN, at the combined total power level of 11,856 MW(t) expected during the license renewal term, uses existing intake and discharge structures and "no changes are expected to the individual unit flow rates as a result of EPU" (TVA 2002). Consumptive and off-stream water uses have not resulted in significant water-use conflicts because of the large volume of Wheeler Reservoir water available, the high river flow rate, and the return of most of the water withdrawn (TVA 2003b). Regulatory control of withdrawal rates and NPDES permit limits for return water quality also mitigate potential conflicts. The staff concludes that the effect of water-use conflicts is within the envelope of impacts considered in the GEIS as a Category 1 issue.

- Accumulation of contaminants in sediments or biota

The three-unit operation at BFN, at the combined total power level of 11,856 WM(t) expected during the license renewal term, uses existing intake and discharge structures and "no changes are expected to the individual unit flow rates as a result of EPU" (TVA 2002). The condensers at BFN are being re-tubed with stainless steel tubing (TVA 2003b). Therefore, accumulation of contaminants associated with the condenser tubes in sediment or biota would not be expected to be a concern during the license renewal term. Furthermore, compliance with the NPDES permit, other provisions of the FWPCA (e.g., Sections 316(a) and 316(b), 401, and 404), and other regulatory requirements are expected to adequately control potential chemical effluent effects (TVA 2003b). The staff concludes that the effect of the accumulation of contaminants in sediments or biota is within the envelope of impacts considered in the GEIS as a Category 1 issue.

- Entrainment of phytoplankton and zooplankton

Because of the large numbers and short generation times of phytoplankton and zooplankton, impacts of entrainment on these organisms have rarely been documented outside the immediate vicinity of the plant and are considered to be of little consequence (NRC 1996). Algal surveys conducted in 1989 (during plant shutdown) and again in 1991 (during plant operation) did not indicate that operation of BFN under current thermal plume criteria had any impact on the phytoplankton community of Wheeler Reservoir (Lowery and Poppe 1992). Results from a two-dimensional, far-field model that included an assessment of the effects on reservoir algal biomass were essentially unchanged with all three units operating at a combined total power level of 11,856 MW(t) (TVA 2003b). The staff concludes that the effect on entrainment of phytoplankton or zooplankton is within the envelope of impacts considered in the GEIS as a Category 1 issue.

- Cold shock

It would not be expected that all three units would go off-line at the same time. Cold-shock mortalities, even at one-unit plants, are relatively rare and usually involve small numbers of fish. No population-level impacts have been observed (NRC 1996). Therefore, any fish that do occupy the thermal plume during winter conditions would still have areas of above-ambient temperatures to occupy during one- or two-unit operation. Furthermore, the high-velocity diffusers provide for rapid mixing of the heated discharge waters with ambient-temperature river water and discourage fish from residing in the warmest portion of the plume. The staff concludes that the effect of cold shock from operation is within the envelope of impacts considered in the GEIS as a Category 1 issue.

- Thermal plume barrier to migrating fish

The impact of the thermal plume is constrained by the NPDES permit. The NPDES permit limits are designed to protect aquatic species, in particular, to prevent the establishment of a thermal plume barrier to fish migration. The licensee will be required to operate within the limits of the NPDES permit during the license renewal term. Furthermore, fish species typical of those that predominate Wheeler Reservoir have a range difference of at least 5°C (9°F) to over 10°C (18°F) between their acclimation temperature and upper avoidance temperature (Cherry et al. 1975). The staff concludes the effect of the thermal plume as a barrier to migrating fish is within the envelope of impacts considered in the GEIS as a Category 1 issue.

- Distribution of aquatic organisms

Past operations of BFN have not been shown to affect the distribution of aquatic organisms in Wheeler Reservoir (TVA 2003b). As discussed in Section 2.2.5, the aquatic biota are primarily affected by physical and chemical changes to the Tennessee River that have occurred from its modification from a free-flowing river to a series of run-of-the-river reservoirs. Within the reservoir, there are three somewhat distinct zones: the tailwaters of the upstream dam, the transition area (within which BFN is located), and the more lacustrine (lake-like) conditions in the area upstream of the reservoir dam. The distribution of aquatic biota in Wheeler Reservoir is primarily influenced by the habitats and physicochemical conditions within each zone. The staff concludes the effect of the distribution of aquatic organisms is within the envelope of impacts considered in the GEIS as a Category 1 issue.

- Premature emergence of aquatic insects

The discharge diffusers will ensure adequate mixing of the discharge flow and the receiving waters. Typically, the warmer water is buoyant and does not impinge directly on the reservoir substrate. The licensee has a considerable amount of benthic data from Wheeler Reservoir that show no impact related to premature emergence of insects. The additional heat associated with the combined total power level of 11,856 MW(t) is not expected to significantly increase the amount of benthic invertebrate habitat that is subject to elevated temperatures. The staff concludes the effect of thermal discharge on premature emergence of aquatic insects is within the envelope of impacts considered in the GEIS as a Category 1 issue.

- <u>Low dissolved oxygen in the discharge</u>

Current dissolved oxygen levels near the BFN site are rated "good" by TVA (TVA 2004b). Results from simulations using a two-dimensional, far-field model that included an assessment of the effects on reservoir dissolved oxygen concentrations were essentially unchanged under all three units operating at a combined total power level of 11,856 MW(t) (TVA 2003b). Thus, as long as the licensee maintains compliance with the NPDES regulatory requirements, operation of all three units at a combined total power level of 11,856 MW(t) of original power is expected to have insignificant effects on dissolved oxygen concentrations. The staff concludes the effect of low dissolved oxygen discharges is within the envelope of impacts considered in the GEIS as a Category 1 issue.

- <u>Losses from predation, parasitism, and disease among organisms exposed to sublethal stresses</u>

Although it is likely that operation of a once-through cooling system will cause some changes in predator-prey relationships, the fact that no long-term changes in population- or community-level effects from operation of BFN have been observed (TVA 2003b) is evidence that losses from predation, parasitism, and disease are not occurring from sublethal stresses (NRC 1996). The Vital Signs Monitoring Program and other assessments of aquatic biota in Wheeler Reservoir have not demonstrated any changes to aquatic organisms related to predation, parasitism, or disease that could be attributable to sublethal stresses (thermal, physical, or chemical) caused by operations of BFN. The Vital Signs Monitoring Reservoir Fish Assemblage Index has been determined for fish in Wheeler Reservoir since the early 1990s. This index considers fish disease, lesions, parasites, and abnormalities as factors in determining the index. The index value downstream of BFN has been as good as or better than other portions of the reservoir (Section 2.2.5). No fish consumption advisories exist for mainstem Wheeler Reservoir (Section 2.2.5). Thermal and chemical discharges from BFN are governed by the NPDES permit. Thermal and chemical discharges can stress aquatic organisms leading to increased parasitism and disease. Discharge limits are established at levels that are protective of aquatic biota. As permit conditions would not change, the effects of BFN operation at a combined total power level of 11,856 MW(t) on predation, parasitism, and disease on organisms exposed to sublethal stresses would likely remain the same. The staff concludes that the effect of predation, parasitism, and disease among organisms exposed to sublethal stresses is within the envelope of impacts considered in the GEIS as a Category 1 issue.

- <u>Stimulation of nuisance organisms</u>

Past operations of BFN have not been shown to stimulate nuisance organisms. Water levels in Wheeler Reservoir are actively managed during the summer to limit mosquito breeding habitat (Section 2.2.5). Physical and chemical treatment of the cooling system has had a controlling influence on the Asiatic clam (*Corbicula fluminea*) in the immediate plant area. Thermal discharges in the immediate area of the diffusers are at a level that can adversely impact Asiatic clams. When ambient reservoir temperatures are 22.4°C (72.4°F) or more, the maximum 24-hour average temperature rise of 5.6°C (10°F) would be above the optimum summer temperatures for the zebra mussel (*Dreissena polymorpha*). Therefore, increased thermal loading associated with operation of the plant at 120 percent power levels would have a further localized controlling influence over these nuisance species. The staff concludes that the effect on the stimulation of nuisance organisms is within the envelope of impacts considered in the GEIS as a Category 1 issue.

- <u>Cooling tower impacts on crops and ornamental vegetation</u>

Although the cooling towers are likely to be operated more frequently with three units operating at a combined total power level of 11,856 MW(t) (TVA 2003b), because they are helper towers, they will be operated less frequently than those located at plants with closed-cycle cooling systems. The staff determined in the GEIS that cooling tower impacts on crops and ornamental vegetation at plants where the cooling towers are operated continuously was not significant. The staff concludes that the impacts of cooling tower operation on crops and ornamental vegetation are within the envelope of impacts considered in the GEIS as a Category 1 issue.

- <u>Cooling tower impacts on native vegetation</u>

Although the cooling towers are likely to be operated more frequently with three units operating at a combined total power level of 11,856 MW(t) (TVA 2003b), because they are helper towers, they will be operated less frequently than those located at plants with a closed-cycle cooling system. The staff determined in the GEIS that cooling tower impacts on native vegetation at plants where the cooling towers are operated continuously was not significant. The staff concludes that the impacts of cooling tower operation on native vegetation are within the envelope of impacts considered in the GEIS as a Category 1 issue.

- <u>Microbiological organisms (occupational health)</u>

As discussed in Section 4.1.5, some thermophilic microbiological organisms have a range of optimum conditions within the range of temperatures that would occur at either 100 percent or 120 percent power levels. BFN was one of nine power plants that participated in a study in the early 1980s on the presence of *Legionella* spp. in power plant cooling systems. As with most locations studied, *Legionella* spp. bacteria were found in ambient-temperature (intake), pre-condenser, post-condenser, and outfall (discharge) waters, though not in concentrations sufficiently high to be a health concern. Subsequent studies determined that concentrated *Legionella* spp. aerosols could present a health concern for workers cleaning condenser tubes and cooling towers. As a precaution, BFN has adopted the practice of having workers engaged in these activities wear appropriate respiratory protection (TVA 2003b). Therefore, even though condenser tube and cooling tower cleaning requirements for a three-unit operation may increase, the potential for occupational health risks would still be negligible, because health risks would not increase due to of the use of appropriate respiratory protection. The staff concludes the effect of microbial organisms on occupational health is within the envelope of impacts considered in the GEIS as a Category 1 issue.

- Noise

The cooling towers are likely to be operated more often when there are three units operating at a combined total power level of 11,856 MW(t) (TVA 2003b), and thus there would be more days per year when noise from tower operations could affect onsite personnel or be detected offsite. However, because these are helper towers, they will be operated intermittently, and not continuously as they are at plants with closed-cycle cooling systems. The staff determined in the GEIS that the impacts of cooling tower noise at plants with continuously operated towers are not significant. The staff concludes the effect of noise from the cooling towers is within the envelope of impacts considered in the GEIS as a Category 1 issue.

Table 4-14. Radiological Impacts of Normal Operations-Related Category 1 Issues that are Potentially Affected by Proposed Extended Power Uprates at Browns Ferry Nuclear Power Plant, Units 1, 2, and 3

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

- Radiation exposures to public (license renewal term)

Some increase in radionuclide emissions might occur as a result of the combined total power level of 11,856 MW(t) (TVA 2003b); the increase would be up to a factor of 1.8 over current two-unit operations if the increase is proportional to the power level. Recent routine emissions at the site have been well below regulatory limits. Furthermore, BFN, regardless of the thermal power level, will be required to operate within the regulatory limits during the license renewal term. The staff concludes that the effects of radiation exposure to the public are within the envelope of impacts considered in the GEIS as a Category 1 issue provided that releases are maintained within the regulatory limits.

- Occupational radiation exposures (license renewal term)

Some increase in worker dose rates might occur as a result of the combined total power level of 11,856 MW(t) (TVA 2003b); the increase would be up to a factor of 1.8 over current two-unit operations if the increase is proportional to the power level. However, application of as low as reasonably achievable (ALARA) principles has reduced worker exposures relative to historic levels, and doses to individual workers at the site would be controlled to remain below regulatory limits. The staff determined in the GEIS that the dose-related impacts to workers are of small significance if doses and releases do not exceed permissible levels in the Commission's Regulations. BFN, regardless of the thermal power level, will be required to operate within the regulatory limits during the license renewal term. The staff concludes the effect of occupational radiation exposure is within the envelope of impacts considered in the GEIS as a Category 1 issue provided that the exposure to workers is maintained within the regulatory limits.

Table 4-15. Socioeconomic-Related Category 1 Issue Potentially Affected by Proposed Extended Power Uprates at Browns Ferry Nuclear Power Plant, Units 1, 2, and 3

ISSUE—10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Section
SOCIOECONOMIC	
Aesthetic impacts (license renewal term)	4.7.6

- Aesthetic impacts (license renewal term)

The cooling towers are likely to be operated more often when there are three units operating at a combined total power level of 11,856 MW(t) (TVA 2003b); thus, there would be more days per year when there is a visible steam plume and when noise from tower operations could be detected offsite. However, because these are helper towers, they will be operated intermittently, and not continuously as they are located at plants with closed-cycle cooling systems. The staff determined in the GEIS that the aesthetic impacts of cooling tower plumes at plants with continuously operated towers are not significant. The staff concludes the effects of aesthetic impacts of cooling tower plumes is within the envelope of impacts considered in the GEIS as a Category 1 issue.

Table 4-16. Postulated Accident-Related Category 1 Issue Potentially Affected by Proposed Extended Power Uprates at Browns Ferry Nuclear Power Plant, Units 1, 2, and 3

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

- <u>Design-basis accidents</u>

TVA is required to submit an updated Final Safety Analysis Report as part of the EPU license amendment application. NRC staff evaluates this Final Safety Analysis Report, the application, and the design of the facility prior to granting or denying the EPU application. If the EPU is granted, the staff will have evaluated design-basis accidents (DBAs) in light of the new power level, and will have determined that postulated DBA doses continue to meet NRC regulations. Therefore, the environmental impacts of DBAs will continue to be small. The staff concludes that the effect of the cooling system operation on DBAs is within the envelope of impacts considered in the GEIS as a Category 1 issue.

Table 4-17. Uranium Fuel Cycle and Waste Management-Related Category 1 Issues Potentially Affected by Proposed Extended Power Uprates at Browns Ferry Nuclear Plant, Units 1, 2, and 3

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

- Offsite radiological impacts (individual effects from other than the disposal of spent fuel and high-level waste)

Offsite impacts of the uranium fuel cycle have been considered by the Commission in Table S-3 in 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. There may be some local increase in radiological emissions in the immediate vicinity of the facility; however, the impact on the entire uranium fuel cycle would be negligible. Regardless of the combined total power level at BFN, the plant and fuel cycle facilities will continue to be required to operate within applicable regulatory limits. The staff concludes the effect of offsite radiological impacts (individual effects from other than the disposal of spent fuel and high-level waste) is within the envelope of impacts considered in the GEIS as a Category 1 issue.

- Offsite radiological impacts (collective effects)

Some increase in radionuclide emissions might occur at BFN as a result of increased fuel requirements for the combined total power level of 11,856 MW(t); the increase would be up to a factor of 1.8 over current two-unit operations if the increase is proportional to the power level. Nevertheless, releases would continue to be required to be within regulatory limits. Collective doses to the population in the vicinity of BFN have been well below levels that would result in estimated health effects; therefore, collective dose to the BFN surrounding population would remain small. Nationwide, a potential increase in annual radiation exposures to the public from BFN would be inconsequential and not substantially change the GEIS conclusions. The staff concludes that the effect of offsite radiological impacts (collective effects) is within the envelope of impacts considered in the GEIS as a Category 1 issue provided that the releases are maintained to within the regulatory limits.

- Offsite radiological impacts (spent fuel and high-level waste)

Some increase in radiation dose to members of the public might result from increased spent fuel generation during reactor operations at a combined total power level of 11,856 MW(t); the increase would be up to a factor of 1.8 over current two-unit operations if the increase is proportional to the power level. During the uprated operational period, public exposures from spent fuel disposal would be maintained within regulatory limits and are expected to remain small. The staff concludes that the effect of offsite impacts (spent fuel and high-level waste) is within the envelope of impacts considered in the GEIS as a Category 1 issue provided that exposure to the public is maintained to within the regulatory limits.

- Nonradiological impacts of the uranium fuel cycle

Uprate of the power level at BFN would result in needs for somewhat larger quantities of fuel, as well as increased need for spent fuel and waste storage and disposal. The nonradiological impacts of these activities would be reflected in needs for additional workforce to carry out fuel manufacturing and waste and spent fuel management activities. Those activities could also result in an additional potential for industrial accidents and illnesses. However, they would not necessarily entail a higher risk than alternative occupations in which the workforce might be engaged. Other nonradiological impacts, such as land use, fugitive dust generation, air-quality impacts, erosion, sedimentation, and disturbance of ecosystems, are unlikely to increase substantially. The effect on the entire U.S. uranium fuel cycle from the additional fuel utilization at BFN would be negligible. The staff concludes that the effect of nonradiological impacts of the uranium fuel cycle is within the envelope of impacts considered in the GEIS as a Category 1 issue.

- Low-level waste storage and disposal

Some increase in radiation dose to members of the public might result from increased low-level waste (LLW) storage and disposal during reactor operations at a combined total power level of 11,856 MW(t); the increase would be up to a factor of 1.8 over current two-unit operations if the increase is proportional to the power level. During the uprated operational period, public exposures from LLW disposal would be maintained within regulatory limits and are expected to remain small. The staff concludes the effect of public exposure from LLW storage and disposal is within the envelope of impacts considered in the GEIS as a Category 1 issue provided that exposure to the public is maintained to within the regulatory limits.

- Mixed waste storage and disposal

Some increase in radiation dose to members of the public and exposure to toxic materials might result from increased mixed waste generation during reactor operations at a combined total power level of 11,856 MW(t); the increase would be up to a factor of 1.8 over current two-unit operations if the increase is proportional to the power level. During the uprated operational period, public exposures from mixed waste disposal would be maintained within regulatory limits and are expected to remain small. Any increase in mixed waste storage would be within the current BFN storage capacity, and additional impact on licensed mixed waste disposal facilities would be minimal. The staff concludes the effect of mixed waste storage and disposal is within the envelope of impacts considered in the GEIS as a Category 1 issue provided that the radiation dose to the public is maintained to within the regulatory limits.

- Onsite spent fuel

Some marginal increase in onsite storage of spent fuel is expected as a result of a combined total power level of 11,856 MW(t), 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 license life for generation including any license renewal term. During the uprated operational period, occupational exposures from spent fuel management would be maintained within regulatory limits and with continuing application of ALARA principles, are expected to remain small. The staff concludes that the effect on occupational exposure from onsite spent fuel is within the envelope of impacts considered in the GEIS as a Category 1 issue provided that the occupational exposure is maintained to within the regulatory limits during the storage period.

- Nonradiological waste

Operation of BFN at uprated power levels is not expected to substantially change the quantities of nonradiological waste generated at the facility. Any small marginal increases in routine nonradiological waste generated at the plant would be well within quantities that could be accommodated by onsite or community waste management facilities, and ongoing waste minimization and recycling programs are expected to continue to reduce the quantities of these wastes. The staff concludes the effect from nonradiological waste is within the envelope of impacts considered in the GEIS as a Category 1 issue.

- Transportation

Some increase in radiation dose to members of the public and transportation workers might result from increased transport of unirradiated fuel, spent fuel, and radiological wastes during reactor operations at a combined total power level of 11,856 MW(t); the increase would be up to a factor of 1.8 over current two-unit operations, if the increase is in proportion to the power level. Because of the regulatory requirements related to fuel shipments, the staff believes that any increase in BFN impact due to the combined total power level will 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. The staff concludes that the effect of transportation of the unirradiated fuel, spent fuel, and radiological wastes is within the envelope of impacts considered in the GEIS as a Category 1 issue provided that the dose to the public and transportation workers is maintained to within the regulatory limits during the renewal period.

4.8 Cumulative Impacts of Operations During the License Renewal Term

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

The impacts of the proposed action are combined with other past, present, and reasonably foreseeable future actions at BFN, 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 time. It is possible that an impact that may be SMALL by itself could result in a MODERATE or LARGE impact when considered in combination with the impacts of other actions on the affected resource. Likewise, if a resource is regionally declining or imperiled, even a SMALL individual impact could be important if it contributes to or accelerates the overall resource decline.

4.8.1 Cumulative Impacts Resulting from Operation of the Plant Cooling System

For the purposes of this analysis, the geographic area considered for cumulative impacts resulting from operation of the BFN cooling system is primarily the Wheeler Reservoir portion of the Tennessee River. Wheeler Reservoir is located within the Lower Tennessee River Basin which extends from Chattanooga, Tennessee, to near Paducah, Kentucky. The main stem of the Tennessee River in this area is highly regulated with few free-flowing reaches. Six major reservoirs are located within the Lower Tennessee River, and three additional reservoirs are located on its major tributaries (USGS 1998). The reservoirs were created for the purpose of power generation, navigation, and flood control. They are also used extensively as sources of drinking water and for recreational activities (USGS 1998). Interbasin transfers of water occur downstream of BFN (i.e., with the Mobile River Basin via the Tennessee-Tombigbee Waterway near the Pickwick Reservoir and with the Cumberland River Basin through the Barkley-Kentucky Canal at the Kentucky Reservoir) (Kingsbury et al. 1999).

The mean annual streamflow in the Lower Tennessee River Basin ranges from about 1017 m^3/s (35,900 cfs) at Chattanooga, Tennessee, to 1858 m^3/s (65,600 cfs) at Paducah, Kentucky. The Elk and Duck Rivers, the two largest tributaries within the lower Tennessee River Basin, contribute about 26 percent of the streamflow gained between Chattanooga and Paducah (Kingsbury et al. 1999). Within the Tennessee River watershed, an average of 46.2 million m^3/d (12.2 billion gpd) were used in 2000 for public supply, industrial water supply, irrigation, and thermoelectric power generation; however, only about 5 percent (2.5 million m^3/d [649 MGD]) was used consumptively. By 2030, water withdrawals are projected to increase to nearly 53 million m^3/d (14 billion gpd) (Hutson et al. 2003). Most of the consumptive use (2.0 million m^3/d [530 MGD]) has occurred upstream of Wheeler Dam, and this is expected to increase to 2.9 million m^3/d (760 MGD) by 2030 (TVA 2003b). Within Wheeler Reservoir, there are eight potable water intakes that withdraw about 0.47 million m^3/d (124 MGD) for municipal and industrial use, while there are 11 municipal plant discharges totaling over 0.11 million m^3/d (30 MGD) and 18 industrial plants discharging more than 9.5 million m^3/d (2513 MGD) (TVA 2003b).

The main land cover in the Lower Tennessee River Basin is forest (55 percent) and row crops and pastureland (41 percent). There are numerous industries along the mainstem of the Tennessee River in northern Alabama. They manufacture and produce a variety of products (e.g., missiles and rockets, electronics, pulp and paper, synthetic fibers, chemicals, aluminum, and nickel-plated foam) (USGS 1998).

Section 2.2.5 discusses the major changes and modifications within the Tennessee River, particularly the Wheeler Reservoir area, that have had the greatest effects on aquatic resources. These include physical and chemical stresses, developments, overfishing (including commercial clam harvests), and introduction of non-native species. Physical and chemical stresses that have impacted the Tennessee River include urban, industrial, and agricultural contaminants (e.g., nutrients, toxic chemicals, sediments); stream modifications (e.g., dams and reservoirs); land use changes (e.g., residential, recreational, agricultural, and industrial development); dredging (e.g., to maintain navigation channels); shoreline modifications; wetland elimination and modification; water diversions (e.g., Tennessee-Tombigbee Waterway); and commercial and recreational boating (TVA 2003b, 2004b).

Construction of the TVA reservoir system significantly altered both the water quality and physical environment of the Tennessee River, with little regard for the subsequent effects on aquatic resources (TVA 2004b). Overall, completion of the water control system on the Tennessee River resulted in the following impacts (Barclay 2004):

- conversion of riverine habitat to reservoir pool habitat
- loss of riverine habitat and associated biota
- conversion of floodplain to reservoir pool
- loss of seasonal floodplain habitat and associated biota
- fragmentation of riverine sections
- disruption of fish migrations
- seasonal fluctuations of pool levels
- thermal stratification
- stress or mortality of organisms or sensitive life stages
- seasonal dissolved oxygen depletion in temperature stratified waters
- ammonia released by the presence of oxygen-depleted water
- disruption of sediment transport
- trapping of sediment, capture of toxic substances associated with substrates,
- toxic substance releases
- nutrient enrichment with consequent changes in habitat quality and associated species.

Within the Lower Tennessee River Basin, nutrient enrichment and pathogens have been identified as water-quality issues affecting both surface water and groundwater. Nonpoint sources for nutrients (nitrogen and phosphorous) include urban runoff, fertilizer application, failing septic tanks, livestock waste, nitrogen fixation, sediment and rock dissolution, and atmospheric deposition (Kingsbury et al.1999).

Because of the altered habitat conditions created by reservoir pools and dam tailwater, State agencies introduced numerous sport and some prey species into the Tennessee River watershed including several trout species, striped bass (*Morone saxatilus*), northern pike (*Esox lucius*), yellow perch (*Perca flavescens*), walleye (*Stizostedion vitreum*), rainbow smelt (*Osmerus mordax*), and alewife (*Alosa pseudoharengus*). Some of the game species are not self-sustaining and, thus, continue to be stocked (TVA 2004b). Non-native species (e.g., common carp [*Cyprinus carpio*], grass carp [*Ctenopharyngodon idella*], Eurasian watermilfoil [*Myriophyllum spicatum*], and Asiatic clam) have impacted native aquatic species. Further spread or establishment of species such as the alewife, bighead carp (*Hypophthalmichthys nobilis*), silver carp (*H. molitrix*), zebra and quagga mussels (*Dreissena bugensis*), rusty crayfish (*Orconectes rusticus*), and the cladoceran *Daphnia lumholtzi* may also have major impacts on the aquatic community dynamics in Wheeler Reservoir.

TVA's reservoir operations policy guides the day-to-day operation of the Tennessee River system, and sets the balance of trade-offs for the sometimes competing uses of water in the system. TVA undertook a study to determine if changes in its reservoir system operating policies could produce a greater overall public value. A no-action alternative and eight alternative operating policies were evaluated. The evaluations included the assumption that the consumptive use of water above Wheeler Dam would increase by 0.87 million m^3/d (230 MGD). Reservoir operations over the 100-year hydrologic record were simulated. Under the proposed alternative, flow requirements would be used to protect water quality and aquatic resources, ensure year-round commercial navigation, and provide an adequate supply of cooling water for TVA's power plants (TVA 2004b).

Under the preferred TVA reservoir system operating policy alternative, drawdown of Wheeler Reservoir would begin on Labor Day rather than on August 1 to increase recreational opportunities. Fluctuations in reservoir levels to strand mosquito eggs and larvae would continue until Labor Day. Also, minimum winter elevations would be raised 15 cm (6 in.) to ensure that the 3.4-m (11-ft) navigation channel is maintained throughout the reservoir (TVA 2004b).

Under its regulatory programs, TVA treats waste water effluents, collects and properly disposes potential contaminants, and undertakes pollution prevention activities that comply with regulatory requirements and minimize the risk of adverse environmental impacts (TVA 2003b). The BFN NPDES permit is renewed every 5 years; this helps to ensure that no changes have been made to the facility that would alter aquatic impacts and that no significant adverse impacts have occurred. Compliance with the NPDES process, other provisions of the FWPCA (e.g., Sections 316[a], 316[b], 401, and 404), and other regulatory requirements are expected to adequately control potential chemical effluent effects. In general, under these regulatory programs, TVA treats waste water effluents, collects and properly disposes potential contaminants, and undertakes pollution prevention activities that comply with regulatory requirements and minimize the risk of adverse environmental impacts.

Future contributions to cumulative impacts to aquatic resources within Wheeler Reservoir would generally occur from those actions that currently cause impacts (e.g., reservoir operations, human habitation, urban and industrial development, agriculture, and commercial and recreational fisheries). There is a potential for severe impacts to aquatic resources from large oil or chemical spills within Wheeler Reservoir or its tributaries, but the risk of such spills is relatively small. The probability of smaller spills is higher, but the impacts from such spills would probably be small, temporary, and additive, and unlikely to severely affect aquatic resources, especially if spill response activities are undertaken when such events occur. The potential exists for the expansion of exotic species that have already begun to occur in the Tennessee River, and for additional exotic species to become established in Wheeler Reservoir.

The reservoir water supply is adequate to meet the needs of BFN for cooling purposes under all conditions. The total BFN intake water flow of 139 m^3/s (4907 cfs) can encompass a significant fraction of the daily average river flow past the plant compared to the 7Q10 values of 250 m^3/s [8700 cfs]); however, consumptive water uses are negligible and are expected to remain so throughout the license renewal term (TVA 2003b). There are no significant cumulative impacts on water supply. The staff, while preparing this assessment, assumed that other industrial, commercial, or public installations could be located in the general vicinity of the BFN site prior to the end of BFN operations. The discharge of water to Wheeler Reservoir from these facilities would be regulated by the Alabama Department of Environmental Management (ADEM). The discharge limits are set considering the overall or cumulative impact of all of the other regulated activities in the area. Compliance with the FWPCA and its NPDES permits minimizes cumulative effects on aquatic resources.

There are also other power plants within the Tennessee River system that impact aquatic biota. Entrainment, impingement, and, for non-hydroelectric plants, thermal discharges occur at other power plants within the Tennessee River system. These include 11 coal-fired plants, 30 hydroelectric facilities, and three nuclear plants (including BFN) operated by the TVA (ScanChattanooga.Com 2001) and non-TVA plants such as the two Calpine combined-cycle plants near Decatur (TVA 2003b). Fish egg entrainment is not likely to be a serious problem at most dams because the freshwater drum and mooneye and, possibly, skipjack herring are the only species with buoyant or semibuoyant eggs. Larvae and juveniles of non-migratory species may only be incidentally susceptible to turbine entrainment, and the resultant effects are not significant to the dynamics of the reservoir's resident fish community (Cada 1990).

The staff determined that the cumulative impacts of BFN cooling system operations (including entrainment and impingement of fish and shellfish, heat shock, or any of the cooling system-related Category 1 issues) are not contributing to an overall decline in water quality or the status of the fishery or other aquatic resources, and no additional mitigation measures are warranted.

Continued operation of BFN will require renewed discharge permits from the ADEM, which will address changing requirements so that cumulative water-quality objectives are served. Therefore, the staff concludes that the potential cumulative impacts of cooling system operation contributed by the continued operation of BFN will be SMALL, and that no further mitigation measures are warranted.

4.8.2 Cumulative Impacts Resulting from Continued Operation of the Transmission Lines

The continued operation of the BFN electrical transmission facilities was evaluated to determine if there is a potential for interactions with other past, present, and future actions that could result in adverse cumulative impacts to terrestrial resources such as wildlife populations, the size and distribution of habitat areas, aquatic resources such as wetlands and floodplains, and both the acute and chronic effects of electromagnetic fields. For purposes of this analysis, the geographic area that encompasses the past, present, and foreseeable future actions that could contribute to adverse cumulative effects is the area serviced by the transmission lines associated with the BFN (Figure 2.4).

TVA follows right-of-way management procedures that were found to be protective of sensitive ecological resources, including wildlife habitat, wetlands, and floodplains (TVA 2003b). TVA maintains maps of known sensitive resources such as wetlands, and maintains the transmission line rights-of-way to minimize impacts, with the result that no net loss of resources occurs. The maintenance procedures minimize disturbance to wildlife and, in many ways, provide greater protection relative to many of the surrounding areas with other land uses.

The staff determined that the electrical current induced by the electromagnetic fields from the BFN transmission lines is well below the NESC recommendations for preventing electrical shock from induced currents. Therefore, continued operation of the BFN transmission lines will not detectably change the overall potential for electrical shock in the future within the analysis area. With respect to chronic effects of electromagnetic fields, although the staff considers the GEIS conclusion of "not applicable" to be appropriate in regard to BFN, the BFN transmission lines are not likely to detectably contribute to the regional exposure to extremely low frequency electromagnetic fields (ELF-EMF). This conclusion is based on the fact that BFN transmission lines primarily pass through sparsely populated, rural areas, with few residences or businesses close enough to have detectable ELF-EMF.

Therefore, since the impacts from maintaining and operating the transmission system are so minor that they will neither destabilize or noticeably alter the existing aquatic or terrestrial environment, the staff determined that the cumulative impacts of continued operation of BFN transmission lines will be SMALL, and that no additional mitigation is warranted.

4.8.3 Cumulative Radiological Impacts

The EPA and NRC established radiological dose limits for protection of the public and workers from both instanteneous and cumulative impacts of exposure to radiation and radioactive materials. These dose limits are codified in 40 CFR Part 190 and 10 CFR Part 20. For the purpose of this analysis, the area within an 80-km (50-mi) radius of the BFN site was included. As stated in Section 2.2.7, TVA has conducted a radiological environmental monitoring program (REMP) around the BFN site since 1968. The REMP measures radiation and radioactive materials from all sources, including BFN. 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 BFN during the license renewal term are small. The NRC and the State of Alabama would regulate any reasonably foreseeable future actions in the vicinity of the BFN site that could contribute to cumulative radiological impacts.

Therefore, the staff concludes that cumulative radiological impacts of continued operations of BFN would be SMALL, and that no further mitigation measures are warranted.

4.8.4 Cumulative Socioeconomic Impacts

Much of the analysis of socioeconomic impacts presented in Section 4.4 of this SEIS already incorporate cumulative impact analysis, because the metrics used for quantification only make sense when placed in the total or cumulative context. For instance, the impact of the total number of additional housing units that may be needed can only be evaluated with respect to the total number of units in the impacted area. Therefore, the geographic area of the cumulative analysis varies depending on the particular impact considered, and may depend on specific boundaries, such as taxation jurisdictions, or may be distance related, as for environmental justice.

The continued operation of BFN is not likely to add to any cumulative socioeconomic impacts beyond those already evaluated in Section 4.4. In other words, the impacts of issues such as transportation or offsite land use are likely to be nondetectable beyond the regions previously evaluated and will quickly decrease with increasing distance from the site. The staff determined that the impacts on housing, public utilities, public services, offsite land use, and environmental justice would all be negligible. There are no reasonably foreseeable scenarios that would alter these conclusions in regard to cumulative impacts.

Related to historic and archeological resources, two sites at BFN that require protection have been identified. TVA has procedures in place to protect these sites, and to take into account the inadvertent discovery of historic and archaeological remains at BFN. There are no plans to construct new facilities in areas that have not been heavily disturbed in the past, or to construct new transmission lines. Therefore, continued operation and maintenance of the BFN site and transmission line rights-of-way would not impact historic or archeological properties beyond the site or rights-of-way boundaries, and therefore, the contribution to cumulative adverse impacts would be negligible.

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

4.8.5 Cumulative Impacts on Groundwater Use and Quality

There are no groundwater withdrawals at BFN, and TVA imports potable water from Athens Water Services, which withdraws water from the Elk River. As described in Section 4.5.1, operation of BFN has not had a detectable impact on groundwater levels in the vicinity of the site. BFN does not discharge any waste to the groundwater. Because there are no groundwater withdrawals or discharges at BFN and none are anticipated in the future, BFN is not causing a detectable change in the regional groundwater usage or quality. Therefore, the contributions to cumulative impacts are SMALL, and no mitigation measures are warranted.

4.8.6 Cumulative Impacts on Threatened or Endangered Species

The geographic area considered in the analysis of potential cumulative impacts to threatened or endangered species includes those Alabama and Mississippi counties that contain the BFN site and its associated transmission line rights-of-way (Colbert, Franklin, Lawrence, Limestone, and Morgan Counties in Alabama, and Itawamba, Lee, Tishomingo, and Union Counties in Mississippi) and the waters of the Tennessee River, particularly Wheeler Reservoir, in the vicinity of the BFN site.[a] As discussed in Sections 2.2.5 and 2.2.6, there are a number of threatened or endangered species that could occur within this area. The staff's findings, presented in the October 25, 2004 (NRC 2004d) BA and in Section 4.6, are that continued operation of BFN, including return to three-unit operation at a total combined power level of 11,856 MW(t) and associated transmission line rights-of-way maintenance during the license renewal term, will have no effect, or is not likely to adversely affect any Federally listed species, nor will it adversely impact any designated critical habitat. Therefore, the BFN contribution to cumulative impacts to Federally protected species or designated critical habitat is SMALL and no mitigation is warranted.

(a) Prentiss County, Mississippi not included. Species accounted for in adjacent counties.

- **Aquatic Species**

Thirty-eight Federally listed aquatic species (including three candidate species) occur (or historically occurred) in either Wheeler Reservoir or its tributaries or in other streams, rivers, or caves within the counties of Alabama and Mississippi within which the BFN transmission lines pass. As mentioned in Section 2.2.5, past actions that have adversely affected these species have included siltation, impoundments, in-stream-habitat disturbance, contaminants, pearl button and cultured pearl industries (for mussel species), and introduced species. As discussed in Section 4.6.1, best management practices are used for transmission line maintenance, which reduces the likelihood of adverse impacts to aquatic habitats and any protected species that may be present within them.

The combination of nonpoint-source pollution (primarily from siltation) and alteration of flow regimes (primarily from impoundments) are anthropogenic factors responsible for about 72 percent of fish imperilment problems in the Southeast (Etnier 2002). These factors are also the major contributor to the endangerment of most of the listed mussel species, while habitat loss, modification, and fragmentation caused by impoundments have impacted the aquatic snail species (Neves et al. 2002). Because some mussels can live to be more than 100 years old, population declines resulting from poor reproductive success may continue for decades. Therefore, extirpation of some species may be a prolonged event, lagging behind the factors directly responsible for attrition of the fauna (Neves et al. 2002). An oil or chemical spill, especially in a tributary stream, could be significant for a listed species that has a limited distribution (e.g., Anthony's riversnail [*Athearnia anthonyi*], slender campeloma [*Campeloma decampi*], and boulder darter [*Etheostoma boschungi*]).

The Asiatic clam competitively interacts with native mussels for food and space. Invasion of the Tennessee River basin by the zebra mussel and the quagga mussel could also be detrimental to native mussels (Neves et al. 2002). The zebra mussel may ultimately cause extinction to several Federally protected mussels or cause other mussel species to become endangered or threatened (Neves et al. 2002). If the black carp (*Mylopharyngodon piceus*) becomes established in the Tennessee River, it could pose a serious threat to the listed mussel and snail species because it feeds almost exclusively upon molluscs (Chick 2002; Jernigan 2003).

The staff determined that the contribution to cumulative impacts to aquatic threatened or endangered species due to continued operation of BFN and its transmission lines would be inconsequential, and that no further mitigation measures are warranted.

- **Terrestrial Species**

There are no Federally listed threatened or endangered species known to occur within at least 5 km (3 mi) of the BFN site. Operation of BFN is not likely to have a detectable effect on terrestrial species located 5 km (3 mi) away from the site. Therefore, operations at the plant site will not have a detectable contribution to the cumulative, regional impacts on threatened or endangered species.

Habitat for some of the Federally listed species could be found within the rights-of-way of BFN transmission lines. However, TVA monitors and tracks populations of Federally listed species on the BFN site and within transmission line rights-of-way. In addition, TVA works with appropriate Federal and State agencies to develop and establish guidelines and safeguards for their contract personnel to follow to protect threatened or endangered species and their habitats during maintenance of transmission line rights-of-way (Muncy et al. 1999). In some cases, the rights-of-way and the maintenance practices may provide for habitat that is not found in surrounding areas with other land uses.

Therefore, the staff determined that the contributions to cumulative impacts to threatened or endangered terrestrial species due to the continued operation of the BFN and associated transmission lines will be inconsequential, and that additional mitigation measures would not be warranted.

4.9 Summary of Impacts of Operations During the License Renewal Term

TVA and the staff discovered no new and significant information related to any of the applicable Category 1 issues associated with BFN operation during the license renewal term. Therefore, the staff concludes that the environmental impacts associated with the Category 1 issues are bounded by the impacts described in the GEIS. For each of the 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 13 Category 2 issues applicable to BFN operation during the license renewal term and for environmental justice and chronic effects of electromagnetic fields. For all 13 issues and environmental justice, the staff's conclusion is that the potential environmental impact of license renewal-term operations of BFN would be of SMALL significance in the context of the standards set forth in the GEIS and that further mitigation is not warranted. In addition, the staff determined that a consensus has not been reached by appropriate Federal health agencies regarding chronic adverse effects from electromagnetic fields. Therefore, no evaluation of this issue is required.

Cumulative impacts of past, present, and reasonably foreseeable future actions were considered, regardless of what agency (Federal or non-Federal) or person undertakes such other actions. For purposes of analysis, where BFN license renewal impacts are deemed to be SMALL, the staff concluded that these impacts would not result in significant cumulative impacts on potentially affected resources.

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."

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

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

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

59 FR 7629. Executive Order 12898, "Federal Actions to Address Environmental Justice in Minority and Low-Income Populations." *Federal Register*. Vol. 59, No. 32. February 16, 1994.

69 FR 41575. Final Regulation to Establish Requirements for Cooling Water Intake Structures at Phase II Existing Facilities. Federal Register. Vol. 69, No. 131. July 9, 2004.

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5.0 Environmental Impacts of Postulated Accidents

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

(1) The environmental impacts associated with the issue have been determined to apply either to all plants or, for some issues, to plants having a specific type of cooling system or other specified plant or site characteristic.

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

(3) Mitigation of adverse impacts associated with the issue has been considered in the analysis, and it has been determined that additional plant-specific mitigation measures are likely not to be sufficiently beneficial to warrant implementation.

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

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

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

5.1 Postulated Plant Accidents

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

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

5.1.1 Design-Basis Accidents

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

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

The environmental impacts of DBAs are evaluated during the initial licensing process, and the ability of the plant to withstand these accidents is demonstrated to be acceptable before issuance of the operating license (OL). The results of these evaluations are found in license documentation such as the staff's safety evaluation report (SER), the licensee's updated final safety analysis report (UFSAR), and Section 5.1 of this supplemental environmental impact statement (SEIS). The licensee is required to maintain the acceptable design and performance criteria throughout the life of the plant, including any extended-life operation. The consequences for these events are evaluated for the hypothetical maximally exposed individual; as such, changes in the plant environment will not affect these evaluations. Because of the requirements that continuous acceptability of the consequences and aging management programs be in effect for license renewal, the environmental impacts as calculated for DBAs should not differ significantly from initial licensing assessments over the life of the plant, including the license renewal 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 make 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 Browns Ferry Nuclear Plant, Units 1, 2, and 3 (BFN), is listed in Table 5-1.

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

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

- Design-basis accidents. Based on information in the GEIS, the Commission found that

  The environmental impacts of design-basis accidents are of small significance for all plants.

The Tennessee Valley Authority (TVA) stated in its Environmental Report (ER) (TVA 2003) that it is not aware of any new and significant information associated with the renewal of the BFN OLs. The staff has not identified any new and significant information during the staff's independent review of the TVA ER, the scoping process, the staff's site visit, its evaluation of other available information, and public comments. Therefore, the staff concludes that there are no impacts of DBAs during the license renewal term beyond those discussed in the GEIS.

5.1.2 Severe Accidents

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

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 BFN, is listed in Table 5-2.

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

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

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

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

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

5.2 Severe Accident Mitigation Alternatives (SAMAs)

10 CFR 51.53(c)(3)(ii)(L) requires that license renewal applicants consider alternatives to mitigate severe accidents if the staff has not previously evaluated 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 BFN; therefore, the remainder of Chapter 5 addresses those alternatives.

5.2.1 Introduction

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

The SAMA evaluation for BFN was a four-step process. In the first step, TVA 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, TVA examined the major risk contributors and identified possible ways (i.e., SAMAs) of reducing that risk. Common ways of reducing risk are changes to components, systems, procedures, and training. TVA initially identified 135 potential SAMAs. TVA screened out SAMAs that were not applicable to BFN because (1) the SAMA was not applicable at BFN because of design differences, (2) the SAMA had already been implemented at BFN, (3) the SAMA was sufficiently similar to and combined with other SAMA candidates, or (4) SAMA costs more than $6 million to implement. This screening reduced the list of potential SAMAs to 43.

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

Finally in the fourth step, the costs and benefits of each of the remaining SAMAs were compared to determine whether the SAMA was cost-beneficial, meaning the benefits of the SAMA were greater than the costs (a positive cost-benefit). In the final analysis, TVA concluded that none of these 43 SAMAs were cost-beneficial for BFN.

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

5.2.2 Estimate of Risk

TVA submitted an assessment of SAMAs for BFN as part of the ER (TVA 2003). This assessment considers all three Browns Ferry units, each operating at 120 percent of their original licensed power level. Ideally, this assessment would take advantage of a plant-specific PSA that reflects operation of all three units at 120 percent of their original licensed power. However, such a PSA is not currently available. Because of the progressive screening nature of the SAMA evaluation, TVA relied on the available PSA information, along with engineering knowledge of the plant, to form a basis for the three-unit SAMA assessment. This assessment was based on the most recent PSAs available for Units 2 and 3 at that time. A PSA for Unit 1 was not available at the time of the SAMA analysis. The assessment was also based on insights from a multiple-unit PSA performed in 1995 to bound the effects of three-unit operation, a plant-specific offsite consequence analysis performed using the MELCOR Accident Consequence Code System 2 (MACCS2) computer program, and insights from the Browns Ferry Individual Plant Examination (IPE) (TVA 1992) and the Individual Plant Examination of External Events (IPEEE) (TVA 1995, 1996, 1997).

Two distinct analyses are combined to form the basis for the risk estimates used in the SAMA analysis: (1) the BFN PSA Unit 2 and Unit 3 models, and (2) a supplemental analysis of offsite 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 PSA models available at the time the ER was submitted, referred to as the Extended Power Uprate (EPU) PSA for Unit 2, and the EPU PSA for Unit 3. The PSAs include a Level 1 analysis to determine the core damage frequency (CDF) from internally initiated events and a Level 2 assessment of containment performance during severe accidents. The scope of the BFN PSAs does not include external events.

The baseline CDFs for the purpose of the SAMA evaluation are approximately 2.6 x 10^{-6} per year for Unit 2 and 3.6 x 10^{-6} per year for Unit 3. The CDFs are based on the risk assessment for internally initiated events at EPU conditions (i.e., 120 percent of their original licensed power level). TVA did not include the contribution to risk from external events within the BFN risk estimates. This is discussed further in Sections G.2.2 and G.6.2.

The breakdown of CDF by initiating event is provided in Table 5-3. As shown in this table, transients and loss of offsite power initiated events are dominant contributors to the CDF.

Table 5-3. BFN Core Damage Frequency

	Unit 2		**Unit 3**	
Initiating Event or Accident Class	**CDF (Per Year)**	**% Contribution to CDF**	**CDF (Per Year)**	**% Contribution to CDF**
Transients	1.6 x 10^{-6}	63	1.8 x 10^{-6}	52
Loss of offsite power (LOOP)	4.8 x 10^{-7}	19	1.1 x 10^{-6}	32
Support system failures	2.2 x 10^{-7}	8	2.3 x 10^{-7}	7
Internal flooding	1.0 x 10^{-7}	4	1.6 x 10^{-7}	5
Loss of coolant accidents (LOCAs)	5.3 x 10^{-8}	2	5.4 x 10^{-8}	2
Stuck open relief valves	4.7 x 10^{-8}	2	5.8 x 10^{-8}	2

Table 5-3. (contd)

Initiating Event or Accident Class	Unit 2 CDF (Per Year)	Unit 2 % Contribution to CDF	Unit 3 CDF (Per Year)	Unit 3 % Contribution to CDF
Interfacing system LOCA (ISLOCA)	4.6×10^{-8}	2	4.6×10^{-8}	1
Total CDF (from internal events)	**2.6×10^{-6}**	**100**	**3.4×10^{-6}**	**100**

Bypass events (i.e., interfacing systems loss of coolant accident) contribute 2 percent or less to the total internal events CDF. Anticipated transients without scram (ATWS) events and station blackout (SBO) events are not specifically identified in the internal events CDF breakdown. In response to a Request for Additional Information (RAI) (NRC 2004), TVA stated that the ATWS CDF is estimated to be 2.3×10^{-7} per year for each unit, and the SBO CDF is 3.7×10^{-8} per year for Unit 2 and 3.9×10^{-8} per year for Unit 3 (TVA 2004). SAMAs to address ATWS and SBO events were considered in the SAMA evaluation. TVA estimated the dose from all postulated accidents to the population within 80 km (50 mi) of the BFN site to be approximately 0.0164 person-Sv (1.64 person-rem) per year for Unit 2, and approximately 0.0195 person-Sv (1.95 person-rem) per year for Unit 3. The breakdown of the population dose by containment release mode is summarized in Table 5-4. No containment failures and early containment failures dominate the population dose. The apparent conclusion that population dose is dominated by events involving no containment failure results from the conservative assignment of key plant damage states to release categories in which containment is assumed to fail.

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

Containment Release Mode	Unit 2 Population Dose (Person-Rem Per Year)	Unit 2 % Contribution	Unit 3 Population Dose (Person-Rem Per Year)	Unit 3 % Contribution
Early containment failure or Containment isolation failure	0.64	39	0.71	36
Bypass	0.01	<1	0.01	<1
Late containment failure	0.11	7	0.16	8
No containment failure	0.88	54	1.07	55
Total Population Dose	**1.64**	**100**	**1.95**	**100**

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

5.2.3 Potential Plant Improvements

Once the dominant contributors to plant risk were identified, TVA searched for ways to reduce that risk. In identifying and evaluating potential SAMAs, TVA considered SAMA analyses performed for other operating plants that have submitted license renewal applications, as well as industry and NRC documents that discuss potential plant improvements, such as NUREG-1560 (NRC 1997b). TVA identified 135 potential risk-reducing improvements (i.e., SAMAs) to plant components, systems, procedures, and training.

All but 43 of the these SAMAs were removed from further consideration because (1) the SAMA was not applicable at BFN because of design differences, (2) the SAMA had already been addressed in the existing BFN design, (3) the SAMA was similar to and could be combined with another SAMA, or (4) the SAMA costs more than $6 million to implement, considering the effects of multiple-unit operation and uncertainties.

The staff concludes that TVA used a systematic and comprehensive process for identifying potential plant improvements for BFN and the set of potential plant improvements identified by TVA is reasonably comprehensive and therefore acceptable.

5.2.4 Evaluation of Risk Reduction and Costs of Improvements

TVA evaluated the risk-reduction potential of the remaining 43 SAMAs that were applicable to BFN. A majority of the SAMA evaluations were performed in a bounding fashion in that the SAMA was assumed to completely eliminate the risk associated with the proposed enhancement. Such bounding calculations overestimate the benefit of the risk reduction and are conservative.

TVA estimated the costs of implementing the 43 candidate SAMAs through the application of engineering judgment and review of prior BFN completed capital projects for similar improvements. The cost estimates provided in the ER accounted for inflation (3 percent per year) to arrive at year 2016 estimated costs. Cost estimates typically included changes to and implementation of procedures, training, and documentation, in addition to any hardware costs (TVA 2003).

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

The staff reviewed the bases for TVA'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 concludes that the risk reduction and the cost estimates provided by TVA are sufficient and appropriate for use in the SAMA evaluation.

5.2.5 Cost-Benefit Comparison

The cost-benefit analysis performed by TVA was based primarily on NUREG/BR-0184 (NRC 1997a) and was executed consistent with this guidance. The total benefit associated with each of the 43 SAMAs was evaluated by TVA. These values were determined for the various averted costs based on the estimated annual reductions in CDF and person-rem dose.

For the TVA SAMA evaluation, it is assumed that with all three units operational, the baseline CDFs and risks for Units 1 and 2 are equal and will be four times greater than the CDF from the Unit 2 EPU PSA. Because Unit 1 is more closely tied to Unit 2 than to Unit 3, it is expected that the impact of Unit 1 operation on the Unit 3 CDF and risk would be smaller than the above impact on Unit 2. Based on this reasoning, the operation of Unit 1 is assumed to result in a factor of two increase in Unit 3 CDF and risk from that indicated by the Unit 3 EPU PSA. Therefore, TVA applied a multiplier of four to the Unit 2 averted cost estimates (benefits), assumed these same benefits for Unit 1, and applied a multiplier of two to the Unit 3 averted cost estimates. Additionally, TVA accounted for analysis uncertainties by comparing the implementation costs with three times the averted cost estimates. Consequently, all SAMAs that were evaluated were eliminated because the cost was expected to exceed the estimated benefit, as adjusted to account for multiple-unit operation and uncertainties.

The staff based its evaluation on TVA's estimated benefits for a 7-percent discount rate, applied the same multipliers as TVA to account for multiple-unit operation, and applied an additional multiplier of two to the averted cost estimates for each SAMA to account for the potential impact of external events. As a result, none of the SAMAs appeared to be potentially cost-beneficial. However, four SAMAs appeared to be within a factor of three of being cost-beneficial. These involve improving/enhancing procedures for load shedding, which would improve direct current (DC) reliability (SAMA B11); improving procedures and hardware changes for use of cross-tied component cooling or service water (SW) pumps (SAMA G04); adding redundant DC control power for the SW pumps (SAMA G12c); and developing procedure(s) to instruct operators to trip unneeded residual heat removal/core spray pumps on loss of room ventilation (SAMA G17). TVA performed a more detailed assessment of each of these SAMAs to more realistically estimate the risk reduction and/or implementation costs for each SAMA. Based on the re-assessment, none of the SAMAs are within a factor of three of being cost-beneficial.

5.2.6 Conclusions

The staff reviewed the TVA SAMA analysis and concluded that the methods used and the implementation of those methods were sound. The treatment of SAMA benefits and costs, the generally large negative net benefits, and the inherently small baseline risks support the general conclusion that the SAMA evaluations performed by TVA are reasonable and sufficient for the license renewal submittal.

The staff considered the impact if the cost and benefits were increased by a factor of three to account for uncertainties and determined that four SAMAs could be potentially cost-beneficial. TVA re-examined each of these SAMAs and provided a more realistic estimate of their benefits and/or implementation costs. As a result of this reassessment, the cost-benefit analyses showed that none of the candidate SAMAs were cost-beneficial.

The staff concludes that none of the candidate SAMAs are cost-beneficial. This conclusion is consistent with the low residual level of risk indicated in the BFN PSA and the fact that BFN has already implemented many plant improvements identified from the Individual Plant Examination (IPE) and IPEEE processes, with the exception of the removal of the transformers, which is scheduled to occur in the future.

5.3 References

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

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

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

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

Tennessee Valley Authority (TVA). 1992. Letter from Mark O. Medford, TVA, to U.S. NRC Document Control Desk. Subject: Browns Ferry Nuclear Plant (BFN) – Response to Generic Letter (GL) 88-20 – "Individual Plant Examination for Severe Accident Vulnerabilities – 10 CFR 50.54(f)," September 1, 1992.

Tennessee Valley Authority (TVA). 1995. Letter from Pedro Salas, TVA, to U.S. NRC Document Control Desk. Subject: Browns Ferry Nuclear Plant (BFN) – Generic Letter (GL) 88-20, Supplement 4, Individual Plant Examination of External Events (IPEEE) for Severe Accident Vulnerabilities – Partial Submittal of Report, July 24, 1995.

Tennessee Valley Authority (TVA). 1996. Letter from Pedro Salas, TVA, to U.S. NRC Document Control Desk. Subject: Browns Ferry Nuclear Plant (BFN) – Units 2 and 3 – Generic Letter (GL) 87-02, Supplement 1, Verification of Seismic Adequacy of Mechanical and Electrical Equipment in Operating Reactors, Unresolved Safety Issue (USI) A-46 and GL 88-20, Supplement 4, Individual Plant Examination of External Events (IPEEE) for Severe Accident Vulnerabilities – Submittal of Seismic Evaluation Reports (TAC Nos. M69431, M69432, M83596 and M83597), June 28, 1996.

Tennessee Valley Authority (TVA). 1997. Letter from T.E. Abney, TVA, to U.S. NRC Document Control Desk. Subject: Browns Ferry Nuclear Plant (BFN) – Unit 3 – Generic Letter (GL) 88-20, Supplement 4, Individual Plant Examination of External Events (IPEEE) for Severe Accident Vulnerabilities – Submittal of Report Internal Fires Analysis (TAC No. M83597), July 11, 1997.

Tennessee Valley Authority (TVA). 2003. *Applicant's Environmental Report – Operating License Renewal Stage, Browns Ferry Nuclear Power Plant Units 1, 2, and 3.* Tennessee Valley Authority, Knoxville, Tennessee.

Tennessee Valley Authority (TVA). 2004. Letter from TVA to NRC, Response to Request for Additional Information (RAI) Regarding Severe Accident Mitigation Alternatives for Browns Ferry Nuclear Plant (BFN) Units 1, 2, and 3 (Accession No. ML043860076). September 30, 2004.

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

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

U.S. Nuclear Regulatory Commission (NRC). 1997b. *Individual Plant Examination Program: Perspectives on Reactor Safety and Plant Performance.* NUREG-1560, Washington, D.C.

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

U.S. Nuclear Regulatory Commission (NRC). 2004. Letter from Michael T. Masnik, U.S. NRC to J.A. Scalice, Tennessee Valley Authority. Subject: Request for Additional Information (RAI) Regarding Severe Accident Mitigation Alternatives for the Browns Ferry Nuclear Plant, Units 1, 2, and 3 (TAC Nos. MC1768, MC1769, and MC1770), April 28, 2004.

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 offsite radiological impacts from the fuel cycle and from high-level waste and spent fuel disposal).

(3) Mitigation of adverse impacts associated with the issue has been considered in the analysis, and it has been determined that additional plant-specific mitigation measures are likely not to be sufficiently beneficial to warrant implementation.

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

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

This chapter addresses the issues 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 Browns Ferry Nuclear Plant, Units 1, 2, and 3 (BFN). The generic potential 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

(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.

to and from One Light-Water-Cooled Nuclear Power Reactor." The GEIS also addresses the impacts from radon-222 and technetium-99. There are no Category 2 issues for the uranium fuel cycle and solid waste management.

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 BFN 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 License Renewal Term

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

The Tennessee Valley Authority (TVA) stated in its Environmental Report (ER) (TVA 2003) that it is not aware of any new and significant information associated with renewal of the BFN operating licenses. The staff has not identified any new and significant information during its independent review of the TVA ER, the scoping process, the staff's site visit, or its evaluation of other available information, such as operation at a combined total power level of 11,856 MW(t). 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 collective offsite radiological impacts from the fuel cycle and from HLW and spent fuel disposal, as discussed below, and that additional plant-specific mitigation measures are not likely to be sufficiently beneficial to be warranted.

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

- <u>Offsite radiological impacts (individual effects from other than the disposal of spent fuel and high level waste)</u>. Based on information in the GEIS, the U.S. Nuclear Regulatory Commission (NRC or 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 TVA ER, the scoping process, the staff's site visit, or its evaluation of other available information, such as operation at a combined total power level of 11,856 MW(t). Therefore, the staff concludes that there are no offsite radiological impacts of the uranium fuel cycle during the license renewal term beyond those discussed in the GEIS.

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

  > The 100 year environmental dose commitment to the U.S. population from the fuel cycle, high level waste and spent fuel disposal excepted, is calculated to be about 14,800 person rem [148 person Sv], or 12 cancer fatalities, for each additional 20-year power reactor operating term. Much of this, especially the contribution of radon releases from mines and tailing piles, consists of tiny doses summed over large populations. This same dose calculation can theoretically be extended to include many tiny doses over additional thousands of years as well as doses outside the U.S. The result of such a calculation would be thousands of cancer fatalities from the fuel cycle, but this result assumes that even tiny

> doses have some statistical adverse health effect which will not ever be mitigated (for example no cancer cure in the next thousand years), and that these doses projected over thousands of years are meaningful. However, these assumptions are questionable. In particular, science cannot rule out the possibility that there will be no cancer fatalities from these tiny doses. For perspective, the doses are very small fractions of regulatory limits and even smaller fractions of natural background exposure to the same populations.
>
> Nevertheless, despite all the uncertainty, some judgement as to the regulatory NEPA [National Environmental Policy Act] implications of these matters should be made and it makes no sense to repeat the same judgement in every case. Even taking the uncertainties into account, the Commission concludes that these impacts are acceptable in that these impacts would not be sufficiently large to require the NEPA conclusion, for any plant, that the option of extended operation under 10 CFR Part 54 should be eliminated. Accordingly, while the Commission has not assigned a single level of significance for the collective effects of the fuel cycle, this issue is considered Category 1.

The staff has not identified any new and significant information during its independent review of the TVA ER, the scoping process, the staff's site visit, or its evaluation of other available information, such as operation at a combined total power level of 11,856 MW(t). Therefore, the staff concludes that there are no offsite radiological impacts (collective effects) from the uranium fuel cycle during the license renewal term beyond those discussed in the GEIS.

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

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

reviewed, and uncertainty is inherent in the models used to evaluate possible pathways to the human environment. The NAS report indicated that 100 millirem [1 mSv] per year should be considered as a starting point for limits for individual doses, but notes that some measure of consensus exists among national and international bodies that the limits should be a fraction of the 100 millirem [1 mSv] per year. The lifetime individual risk from 100 millirem [1 mSv] annual dose limit is about 3×10^{-3}.

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

> Nevertheless, despite all the uncertainty, some judgement as to the regulatory NEPA implications of these matters should be made and it makes no sense to repeat the same judgement in every case. Even taking the uncertainties into account, the Commission concludes that these impacts are acceptable in that these impacts would not be sufficiently large to require the NEPA conclusion, for any plant, that the option of extended operation under 10 CFR part 54 should be eliminated. Accordingly, while the Commission has not assigned a single level of significance for the impacts of spent fuel and high level waste disposal, this issue is considered Category 1.

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

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

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

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

The staff has not identified any new and significant information during its independent review of the TVA ER, the scoping process, the staff's site visit, or its evaluation of other available information, including operation at a combined total of 11,856 MW(t). Therefore, the staff concludes that there are no offsite radiological impacts related to spent fuel and HLW disposal during the license renewal term beyond those discussed in the GEIS.

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

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

  The staff has not identified any new and significant information during its independent review of the TVA ER, the scoping process, the staff's site visit, or its evaluation of other available information, such as operation at a combined total power level of 11,856 MW(t). Therefore, the staff concludes that there are no nonradiological impacts of the uranium fuel cycle during the license renewal term beyond those discussed in the GEIS.

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

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

  The staff has not identified any new and significant information during its independent review of the TVA ER, the scoping process, the staff's site visit, or its evaluation of other available information, such as operation at a combined total power level of 11,856 MW(t). Therefore, the staff concludes that there are no impacts of low-level waste storage and disposal associated with the license renewal term beyond those discussed in the GEIS.

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

  > The comprehensive regulatory controls and the facilities and procedures that are in place ensure proper handling and storage, as well as negligible doses and exposure to toxic materials for the public and the environment at all plants. License renewal will not increase the small, continuing risk to human health and the environment posed by mixed waste at all plants. The radiological and 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 TVA ER, the scoping process, the staff's site visit, or its evaluation of other available information, such as operation at a combined total power level of 11,856 MW(t). Therefore, the staff concludes that there are no impacts of mixed waste storage and disposal associated with the license renewal term beyond those discussed in the GEIS.

- Onsite 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 TVA ER, the scoping process, the staff's site visit, or its evaluation of other available information, such as operation at a combined total power level of 11,856 MW(t). Therefore, the staff concludes that there are no impacts of onsite spent fuel associated with the license renewal term 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 TVA ER, the scoping process, the staff's site visit, or its evaluation of other available information, such as operation at a combined total power level of 11,856 MW(t). Therefore, the staff concludes that there are no nonradiological waste impacts during the license renewal term beyond those discussed in the GEIS.

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

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

  BFN 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 TVA ER, the scoping process, the staff's site visit, or its evaluation of other available information, such as operation at a combined total power level of 11,856 MW(t). Therefore, the staff concludes that there are no impacts of transportation associated with the license renewal term beyond those discussed in the GEIS.

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."

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

7.0 Environmental Impacts of Decommissioning

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

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

(1) The environmental impacts associated with the issue have been determined to apply either to all plants or, for some issues, to plants having a specific type of cooling system or other specified plant or site 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, and therefore, additional plant-specific review of these issues is required. There are no Category 2 issues related to decommissioning.

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

7.1 Decommissioning

Category 1 issues in Table B-1 of Title 10 of the Code of Federal Regulations (CFR) Part 51, Subpart A, Appendix B that are applicable to Browns Ferry Nuclear Plant, Units 1, 2, and 3 decommissioning following the renewal term are listed in Table 7-1. Tennessee Valley Authority (TVA) stated in its Environmental Report (ER) (TVA 2003) that it is aware of no new and significant information regarding the environmental impacts of Browns Ferry Nuclear Plant, Units 1, 2, and 3 license renewal. The staff has not identified any new and significant information during its independent review of the TVA ER, the staff's site visit, the scoping process, or its evaluation of other available information, such as operation at a combined total power level of 11,856 MW(t). 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 Browns Ferry Nuclear Power Plant, Units 1, 2,and 3 Following the License Renewal Term

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

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

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

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

The staff has not identified any new and significant information during its independent review of the TVA ER, the staff's site visit, the scoping process, or its evaluation of other available information, such as operation at a combined total power level of 11,856 MW(t). 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.

- <u>Waste management</u>. 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 TVA ER, the staff's site visit, the scoping process, or its evaluation of other available information, such as operation at a combined total power level of 11,856 MW(t). 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.

- <u>Air quality</u>. 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 TVA ER, the staff's site visit, the scoping process, or its evaluation of other available information, such as operation at a combined total power level of 11,856 MW(t). 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.

- <u>Water quality</u>. 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 TVA ER, the scoping process, the staff's site visit, or its evaluation of other available information, such as operation at a combined total power level of 11,856 MW(t). 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 TVA ER, the scoping process, the staff's site visit, or its evaluation of other available information, such as operation at a combined total power level of 11,856 MW(t). 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 TVA ER, the scoping process, the staff's site visit, or its evaluation of other available information, such as operation at a combined total power level of 11,856 MW(t). 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."

Tennessee Valley Authority (TVA). 2003. *Applicant's Environmental Report – Operating License Renewal Stage, Browns Ferry Units 1, 2, and 3.* Tennessee Valley Authority, Knoxville, Tennessee.

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

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

U.S. Nuclear Regulatory Commission (NRC). 2002. *Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities. Supplement 1 Regarding the Decommissioning of Nuclear Power Reactors. Final Report.* NUREG–0586, Supplement 1, Volumes 1 and 2. Office of Nuclear Reactor Regulation, Washington, D.C.

8.0 Environmental Impacts of Alternatives to Operating License Renewal

This chapter examines the potential environmental impacts associated with denying the renewal of the operating licenses (OLs) (i.e., the no-action alternative) for Browns Ferry Nuclear Power Plant, Units 1, 2, and 3 (BFN); the potential environmental impacts from electric generating sources other than BFN; the possibility of purchasing electric power from other sources to replace power generated by BFN 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 BFN. 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.

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

8.1 No-Action Alternative

NRC's regulations implementing the National Environmental Policy Act of 1969 (NEPA) specify that the no-action alternative be discussed in an NRC environmental impact statement (EIS) (10 CFR Part 51, Subpart A, Appendix A(4)). For license renewal, the no-action alternative refers to a scenario in which NRC would not renew the OLs for the three BFN units. The Tennessee Valley Authority (TVA) would then decommission the three BFN units after plant operations cease.

(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.

TVA states in its Environmental Report (ER) (TVA 2003) that if renewal of the Unit 1 OL is denied, further work on Unit 1 recovery and restart would terminate because restart would be economically infeasible. Operation of Units 2 and 3 would cease upon expiration of their OLs in 2014 and 2016, respectively. TVA would likely concurrently decommission all three units after the expiration of the Unit 3 OL (TVA 2003).

Under the no-action alternative, replacement of BFN electricity generation capacity would be met by (1) TVA generating alternatives other than BFN, (2) power purchased from other electricity providers, (3) demand-side management (DSM) and energy conservation, or (4) some combination of these options. The environmental impacts associated with alternative generation technologies are discussed in Section 8.2.

TVA will be required to comply with NRC decommissioning requirements at 10 CFR 50.82 whether or not the BFN OLs are renewed. If the OLs are renewed, decommissioning activities may be postponed for up to an additional 20 years.

The environmental impacts associated with decommissioning under both license renewal and the no-action alternative would be bounded by the discussion of impacts in Chapter 7 of the GEIS, Chapter 7 of this supplemental environmental impact statement (SEIS), and Supplement 1 to the *Final Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities Regarding the Decommissioning of Nuclear Power Reactors* (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.

The environmental impacts resulting from the no-action alternative are summarized in Table 8-1 and are discussed in the following paragraphs. Implementation of the no-action alternative would also have certain positive impacts in that adverse environmental impacts associated with the current operation of BFN would be eliminated.

Table 8-1. Summary of Environmental Impacts of the No-Action Alternative at the Browns Ferry Nuclear Power Plant, Units 1, 2, and 3

Impact Category	Impact	Comment
Land Use	SMALL	Onsite impacts expected to be temporary. No offsite impacts expected.
Ecology	SMALL	Impacts to ecology are expected to be temporary and can be mitigated using best management practices.
Water Use and Quality	SMALL	Water use would decrease. Water quality unlikely to be adversely affected.
Air Quality	SMALL	Greatest impact is likely to be from fugitive dust; impact can be mitigated using best management practices.

Table 8-1. (contd)

Impact Category	Impact	Comment
Waste	SMALL	Low-level radioactive waste (LLW) would be disposed of in licensed facilities. High-level radioactive waste (HLW) can be safely stored until a permanent HLW repository is available.
Human Health	SMALL	Radiological doses to workers and members of the public are expected to be within regulatory limits and comparable to, or lower than, doses from operating plants. Occupational injuries are possible, but injury rates at nuclear power plants are below the U.S. average industrial rate.
Socioeconomics	MODERATE	Decrease in employment in Limestone County and surrounding counties and tax revenues in Limestone County.
Aesthetics	SMALL	Positive impact from eventual removal of buildings and structures. Some noise impact during decommissioning operations.
Historic and Archaeological Resources	SMALL	Minimal impact on land utilized during plant operations. Land occupied by BFN would likely be retained by TVA for other purposes.
Environmental Justice	SMALL	Some loss of employment opportunities and social programs is expected.

8.1.1 Land Use

Temporary changes in onsite land use could occur during decommissioning. Temporary changes may include addition or expansion of staging and laydown areas or construction of temporary buildings and parking areas. Offsite land-use impacts associated with uranium mining would no longer occur. In the GEIS, the staff estimated that approximately 400 ha (1000 ac) would be affected for mining the uranium and processing it during the operating life of a 1000-megawatt-electric (MW[e]) nuclear power plant (NRC 1996). Following decommissioning, the land occupied by BFN would likely be retained by TVA for other purposes. It is expected that the existing transmission system, including rights-of-way, would be retained. Eventual sale or transfer of the land occupied by the plant, however, could result in changes to land use. Notwithstanding this possibility, the impacts of the no-action alternative on land use are considered SMALL.

8.1.2 Ecology

Impacts on aquatic ecology could result from removal of in-water pipes and structures. Any impacts to aquatic ecology would likely be short term and could be mitigated. The aquatic environment is expected to recover naturally. Impacts on the terrestrial ecology could occur as a result of land disturbance for additional laydown yards, stockpiles, and support facilities. Land disturbance is expected to be minimal and result in relatively short-term impacts that can be mitigated using best management practices. The land is expected to recover naturally. Overall, the ecological impacts associated with decommissioning are considered SMALL.

8.1.3 Water Use and Quality

Cessation of plant operations would result in a significant reduction in water use because reactor cooling would no longer be required. As plant staff size decreases, the demand for potable water is expected to also decrease. Onsite disposal of demolition debris could result in minimal impacts to water quality. Overall, water use and quality impacts of decommissioning are considered SMALL.

8.1.4 Air Quality

Decommissioning activities that can adversely affect air quality include dismantlement of systems and equipment, demolition of buildings and structures, and the operation of internal combustion engines. The most likely adverse impact would be the generation of fugitive dust. Best management practices, such as seeding and wetting, can be used to minimize the generation of fugitive dust. Overall, air quality impacts associated with decommissioning activities are considered SMALL.

8.1.5 Waste

Decommissioning activities would result in the generation of radioactive and nonradioactive waste. The volume of LLW is related to the type and size of the plant, the decommissioning option chosen, and the waste treatment and volume reduction procedures used. LLW must be disposed of in a facility licensed by NRC or a State with authority delegated by NRC. Recent advances in volume reduction and waste processing have significantly reduced waste volumes. A permanent repository for HLW is not currently available. The NRC has made a generic determination that, if necessary, spent fuel generated in any reactor can be stored safely and without significant environmental impacts for at least 30 years beyond the licensed life for operation (which may include the term of a revised or renewed license) of that reactor at its spent fuel storage basin or at either onsite or offsite independent spent fuel storage installations (10 CFR 51.23(a)). Disposal of nonradioactive waste would be at onsite and offsite licensed disposal facilities. Overall, waste impacts associated with decommissioning activities are considered SMALL.

8.1.6 Human Health

Radiological doses to occupational workers during decommissioning activities are estimated to average approximately 5 percent of the dose limits in 10 CFR Part 20, and to be similar to, or lower than, the doses experienced by workers in operating nuclear power plants. Collective doses to members of the public and to the maximally exposed individual as a result of decommissioning activities are estimated to be well below the limits in 10 CFR Part 20, and to be similar to, or lower than, the doses received from operating nuclear power plants. Occupational injuries to workers engaged in decommissioning activities are possible. However, historical injury and fatality rates at nuclear power plants have been lower than the average U.S. industrial rates. Overall, the human health impacts associated with decommissioning activities are considered SMALL.

8.1.7 Socioeconomics

If BFN ceased operation, there would be a decrease in employment and tax revenues associated with the closure. Impacts on employment (primary and secondary) and population would occur over a wide area. BFN employees reside in a number of counties; however, approximately 75 percent of employees live in Lauderdale, Limestone, Madison, and Morgan Counties (TVA 2003).

Tax-related impacts would occur primarily in Limestone County and surrounding counties. TVA makes tax-equivalent payments to states served by TVA which in turn redistribute some of the tax payments to the counties that are served by TVA power. The distribution of those payments to political subdivisions in the vicinity of BFN is discussed in Section 2.2.8.5. The no-action alternative would result in the loss of the tax-equivalent payments attributable to BFN as well as the loss of plant payrolls 20 years earlier than if the OLs were renewed. There would also be an adverse impact on housing values and the local economy if BFN were to cease operations.

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

The staff concluded that when the property tax revenue from a nuclear power plant comprises 10 percent or less of the tax revenue of a local jurisdiction, the socioeconomic impacts associated with the loss of the plant's tax revenue as a result of plant closure would likely be minor. Because the tax payments received by Limestone County from TVA are 10 percent or less of total tax revenue (see Table 2-12), socioeconomic impacts to Limestone County resulting from loss of this revenue would be minimal.

TVA employees working at BFN contribute time and money toward community involvement, including school, churches, charities, and other civic activities. It is likely that with a reduced presence in the community following decommissioning, community involvement efforts by TVA and its employees in the region would be less.

Overall, the socioeconomic impacts associated with non-renewal of the BFN OLs and decommissioning of BFN Units 1, 2, and 3 are considered MODERATE.

8.1.8 Aesthetics

Decommissioning would result in the eventual dismantlement of buildings and structures at the BFN site resulting in a positive aesthetic impact. Noise would be generated during decommissioning operations that may be detectable offsite; however, the impact is unlikely to be of large significance. Overall, the aesthetic impacts associated with decommissioning are considered SMALL.

8.1.9 Historic and Archaeological Resources

The amount of undisturbed land needed to support the decommissioning process would be relatively small. Activities conducted within operational areas are not expected to have a detectable effect on important cultural resources because these areas have likely been impacted during the operating life of BFN. Minimal disturbance of land outside TVA's operational area for decommissioning activities is expected. Historic and archaeological resources on undisturbed portions of the plant site are not expected to be adversely affected. The site would likely be retained by TVA following decommissioning. Eventual sale or transfer of the site, however, could result in adverse impacts to cultural resources if the land-use pattern changes dramatically. Notwithstanding this possibility, the impacts of the no-action alternative on historic and archaeological resources are considered SMALL.

8.1.10 Environmental Justice

Current operations at BFN have no disproportionate adverse impacts on the minority and low-income populations of Limestone County and surrounding counties, and no environmental pathways have been identified that would cause disproportionate impacts. Closure of the plant would result in decreased employment opportunities and tax revenues in Limestone County and surrounding counties as a result of reduced in-lieu-of-tax payments from TVA. Together, these impacts could result in secondary job losses (such as retail, services, etc.) that could have negative and disproportionate impacts on minority or low-income populations. Overall, however, the environmental justice impacts under the no-action alternative are considered SMALL.

8.2 Alternative Energy Sources

This section discusses the environmental impacts associated with alternative sources of electric power to replace the baseload[(a)] electric power generating capacity of BFN assuming that the OLs are not renewed.

The TVA ER states that the combined generating capacity of BFN Units 1, 2, and 3 at full uprated power will be 3840 MW(e)[(b)] (TVA 2003). This level of power production will make BFN among the largest, if not the largest, thermal generating station in the United States (DOE/EIA 2002). If the BFN OLs are not renewed, it is unlikely that this level of power (3840 MW[e]) would be produced from alternative generating sources at the BFN site or any other single alternative site. For purposes of the Section 8.2 analysis, it is assumed that replacement power production for the 3840 MW(e) will occur at more than one site and that the BFN site could be one site for siting new alternative power generating sources. Siting of additional energy sources at the BFN site would likely require TVA to acquire additional land beyond the current site boundary. Such acquisition would be complicated by the fact that there are nearby residential areas both upriver and downriver from the BFN site; however, the site could be expanded to the northeast.

The order of presentation of alternative energy sources in Section 8.2 does not imply which alternative would be most likely to occur or to have the least environmental impacts. The following generation alternatives are considered in detail:

- pulverized coal (Section 8.2.1)
- coal gasification (Section 8.2.2)

(a) 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; that is, these units generally run near full load continuously.
(b) One-MW(e) represents one million watts of electric capacity.

- natural gas combined-cycle (Section 8.2.3)
- new nuclear (Section 8.2.4).

Consistent with the TVA ER, the principal cooling alternative considered for each alternative energy plant is closed-cycle wet cooling using mechanical draft cooling towers. For completeness, the alternative of once-through cooling is considered, although the use of once-through cooling for newly constructed power plants is limited by the U.S. Environmental Protection Agency (EPA) requirements in 40 CFR Part 125, Subpart I, for cooling water intake structures for new facilities under Section 316(b) of the Clean Water Act.

The alternative of purchasing power from other sources to replace power generated at BFN is discussed in Section 8.2.5. Other power generation alternatives and conservation alternatives considered by the staff and found not to be reasonable replacements for the BFN generation capacity are discussed in Section 8.2.6. Section 8.2.7 discusses the environmental impacts of a combination of generation and conservation alternatives.

Each year, the Energy Information Administration (EIA), a component of the U.S. Department of Energy (DOE), issues an Annual Energy Outlook. The 2004 report projects that combined-cycle,[(a)] combustion turbine, or distributed generation technology fueled by natural gas is likely to account for approximately 62 percent of new electricity generating capacity added between 2002 and 2025 (DOE/EIA 2004). Combined-cycle technology can be used to meet baseload requirements. Coal-fired plants are projected by EIA to account for approximately 33 percent of new capacity during this period. Coal-fired plants are generally used to meet baseload requirements. Renewable energy sources, primarily wind and biomass units, are projected by EIA to account for the remaining 5 percent of capacity additions. EIA's projections are based on the assumption that providers of new generating capacity will seek to minimize cost while meeting applicable environmental requirements. Combined-cycle plants are projected by EIA to have the lowest adjusted generation cost for new plants in 2010 (DOE/EIA 2004). Coal-fired plants are projected to have the lowest adjusted generation cost for new plants in 2025 (DOE/EIA 2004).

EIA projects that oil-fired plants will account for no new generation capacity in the United States through the year 2025, except for limited industrial combined heat and power applications, because of higher fuel costs and lower efficiencies (DOE/EIA 2004).

(a) In the combined-cycle unit, hot combustion gases in a combustion turbine rotate the turbine to generate electricity. Waste combustion heat from the combustion turbine is routed through a heat-recovery boiler to make steam to generate additional electricity.

EIA's reference case also projects that new nuclear power plants will not account for any new generation capacity in the United States through the year 2025 because of the relative economics of competing technologies (DOE/EIA 2004). In spite of this projection, a new nuclear plant alternative for replacing power generated by BFN was considered in the TVA ER and is discussed in Section 8.2.4.

If an alternative generating technology were selected to replace power generated by BFN, Units 1, 2, and 3 would be decommissioned. Environmental impacts associated with decommissioning are discussed in Section 8.1 and are not otherwise addressed in Section 8.2.

8.2.1 Pulverized Coal-Fired Generation

In a pulverized coal-fired generation system, pieces of coal are crushed between balls or cylindrical rollers. The raw coal is then fed into the pulverizer along with air heated to about (343°C) 650°F from the boiler. As the coal is crushed by the rolling action, the hot air both dries it and moves the usable fine coal powder to a burner in the boiler where it is combusted.

In its ER, TVA considered the construction of 1200-MW(e) pulverized coal power stations, composed of two 600-MW(e) subcritical units (TVA 2003). At least three of these stations would be needed to replace the generating capacity of BFN. Each unit would have its own subcritical steam generator and condensing steam turbine generator. The subcritical steam generators would be balanced draft pulverized coal furnaces with drum type, single reheat boilers. Each unit would be an eight-heater cycle design with four low-pressure feedwater heaters, three high-pressure feedwater heaters, and a de-aerator. Ignition fuel would be No. 2 fuel oil.

Major structures for the pulverized coal-fired facility would include the boiler building, turbine and control building, and limestone preparation building. TVA assumed a single common concrete chimney for each station, with dual flues for wet stack gas (TVA 2003).

The pulverized coal-fired stations could be located near the coal supply (i.e., at the "mine mouth") or at a location with suitable cooling water that is closer to the loads to be served. For a mine-mouth plant, the impacts of coal transportation would be relatively small. However, lime or limestone, which is used in the scrubbing process for control of sulfur dioxide emissions,[a] would still need to be delivered to the plant site. Additionally, transmission line impacts would

(a) In a typical wet scrubber, lime (calcium hydroxide) or limestone (calcium carbonate) is injected as a slurry into the hot effluent combustion gases to remove entrained sulfur dioxide. The lime-based scrubbing solution reacts with sulfur dioxide to form calcium sulfite, which precipitates out and is removed in sludge form.

likely be greater for a mine-mouth plant than for a plant sited closer to the areas ultimately needing the power generated at the plant. For a plant not located at the mine mouth, coal would be delivered by railroad or barge.

Although the license renewal term is only 20 years, the impact of operating coal-fired stations for 40 years is considered (as a reasonable projection of the operating life of a coal-fired plant).

8.2.1.1 Closed-Cycle Cooling System

The overall impacts of constructing three 1200-MW(e) pulverized coal-fired power stations using closed-cycle cooling are discussed in the following sections and summarized in Table 8-2. The use of three 1200-MW(e) units is intended to be an approximation of the uprated BFN capacity; actual capacity of BFN is slightly larger – 3840 MW(e). It is unlikely that the three 1200-MW(e) stations would be located at a single site.

- **Land Use**

Approximately 400 ha (1000 ac) would be required for construction and operation of each 1200-MW(e) station. This area includes land for a barge unloading facility, the coal pile, a limestone pile, ash and scrubber solids disposal area, and plant buildings and structures, but it does not include land for an associated coal mine, transmission lines, access road, and railroad spur (TVA 2003).

In the GEIS, the staff estimated that approximately 8800 ha (34 mi^2) would be affected for mining the coal and disposing of the waste to support a 1000-MW(e) coal plant during its operational life (NRC 1996). A replacement coal-fired plant to replace the 3840-MW(e) capacity of BFN would affect proportionately more land.

Construction of each station would permanently change the land use at the site, and would most likely involve an irretrievable but moderate loss of forest land and/or farmland. Because of the use of erosion control practices during and following construction, no significant impacts to plant site soils are anticipated.

The impacts of three 1200-MW(e) pulverized coal-fired generating stations on land use is best characterized as MODERATE to LARGE. The impacts would definitely be greater than the alternative of renewing the BFN OLs.

Table 8-2. Summary of Environmental Impacts of Pulverized Coal-Fired Generation Using Closed-Cycle Cooling

Impact Category	Impact	Comment
Land Use	MODERATE to LARGE	Approximately 1200 ha (3000 ac) for power block; coal handling, storage, and transportation facilities; infrastructure facilities; and waste disposal. Mining the coal and disposal of waste could impact more than 30,000 ha (120 mi^2). Additional land impacts for limestone mining, electric power transmission lines, rail spurs, and cooling water intake and discharge pipelines.
Ecology	MODERATE to LARGE	Impacts would depend on location and ecology of the site, surface water body used for intake and discharge, and electric power transmission line route; potential habitat loss and fragmentation; reduced productivity and biological diversity; impacts to terrestrial ecology from cooling tower drift.
Water Use and Quality	SMALL to MODERATE	Impacts would depend on the volume of water withdrawn and discharged, the constituents in the discharge water, and the characteristics of the surface water body. Discharges would be regulated by the State or EPA.
Air Quality	MODERATE	Air emissions from three pulverized coal-fired plants sized to replace the uprated BFN capacity would be approximately: Sulfur oxides – 13,300 MT/yr (14,700 tons/yr) Nitrogen oxides – 15,900 MT/yr (17,500 tons/yr) PM_{10} – 3200 MT/yr (3500 tons/yr) Carbon monoxide – 4130 MT/yr (4550 tons/yr) Small amounts of mercury and other hazardous air pollutants and naturally occurring radioactive materials, mainly uranium and thorium. 40 million MT/yr (44 million tons/yr) of unregulated carbon dioxide.
Waste	MODERATE	For three 1200-MW(e) stations, potentially marketable material waste streams include 900,000 MT/yr (990,000 tons/yr) of fly ash, 224,400 MT/yr (247,500 tons/yr) of bottom ash, and 1,662,000 MT/yr (1,833,000 tons/yr) of flue gas desulfurization sludge (gypsum). Unusable waste streams would include 1695 MT/yr (1869 tons/yr) of raw water treatment sludges and 1062 MT/yr (1170 tons/yr) of general water treatment sludges.
Human Health	SMALL	Impacts are uncertain, but considered SMALL in the absence of more quantitative data.

Table 8-2. (contd)

Impact Category	Impact	Comment
Socioeconomics	MODERATE	Construction impacts depend on location and how many plants are constructed at the location. Limestone County could experience loss of BFN tax base and employment. Transportation impacts would result from commuting workers and delivery of coal and lime/limestone by rail or barge. Overall, impacts are considered MODERATE.
Aesthetics	MODERATE to LARGE	Impacts would depend on the site selected and the surrounding land features. Power block, exhaust stacks, cooling towers, and cooling tower plumes would be visible from nearby areas. If needed, new electric power transmission lines and/or a rail spur could have a significant aesthetic impact. Noise impact from plant operations and intermittent sources such as rail transportation of coal would be noticeable. Overall, visual and noise impacts are considered MODERATE to LARGE.
Historic and Archeological Resources	SMALL	New plant locations would necessitate cultural resource studies. Any potential impacts can likely be effectively managed.
Environmental Justice	SMALL to MODERATE	Impacts would vary depending on population distribution at the site. Impacts in Limestone County would be the same as those under the no-action alternative.

- **Ecology**

The coal-fired generation alternative would introduce construction impacts and new incremental operational impacts. Even assuming siting at a previously disturbed area, the impacts would alter the ecology. Impacts could include wildlife habitat loss, reduced productivity, habitat fragmentation, and a local reduction in biological diversity. Use of cooling makeup water from a nearby surface water body could have adverse aquatic resource impacts. If needed, construction and maintenance of a transmission line and a rail spur would have ecological impacts. There could be impacts to terrestrial ecology from cooling tower drift. Overall, the ecological impacts would be MODERATE to LARGE.

- **Water Use and Quality**

Construction of each power station (including transmission lines and access roads) would affect surface water hydrology, but sites could be chosen to avoid extensive site excavation, filling, or grading. New construction would disturb the land surface, which may temporarily affect surface water quality. Potential water quality impacts would consist of suspended solids from disturbed soils, biochemical oxygen demand, nutrient loading from disturbed vegetation, and oil and grease from construction equipment. New construction activities that disturb 2 ha (5 ac) or more would require a National Pollutant Discharge Elimination System (NPDES) permit for storm water discharges from the site to ensure the implementation of best management practices and to minimize impacts to surface waters during construction. To minimize the impacts of storm water flow erosion during construction, onsite retention areas (storm water detention pond) would be designed to detain storm water from the 25-year, 24-hour rainfall event. Runoff detention ponds would be designed to detain runoff within the containment areas to allow for settling and to reduce peak discharges. Best management practices would also be required during construction to minimize water quality impacts. Construction would cause no significant consumption of surface water resources. Sanitary waste water would most likely be routed to a publicly owned treatment works, if available. If a sanitary waste treatment system was not available, one would be constructed (TVA 2003).

During operation, approximately 90.5 percent of the 908 L/s (14,400 gal/min) plant intake water requirement for each 1200-MW(e) station would be for cooling tower makeup water flow, or about 822.7 L/s (13,040 gal/min). This amount of water consumption is normally obtainable from river intake or wells with a negligible impact on water availability downstream or in the vicinity of the plant. Cooling water for the main condensers and miscellaneous components would be recirculated through the cooling towers, with the blowdown (i.e., the fraction of circulated water that is discharged to prevent the buildup of dissolved salts and minerals) and other plant operational waste water streams subsequently being discharged through diffusers. A biocide would be used to protect the cooling water system from biological growths. Cooling tower blowdown amounting to 164 L/s (2600 gal/min) is expected to be several times larger than any other waste water stream, but it would not contain any detectable amounts of priority pollutants. Plant process waste water streams would include demineralizer regeneration wastes (11.4 L/s [180 gal/min]), steam cycle blowdown (13 L/s [200 gal/min]), and service water/pre-treatment waste and chemical drains (5.80 L/s [92 gal/min]). Plant waste water outfalls would also require a National Pollutant Discharge Elimination System (NPDES) permit, with established treatment standards and discharge limits. To prevent leachate in storm water runoff from entering the surficial aquifer, the coal storage area and the runoff basin would be lined with low-permeability materials. Runoff streams from the coal pile, fly ash and bottom ash piles, and gypsum storage area would be collected in the lined recycle basin for reuse (which would be sized to exceed capacity requirements for the 25-year, 24-hour storm event), with no direct discharge to the surface water (TVA 2003).

Overall, water use and quality impacts can be characterized as SMALL to MODERATE.

- **Air Quality**

The air quality impacts of coal-fired generation vary considerably from those of nuclear generation due to emissions of sulfur oxides (SO_x), nitrogen oxides (NO_x), particulates, carbon monoxide, hazardous air pollutants such as mercury, and naturally occurring radioactive materials. Estimated emissions for SO_x, NO_x, PM_{10} (particulate matter with an aerodynamic diameter less than or equal to 10 μm), and carbon monoxide are shown in Table 8-2. The emissions are for new pulverized coal-fired plants meeting all applicable regulatory requirements with a capacity sufficient to replace the power generated at the BFN.

A new coal-fired generating plant would need to meet the new source review requirements in Title I of the Clean Air Act (42 USC 7491). The plant would need an operating permit issued under Title V of the Clean Air Act. The plant would also need to comply with the new source performance standards for new generating plants in 40 CFR Part 60, Subpart Da. The standards establish limits for particulate matter and opacity (40 CFR 60.42a), sulfur dioxide (SO_2) (40 CFR 60.43a), and NO_x (40 CFR 60.44a).

EPA has various regulatory requirements for visibility protection in 40 CFR Part 51, Subpart P, including a specific requirement for review of any new major stationary source in an area designated as attainment or unclassified under the Clean Air Act.

Section 169A of the Clean Air Act establishes a national goal of preventing future and remedying existing impairment of visibility in mandatory Class I Federal areas when impairment results from air pollution caused by human activities. In addition, EPA issued a new regional haze rule in 1999 (64 FR 35714). The rule specifies that State agencies must establish goals for reasonable progress toward achieving natural visibility conditions for each mandatory Class I Federal area located within a state. 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 51.30(d)(1)). If a new coal-fired power plant were located close to a mandatory Class I area, additional air pollution control requirements could be imposed.

In 1998, EPA issued a rule requiring 22 eastern states to revise their state implementation plans to reduce NO_x emissions. Nitrogen oxide emissions contribute to violations of the national ambient air quality standard for ozone (40 CFR 50.9). The total amount of NO_x that can be emitted by each of the 22 states in the year 2007 ozone season (May 1 through September 30, 2007) is specified in 40 CFR 51.121(e). For Alabama, the amount is 108,706 MT (119,827 tons). Any new coal-fired power plant sited in Alabama would be subject to these limitations.

A new coal-fired power plant would be subject to the requirements in Title IV of the Clean Air Act. Title IV was enacted to reduce emissions of SO_2 and NO_x, the two principal precursors of acid rain, by restricting emissions of these pollutants from power plants. Title IV caps aggregate annual power plant SO_2 emissions and imposes control on SO_2 emissions through a system of marketable allowances. EPA issues one allowance for each ton of SO_2 that a unit is allowed to emit. New units do not receive allowances but are required to have allowances to cover their SO_2 emissions. Owners of new units must therefore acquire allowances from owners of other power plants by purchase or reduce SO_2 emissions at other power plants they own. Allowances can be banked for use in future years. Thus, a new coal-fired power plant would not add to net regional SO_2 emissions, although it might do so locally. Regardless, SO_2 emissions would be greater for the coal alternative than the OL renewal alternative because a nuclear power plant releases almost no SO_2 during normal operations.

Section 407 of the Clean Air Act establishes technology-based emission limitations for NO_x emissions. The market-based allowance system used for SO_2 emissions is not used for NO_x emissions. A new coal-fired power plant would be subject to the new source performance standards for such plants at 40 CFR 60.44a(d)(1). This regulation, issued on September 16, 1998 (63 FR 49453), limits the discharge of any gases that contain nitrogen oxides (expressed as NO_2) in excess of 200 ng/J of gross energy output (1.6 lb/MWh), based on a 30-day rolling average.

EPA issued the Clean Air Interstate Rule (CAIR) in 2005 (EPA 2005a). CAIR provides a Federal framework requiring certain states to reduce emissions of SO_2 and NO_x. EPA anticipates that states will achieve this reduction primarily by limiting emissions from the power generation sector. CAIR covers 28 eastern states and the District of Columbia. Any new fossil-fired power plant sited in Alabama would be subject to the CAIR limitations.

In 2005, EPA issued a final rule limiting mercury emissions from coal-fired power plants (EPA 2005b). Emissions are capped at specified, nationwide levels. A first-phase cap of 34 MT/yr (38 tons/yr) becomes effective in 2010 and a second-phase cap of 13 MT/yr (15 tons/yr) becomes effective in 2018. Plant owners must demonstrate compliance with the standard by holding one "allowance" for each ounce of mercury emitted in any given year. Allowances are transferable among regulated plants. Any new coal-fired power plant sited in Alabama would be subject to this rule.

Coal contains uranium and thorium. Uranium concentrations are generally in the range of 1 to 10 parts per million. Thorium concentrations are generally about 2.5 times greater than uranium concentrations (Gabbard 1993). One estimate is that a 1000-MW(e) coal-fired plant had an annual release of approximately 4.7 MT (5.2 tons) of uranium and 11.6 MT (12.8 tons) of thorium in 1982 (Gabbard 1993). The population dose equivalent from the uranium and thorium releases and daughter products produced by the decay of these isotopes has been calculated to be significantly higher than that from nuclear power plants (Gabbard 1993).

A coal-fired plant would also have unregulated carbon dioxide emissions that could contribute to global warming. TVA estimates that pulverized coal-fired plants sufficient to replace the power generated at BFN would emit approximately 40 million MT/yr (44 million tons/yr) of carbon dioxide (TVA 2003).

During the construction of a coal-fired plant, fugitive dust would be generated. Exhaust emissions would come from vehicles and motorized equipment used during the construction process. In addition, coal-handling equipment would introduce fugitive particulate emissions.

The GEIS analysis did not quantify emissions from coal-fired power plants but implied that air quality 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.

Overall, the air quality impacts associated with three new 1200-MW(e) pulverized coal-fired stations to replace the power generated at BFN would be MODERATE. The impacts would be clearly noticeable, but would not destabilize air quality.

- **Waste**

Coal combustion generates waste in the form of ash, and equipment for controlling air pollution generates additional ash, spent selective catalytic reduction (SCR) catalyst, and scrubber sludge.

Pulverized coal-fired plants would produce solid material streams in significant quantities, including both potential by-products and unusable solid wastes. The potentially marketable material streams for three 1200-MW(e) units are shown in Table 8-2. All of these by-product and waste streams are classified as non-hazardous, as determined by the Resource Conservation and Recovery Act (RCRA) toxicity characteristic leaching procedure (TVA 2003). Provision would be made to store fly ash, bottom ash, and scrubber by-products onsite indefinitely. If permitted, it might be possible to inject ash into underground mine works in the future. TVA would explore the market potential and economic benefit of selling the ash and scrubber by-products to wallboard manufacturers. Water treatment sludges would be disposed at a State-approved landfill, either onsite or offsite. Spent SCR catalyst would be regenerated or disposed offsite. Waste impacts to groundwater and surface water could extend beyond the operating life of the plant if leachate and runoff from the waste storage area occurred. 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, EPA issued a "Notice of Regulatory Determination on Wastes from the Combustion of Fossil Fuels" (65 FR 32214). EPA concluded that some form of national regulation is warranted to address coal combustion waste products because (1) the composition of these wastes could present danger to human health and the environment under certain conditions; (2) EPA has identified 11 documented cases of proven damages to human health and the environment by improper management of these wastes in landfills and surface impoundments; (3) present disposal practices are such that, in 1995, these wastes were being managed in 40 to 70 percent of landfills and surface impoundments without reasonable control in place, particularly in the area of groundwater monitoring; and (4) EPA identified gaps in State oversight of coal combustion wastes. Accordingly, EPA announced its intention to issue regulations for disposal of coal combustion waste under subtitle D of RCRA.

Debris would be generated during construction activities for the three 1200-MW(e) units. Such debris would be disposed in landfills.

For all of the preceding reasons, the appropriate characterization of impacts from waste generated from burning pulverized coal is MODERATE; the impacts would be clearly noticeable but would not destabilize any important resource.

- **Human Health**

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

The staff stated in the GEIS that there could be human health impacts (cancer and emphysema) from inhalation of toxins and particulates from a coal-fired plant, but 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 because of 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 at a newly constructed coal-fired plant are characterized as SMALL.

- **Socioeconomics**

The projected construction period for a 1200-MW(e) pulverized coal-fired power plant would be 54 months, with the first unit becoming operational at 48 months (TVA 2003). The total construction workforce would ramp up to the peak of 1100 workers over the first 18 months and then remain there until beginning to decline at 30 months to 500 workers at 42 months (TVA 2003). The total number of workers would exceed 500 for approximately 30 months. The peak number of workers would noticeably affect the local workforce for most sites, but the jobs would be temporary and many of the workers would commute from surrounding areas. The influx of workers could noticeably affect local school systems and other social services.

For a mine-mouth plant, the mining process preparation would increase the local construction employment to a base of 1500 workers for 4 years, peaking at 2500 workers (TVA 2003). A construction workforce of this size would have a noticeable impact for most prospective sites.

The permanent operating staff for a 1200-MW(e) pulverized coal-fired power plant would be approximately 120 workers. If the plant were sited at a mine mouth, the projected local employment for the mining operation would be approximately 320 workers (TVA 2003).

The coal-fired plants would provide a new tax base for the local communities in which they were sited through the in-lieu-of-tax payments made by TVA. In-lieu-of-tax payments in Limestone County would likely decrease if the BFN OLs were not renewed. For all of these reasons, the nontransportation socioeconomic impacts for new pulverized coal-fired plants would be noticeable, but would be unlikely to destabilize the area.

For transportation related to commuting of plant operating personnel for a 1200-MW(e) pulverized coal-fired power plant, the impacts are considered negligible. Transportation impacts would be temporary, noticeable, but not destabilizing during plant construction.

The GEIS states that socioeconomic impacts at a rural site would be larger than at an urban site, because more of the peak construction workforce would need to move to the area to work (NRC 1996).

Coal and lime/limestone would likely be delivered by rail to each power plant, although barge delivery is feasible for a site located on a navigable body of water. Socioeconomic impacts associated with rail transportation would likely have some impact to the community. Barge delivery of coal and lime/limestone would likely have minor socioeconomic impacts.

For power plants not located at the mine mouth, socioeconomic impacts would also occur at the site of coal mining.

Overall, the staff concludes that socioeconomic impacts associated with constructing and operating three 1200-MW(e) pulverized coal-fired plants would be MODERATE.

- **Aesthetics**

The coal-fired power block could be as much as 60 m (200 ft) tall and could be visible offsite during daylight hours. The exhaust stack could be as high as 200 m (650 ft). The stack would likely be highly visible in daylight hours for distances greater than 16 km (10 mi). The plant and associated stack would also be visible at night because of outside lighting. The Federal Aviation Administration generally requires that all structures exceeding an overall height of 60 m (200 ft) above ground level have markings and/or lighting so as not to impair aviation safety (FAA 2000). Visual impacts of a new coal-fired plant could be mitigated by landscaping and color selection for buildings that is consistent with the environment. Visual impact at night could be mitigated by reduced use of lighting, provided the lighting meets Federal Aviation Administration requirements, and appropriate use of shielding. Overall, the addition of the coal-fired unit and the associated exhaust stack would likely have some aesthetic impact. There could be a significant aesthetic impact if construction of a new transmission line and/or rail spur were needed.

Coal-fired generation would introduce mechanical sources of noise that would be audible offsite. Sources contributing to total noise produced by plant operation are classified as continuous or intermittent. Continuous sources include the mechanical equipment associated with normal plant operations. Intermittent sources include the equipment related to coal handling, solid-waste disposal, transportation related to coal and lime/limestone delivery, use of outside loudspeakers, and the commuting of plant employees. The noise impacts of a coal-fired plant would be slightly greater than those of current operations at BFN. Noise impacts associated with rail delivery of coal and lime/limestone would be most significant for residents living in the vicinity of the facility and along the rail route. Although noise from passing trains significantly raises noise levels near the rail line, the short duration of the noise reduces the impact. Nevertheless, given the frequency of train transport and the fact that many people are likely to be within hearing distance of the rail route, the impacts of noise on residents in the vicinity of the facility and the rail line would be noticeable. Noise associated with barge transportation of coal and lime/limestone would be minimal. Noise and light from the pulverized coal-fired power plants would be detectable offsite. Aesthetic impacts at the plant site would be mitigated if the plant were located in an industrial area adjacent to other power plants.

Overall, the aesthetic impacts associated with new pulverized coal-fired power plants can be categorized as MODERATE to LARGE.

- **Historic and Archaeological Resources**

Before construction at any 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 lines, rail lines, or other rights-of-way). Historic and archaeological resource impacts can generally be effectively managed and as such are considered SMALL.

- **Environmental Justice**

Environmental justice impacts would depend upon the sites chosen for the pulverized coal-fired power plants and the nearby population distribution. Construction activities would offer new employment possibilities, but could have negative impacts on the availability and cost of housing, which could disproportionately affect minority and low-income populations. Impacts in Limestone County would be the same as those under the no-action alternative. Overall, environmental justice impacts are likely to be SMALL to MODERATE.

8.2.1.2 Once-Through Cooling System

The environmental impacts of constructing and operating a pulverized coal-fired power plant using a once-through cooling system are essentially the same as the impacts for a coal-fired plant using closed-cycle cooling with wet cooling towers. However, there are some environmental differences between the closed-cycle and once-through cooling systems. Table 8-3 summarizes the incremental differences.

Table 8-3. Summary of Environmental Impacts of Pulverized Coal-Fired Generation with Once-Through Cooling

Impact Category	Change in Impacts from Closed-Cycle Cooling System
Land Use	10 to 12 ha (25 to 30 ac) less land required per 1200-MW(e) unit because cooling towers and associated infrastructure are not needed.
Ecology	Impacts would depend on ecology at the site. No impacts to terrestrial ecology from cooling tower drift. Increased water withdrawal with possible greater impacts to aquatic ecology.
Surface Water Use and Quality	No discharge of cooling tower blowdown. Increased water withdrawal and more thermal load on receiving body of water.
Groundwater Use and Quality	No change
Air Quality	No change
Waste	No change
Human Health	No change
Socioeconomics	No change
Aesthetics	Less aesthetic impact because cooling towers would not be used.
Historic and Archaeological Resources	Less land impacted.
Environmental Justice	No change

8.2.2 Coal Gasification

Coal gasification is a method of producing relatively clean, burnable gas from almost any type of coal or from petroleum coke. The basic process involves crushing the coal and partially oxidizing the carbon in the coal. Partial oxidation converts the coal into a gaseous fuel composed primarily of combustible hydrogen and carbon monoxide. The gas can be piped directly into a gas turbine to generate electricity. The exhaust from the gas turbine is ducted into a heat recovery steam generator to produce steam for a conventional steam turbine generator. To make the overall process both environmentally safe and thermally efficient, a coal gasification plant must integrate a number of different technologies. Major systems include fuel preparation, an air separation unit, a gasifier, acid gas removal, sulfur recovery, a combustion turbine generator, a heat recovery steam generator, and a steam turbine generator (TVA 2003).

In its ER TVA evaluated the construction and operation of a 2720-MW(e) coal gasification plant sited at TVA's unfinished Bellefonte nuclear plant site. Additional capacity beyond the 2720-MW(e) plant, probably sited at another location, would be needed to fully replace the 3840-MW(e) uprated capacity of BFN. The Bellefonte site comprises approximately 610 ha (1500 ac) and is located adjacent to the Tennessee River (Guntersville Lake) in Jackson County, Alabama. Construction access routes are completed at the Bellefonte site, and basic support functions (i.e., electric power, potable water, sanitary waste disposal, office buildings, parking lots, railways, and barge unloading facility) are in place (TVA 2003). Almost all of the basic site preparation work, such as grading, has been completed.

The coal gasification plant would have eight 340-MW(e) modules, each consisting of one coal gasification plant, one combustion turbine, and one heat recovery steam generator. The steam recovered from each module would be collected and routed to the two existing low-pressure steam turbine generators, four modules per steam turbine. An air separation plant would be constructed for each gasifier to supply the pressurized 95 percent (by volume) oxygen required for the oxygen-blown gasifiers (TVA 2003).

Delivery of coal and/or petroleum coke to the Bellefonte site would be needed. Approximately 21,800 MT (24,000 tons) of fuel would be shipped in daily, probably via barge (TVA 2003). If coal is used as fuel, the origin would likely be southern Illinois. If petroleum coke is used as fuel, the origin would likely be Texas or Louisiana, states with extensive refining industries. Approximately 218 MT/day (240 tons/day) of limestone would likely be required for air pollution control. Trucking would be used for limestone delivery. Fuel oil would be required for startup activities, but would not be used as a backup fuel (TVA 2003).

8.2.2.1 Closed-Cycle Cooling System

The overall impacts of constructing a coal gasification plant at the Bellefonte site are discussed in the following sections and summarized in Table 8-4. Additional impacts would occur at another location as necessary to fully replace the 3840-MW(e) capacity of BFN. The impact categorizations in Table 8-4 are based on 3840 MW(e) of coal gasification generating capacity.

- **Land Use**

TVA assumes siting of the coal gasification facility at the existing unfinished Bellefonte nuclear plant site (TVA 2003). The existing cooling towers and circulating water system at the Bellefonte site would be used. There is an existing 39.9-km (24.8-mi) 500-kV transmission line to the Bellefonte site that is not energized (TVA 2003). Approximately 77 ha (190 ac) to the southwest of the existing cooling towers would be used to construct new facilities. Construction

Table 8-4. Summary of Environmental Impacts of Coal Gasification Using Closed-Cycle Cooling

Impact Category	Impact	Comment
Land Use	MODERATE to LARGE	Impact at the Bellefonte site would be minor, but there would be offsite impacts for coal and limestone mining. At another site, several hundred acres would be impacted for the power block; fuel handling, storage, and transportation facilities; infrastructure facilities; and waste disposal. Additional land impacts for coal and limestone mining, electric power transmission lines, and cooling water intake and discharge pipelines.
Ecology	SMALL to LARGE	Impact at the Bellefonte site would be SMALL to MODERATE. Impacts at another site could be as much as LARGE and would depend on the location and the ecology of the site, the surface water body used for intake and discharge, and the electric power transmission line route; potential habitat loss and fragmentation; reduced productivity and biological diversity; impacts to terrestrial ecology from cooling tower drift.
Water Use and Quality	SMALL to MODERATE	Impact would depend on the volume of water withdrawn and discharged, the constituents in the discharge water, and the characteristics of the surface water body. Discharges at the Bellefonte site would be regulated by the Alabama Department of Environmental Management.
Air Quality	MODERATE	Air emissions from coal gasification plants sized to fully replace BFN capacity would be approximately: Sulfur oxides – 10,700 MT/yr (11,800 tons/yr) Nitrogen oxides – 4881 MT/yr (5380 tons/yr) PM_{10} – 1524 MT/yr (1680 tons/yr) Carbon monoxide – 5661 MT/yr (6240 tons/yr) Small amounts of mercury and other hazardous air pollutants would be discharged along with approximately 28 million MT/yr (31 million tons/yr) of unregulated carbon dioxide.

Table 8-4. (contd)

Impact Category	Impact	Comment
Waste	MODERATE	Waste streams from the 2720-MW(e) plant would be 457,000 MT/yr (504,000 tons/yr) of slag, 36,000 MT/yr (40,000 tons/yr) of fly ash, 180,000 MT/yr (200,000 tons/yr) of sulfur, 1161 MT/yr (1280 tons/yr) of raw water treatment sludge, 730 MT/yr (800 tons/yr) of general waste water treatment sludge, and 36 MT/yr (40 tons/yr) of sludges from the biotreatment of gasification process waste water.
Human Health	SMALL	Impacts are uncertain, but considered to be SMALL in the absence of more quantitative data.
Socioeconomics	MODERATE	Peak construction employment at the Bellefonte site would be approximately 2200 workers. The operating workforce would be approximately 530. Limestone County could experience loss of BFN tax base and employment. Transportation impacts would result from commuting workers and delivery of coal and lime/limestone. Transportation of coal to the Bellefonte site would likely be by barge with negligible socioeconomic impacts. Overall, impacts at the Bellefonte site or at an alternate site are considered MODERATE.
Aesthetics	MODERATE to LARGE	Introduction of 12 new emission stacks 99.1 m (325 ft) high and two flaring stacks 60 m (200 ft) high at the Bellefonte site. No new transmission lines or cooling towers at the Bellefonte site. If needed at an alternate site, new electric power transmission lines and/or a rail spur could have significant aesthetic impacts.
Historic and Archeological Resources	SMALL	The Bellefonte site has had previous surveys for historic and archeological resources. New plant locations would necessitate cultural resource studies. Any potential impacts can likely be effectively managed.
Environmental Justice	SMALL to MODERATE	Impacts would vary depending on population distribution and makeup water at the site. Impacts in Limestone County would be the same as those under the no-action alternative.

in this location would require the demolition or relocation of several existing buildings and underground utilities. After completion of demolition, the area would be cleared of existing vegetation, then leveled to an elevation above the 500-year floodplain (TVA 2003). Construction would include the preparation of an area for disposal of unmarketable slag. There would be offsite land impacts to supply coal and limestone for the plant.

At another site, several hundred acres would be impacted for the power block; fuel handling, storage, and transportation facilities; infrastructure facilities; and waste disposal. There would be additional land impacts for coal and limestone mining, electric power transmission lines, and cooling water intake and discharge pipelines.

In the GEIS, the staff estimated that approximately 8800 ha (34 mi^2) would be affected for mining the coal and disposing of the waste to support a 1000-MW(e) coal plant during its operational life (NRC 1996). A replacement coal gasification plant to replace the 3840-MW(e) capacity of BFN would affect proportionately more land.

Overall, land-use impacts can be characterized as MODERATE to LARGE.

- **Ecology**

At the Bellefonte site, there are no Federally or State-listed threatened or endangered plant species (TVA 2003). Construction of barge facilities could result in some reduction in roosting and foraging sites for raptors, bats, waterfowl, and wading birds such as great egrets, green herons, and great blue herons. There are no caves at the Bellefonte site that support the Federally endangered Indiana and gray bats, but they are known to forage along the Guntersville Lake shoreline. However, areas close to the Bellefonte site have an extensive network of similar wooded shoreline and shallow lagoon habitats. Therefore, the impacts associated with new coal gasification facilities are expected to be minimal. Lowering the existing diffuser at the site and constructing the barge terminal and mooring cells would require in-stream dredging to remove approximately 115,000 m^3 (150,000 yd^3) of material, resulting in impacts on resident aquatic communities. However, surveys have found no toxic sediments and a low average density of mussels in the area, and it is expected that the dredge material would be disposed on land (TVA 2003). Because water intake demand would be small compared to the total water mass flowing past the Bellefonte site, there would be little potential for significant entrainment or impingement impacts (TVA 2003). The existing Bellefonte water intake structure would be used. The greatest impacts of entrainment and impingement would result from water withdrawn from the upstream productive overbank, although losses to the lake fish community should be minimal due to the large amounts of similar habitat near the plant and in other areas of the lake (TVA 2003). There could be impacts to terrestrial ecology from cooling tower drift.

At another site, the coal gasification alternative would introduce construction impacts and new incremental operational impacts. Even assuming siting at a previously disturbed area, the impacts would alter the ecology. Impacts could include wildlife habitat loss, reduced productivity, habitat fragmentation, and a local reduction in biological diversity. Use of cooling makeup water from a nearby surface water body could have adverse aquatic resource impacts. If needed, construction and maintenance of a transmission line and a rail spur would have ecological impacts.

Overall, the ecological impacts at the Bellefonte site are considered SMALL to MODERATE and at another site SMALL to LARGE.

- **Water Use and Quality**

Raw water for construction and operation at the Bellefonte site would be obtained from the Tennessee River. The quantities needed would be unlikely to have a significant effect on the river. The highest sustained water needs during operation would be approximately 2315 L/s (36,700 gal/min), or about 0.21 percent of the average river flow. Of the 2315 L/s, 1142 L/s (18,100 gal/min) would be for cooling system makeup water. Both existing closed-cycle natural draft cooling towers on the Bellefonte site would be used (TVA 2003).

Potable water is supplied to the Bellefonte site by the City of Hollywood, which receives its water from the City of Scottsboro. The Bellefonte site is connected to the Hollywood municipal sewage system treatment plant located adjacent to the south side of the site. The sewage treatment plant serves the Bellefonte site and residential customers in the area, but currently it does not have sufficient capacity to handle the increased demand of a large construction workforce and would have to be enlarged (TVA 2003).

No significant construction-related impacts to surface water resources would be expected as a result of the project. The majority of the power plant and associated facilities would be constructed on land that has been previously disturbed due to construction activities related to the uncompleted Bellefonte nuclear plant. Construction of new facilities and overall site reclamation activities would affect surface hydrology, but extensive site excavation, filling, or grading would not be needed. The primary surface water impact during construction would be soil erosion, which could be kept low by the use of best management practices. To minimize the impacts of storm water flow during construction, a storm water retention pond would be designed to retain storm water from the 25-year, 24-hour rainfall event, in compliance with regulatory requirements (TVA 2003).

The surface water resources within the areas of the proposed development at the Bellefonte site are currently monitored under an NPDES permit issued by the Alabama Department of Environmental Management.

Any impacts to groundwater during operation would most likely be associated with storage and handling of feedstocks and the storage, handling, and disposal of wastes generated. Runoff from the coal and petroleum coke storage areas would be collected in a drainage basin and treated as needed (TVA 2003).

At another site, water use and quality impacts would depend on the volume of water withdrawn and discharged, the constituents in the discharge water, and the characteristics of the surface water body. Discharges would be regulated by the State or by EPA. Construction-related impacts at another site may be significantly greater than at the Bellefonte site; however, they would be mitigable and temporary.

Overall, water use and quality impacts at the Bellefonte site or another site can be characterized as SMALL to MODERATE.

- **Air Quality**

The air quality impacts of coal-fired generation vary considerably from those of nuclear generation emissions of SO_2, NO_x, particulates, carbon monoxide, and hazardous air pollutants such as mercury, and naturally occurring radioactive materials.

Estimated air emissions for a coal gasification plant meeting all applicable regulatory requirements and sized to fully replace the 3840-MW(e) uprated capacity of BFN are shown in Table 8-4 (TVA 2003). The estimated emissions are based on using petroleum coke as fuel. Emissions of SO_x are higher for petroleum coke than if coal is used as the fuel.

A new coal gasification generating plant would need to meet the new source review requirements in Title I of the Clean Air Act. The plant would need an operating permit issued under Title V of the Clean Air Act. The plant would also need to comply with the new source performance standards for new generating plants in 40 CFR Part 60, Subpart Da. The 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).

EPA has various regulatory requirements for visibility protection in 40 CFR Part 51 Subpart P, including a specific requirement for review of any new major stationary source in an area designated as attainment or unclassified under the Clean Air Act. All of Jackson County, Alabama, the location of the Bellefonte site, is classified as attainment or unclassified for criteria pollutants under the Clean Air Act.[a]

Section 169A of the Clean Air Act establishes a national goal of preventing future and remedying existing impairment of visibility in mandatory Class I Federal areas when impairment is from air pollution resulting from human activities. In addition, EPA issued a new regional haze rule in 1999 (64 FR 35714). The rule specifies that for each mandatory Class I Federal

(a) Existing criteria pollutants under the Clean Air Act are ozone, carbon monoxide, particulates, sulfur dioxide, lead, and nitrogen oxide. Ambient air standards for criteria pollutants are set out at 40 CFR Part 50.

area located within a state, state agencies 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 new coal gasification power plant were located close to a mandatory Class I area, additional air pollution control requirements could be imposed. The nearest Class I area to the Bellefonte site is the Cohutta Wilderness, which is approximately 120 km (75 mi) distant (TVA 2003).

In 1998, the EPA issued a rule requiring 22 eastern states to revise their state implementation plans to reduce NO_x emissions. Nitrogen oxide emissions contribute to violations of the national ambient air quality standard for ozone (40 CFR 50.9). The total amount of NO_x that can be emitted by each of the 22 states in the year 2007 ozone season (May 1 through September 30) is set out at 40 CFR 51.121(e). For Alabama, the amount is 108,706 MT (119,827 tons). Any new fossil-fired power plant sited in Alabama would be subject to these limitations.

EPA issued the Clean Air Interstate Rule (CAIR) in 2005 (EPA 2005a). CAIR provides a Federal framework requiring certain states to reduce emissions of SO_2 and NO_x. EPA anticipates that states will achieve this reduction primarily by limiting emissions from the power generation sector. CAIR covers 28 eastern states and the District of Columbia. Any new fossil-fired power plant sited in Alabama would be subject to the CAIR limitations.

In 2005, EPA issued a final rule limiting mercury emissions from coal-fired power plants (EPA 2005b). Emissions are capped at specified, nationwide levels. A first-phase cap of 34 MT/yr (38 tons/yr) becomes effective in 2010 and a second-phase cap of 13 MT/yr (15 tons/yr) becomes effective in 2018. Plant owners must demonstrate compliance with the standard by holding one "allowance" for each ounce of mercury emitted in any given year. Allowances are transferable among regulated plants. Any new coal-fired power plant sited in Alabama would be subject to this rule.

A coal gasification plant would also have unregulated carbon dioxide emissions that could contribute to global warming. TVA estimates that coal gasification plants sufficient to replace the power generated at BFN would emit approximately 28 million MT/yr (31 million tons/yr) of carbon dioxide (TVA 2003).

Overall, the air quality impacts associated with new coal gasification plants to replace the power generated at BFN would be MODERATE. The impacts would be clearly noticeable, but would not destabilize air quality.

- **Waste**

The major solid waste and by-product streams would be generated by the gasifiers. Slag, fly ash, and sulfur account for more than 99 percent of the solids produced by coal gasification plants, with the remaining 1 percent consisting of spent catalysts and water treatment sludges. The generation rates in tons per year for a 2720-MW(e) plant are shown in Table 8-4 (TVA 2003). The slag produced is an inert, glass-like material that has been found in coal gasification demonstrations to be nonleachable (TVA 2003). Based on testing at gasification demonstration plants, the slag and fly ash from gasification of eastern bituminous coal is expected to be below the RCRA threshold limits for hazardous designation (TVA 2003). Most of the sulfur in the coal is converted to hydrogen sulfide in the synthetic gas. The hydrogen sulfide is removed by acid gas removal and then converted to elemental sulfur by-product in the sulfur recovery system. TVA anticipates that the slag, fly ash, and sulfur produced at a coal gasification plant would be of sufficient quality to be marketed (TVA 2003).

There would be three process solid waste streams composed of sludges from raw water or waste water treatment: raw water treatment sludge, general waste water treatment sludge, and sludge from the biotreatment of gasification process waste water. Generation amounts are shown in Table 8-4. These sludges are typically not hazardous and would be disposed of at nearby State-approved municipal disposal sites (TVA 2003).

Construction-related debris would be generated during construction activities for the coal gasification units and disposed at a landfill.

For all the preceding reasons, the appropriate characterization of waste impacts from coal gasification is MODERATE; the impacts would be clearly noticeable but would not destabilize any important resource.

- **Human Health**

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

The staff stated in the GEIS that there could be human health impacts (cancer and emphysema) from inhalation of toxins and particulates from a coal-fired plant, but did not identify the significance of these impacts (NRC 1996). In addition, the discharges of uranium and thorium from coal-fired plants can 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 at a newly constructed coal gasification plant are characterized as SMALL.

- **Socioeconomics**

Peak employment during construction at the Bellefonte site would be approximately 2200 workers (TVA 2003). The peak number of workers would noticeably affect the local workforce near the Bellefonte site, but the jobs would be temporary and many of the workers would commute from surrounding areas. The influx of workers could noticeably affect local school systems and other social services. The permanent operating staff would be approximately 530 workers (TVA 2003).

The coal gasification plants would provide a new tax base for Jackson County and any other local communities in which they were sited through the in-lieu-of tax payments made by TVA. In-lieu-of-tax payments in Limestone County would likely decrease if the BFN OLs were not renewed. For all these reasons, the nontransportation socioeconomic impacts for new coal gasification plants would be noticeable, but would be unlikely to destabilize the area.

For transportation related to commuting of plant operating personnel, the impacts are considered negligible. Transportation impacts would be noticeable, temporary, but not destabilizing during plant construction.

The GEIS states that socioeconomic impacts at a rural site would be larger than at an urban site, because more of the peak construction workforce would need to move to the area to work (NRC 1996).

Coal and lime/limestone would likely be delivered by barge to the Bellefonte site (TVA 2003). Approximately 17 barges of coal per day would be delivered (TVA 2003). Some recreational impact would result from increased barge traffic. Nevertheless, barge delivery of coal and lime/limestone would likely have minor socioeconomic impacts. At an alternate site, rail delivery of coal and lime/limestone could be needed.

For coal gasification power plants not located at the mine mouth, socioeconomic impacts would also occur at the site of the coal mine.

Overall, the staff concludes that socioeconomic impacts associated with constructing and operating new coal gasification plants would be MODERATE.

- **Aesthetics**

The 2720-MW(e) coal gasification plant would have 12 stacks for emissions that would be approximately 99.1 m (325 ft) high (TVA 2003). In addition, the completed plant would have two flaring stacks to burn waste gas approximately 60 m (200 ft) in height. Flaring operations would generally be visible within a 5-km (3-mi) radius, particularly at night. The stacks would not rise to the height of the existing cooling towers at the Bellefonte site, but would be visible up to 10 km (6 mi) away. Vapor fog from the cooling towers and stack emissions could be visible from distances of 16 km (10 mi) or more. There is an existing 40-km (24.8-mi) 500-kV transmission line to the Bellefonte site that is not energized (TVA 2003). Consequently, there would not be a new incremental aesthetic impact associated with transmission lines. Overall, construction and operation of a new coal gasification plant at the Bellefonte site would likely have a MODERATE aesthetic impact.

At an alternate site, aesthetic impacts would be similar to those at the Bellefonte site. If needed, new electric power transmission lines and/or a rail spur could have significant aesthetic impacts. Overall, aesthetic impacts at an alternate site would be MODERATE to LARGE.

- **Historic and Archaeological Resources**

A 1972 archaeological survey of the Bellefonte site identified five historic sites, none of which are within proposed construction zones for a coal gasification plant (TVA 2003). The original Town of Bellefonte was located just offsite and determined in 1974 to be eligible for placement on the National Register of Historic Places. Prior to the initiation of construction of the uncompleted Bellefonte nuclear plant, the Alabama State Historic Preservation Office determined that no mitigation would be required. Since that time all structures have been removed by landowners (TVA 2003).

Before construction at an alternative site, studies would likely be needed to identify, evaluate, and address mitigation of the potential impacts of new plant construction on archaeological 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 line, rail lines, or other rights-of-way). Historic and archaeological resource impacts can generally be effectively managed and would likely be SMALL.

- **Environmental Justice**

Environmental justice impacts would depend upon the population distribution around the Bellefonte site or other alternative sites. Construction activities would offer new employment possibilities, but could have negative impacts on the availability and cost of housing, which could disproportionately affect minority and low-income populations. Impacts in Limestone County would be the same as those under the no-action alternative assuming no construction of a coal gasification plant at the BFN site. Overall, environmental justice impacts are likely to be SMALL to MODERATE.

8.2.2.2 Once-Through Cooling System

The environmental impacts of constructing and operating a coal gasification plant using a once-through cooling system are essentially the same as the impacts for a coal gasification plant using closed-cycle cooling with wet cooling towers. However, there are some environmental differences between the closed-cycle and once-through cooling systems. Table 8-5 summarizes the incremental differences.

Table 8-5. Summary of Environmental Impacts of a Coal Gasification Plant with Once-Through Cooling

Impact Category	Change in Impacts from Closed-Cycle Cooling System
Land Use	Less land required because cooling towers and associated infrastructure are not needed.
Ecology	Impacts would depend on ecology at the site. No impacts to terrestrial ecology from cooling tower drift. Increased water withdrawal with possible greater impacts to aquatic ecology.
Surface Water Use and Quality	No discharge of cooling tower blowdown. Increased water withdrawal and more thermal load on receiving body of water.
Groundwater Use and Quality	No change
Air Quality	No change
Waste	No change

Table 8-5. (contd)

Impact Category	Change in Impacts from Closed-Cycle Cooling System
Human Health	No change
Socioeconomics	No change
Aesthetics	Less aesthetic impact because cooling towers would not be used.
Historic and Archaeological Resources	Less land impacted.
Environmental Justice	No change

8.2.3 Natural Gas Combined-Cycle Generation

The TVA ER considers the construction of 510-MW(e) natural gas combined-cycle power plants using mechanical draft cooling towers. Seven such plants would be needed to replace most of the 3840-MW(e) uprated capacity of BFN. It is likely that multiple locations would be needed for this number of plants. At each location it is likely that a new transmission line would need to be constructed to connect to existing lines. In addition, construction or upgrade of a natural gas pipeline from the plant location to a supply point where a firm supply of gas would be available would be needed.

Although the OL renewal term is only 20 years, the impact of operating the natural gas combined-cycle alternative for 40 years is considered (as a reasonable projection of the operating life of a natural gas combined-cycle plant).

8.2.3.1 Closed-Cycle Cooling System

The overall impacts associated with the construction and operation of natural gas combined-cycle plants of sufficient capacity to replace the uprated BFN are summarized in Table 8-6 and are discussed in the following sections.

- **Land Use**

Each 510-MW(e) natural gas combined-cycle plant would require approximately 80 ha (200 ac) (TVA 2003). Additional land would be impacted for construction of a transmission line and natural gas pipeline to serve the plant. For any new natural gas combined-cycle plant, additional land would be required for natural gas wells and collection stations. In the GEIS, the staff

Table 8-6. Summary of Environmental Impacts of Natural Gas Combined-Cycle Generation Using Closed-Cycle Cooling

Impact Category	Impact	Comment
Land Use	MODERATE to LARGE	Approximately 560 ha (1400 ac) would be needed to fully replace BFN capacity. Additional site-specific impacts for natural gas pipeline, electric power transmission lines, rail spurs, and cooling water intake and discharge pipelines.
Ecology	MODERATE	Impact depends on location and ecology of the site, surface water body used for intake and discharge, and electric power transmission line and natural gas pipeline routes; potential habitat loss and fragmentation; reduced productivity and biological diversity; and impacts to terrestrial ecology from cooling tower drift.
Water Use and Quality	SMALL to MODERATE	Impact would depend on the volume of water withdrawn and discharged, the constituents in the discharge water, and the characteristics of the surface water body. Discharges would be regulated by the State or EPA.
Air Quality	MODERATE	Air emissions to fully replace BFN capacity would be approximately: Sulfur oxides – 67 MT/yr (74 tons/yr) Nitrogen oxides – 1295 MT/yr (1428 tons/yr) PM_{10} – 1188 MT/yr (1310 tons/yr) Carbon monoxide – 4941 MT/yr (5446 tons/yr) Small amounts of hazardous air pollutants would be discharged along with 17.1 million MT/yr (18.9 million tons/yr) of unregulated carbon dioxide.
Waste	SMALL	The only significant waste would be spent SCR catalyst used for control of nitrogen oxide emissions.
Human Health	SMALL	Impacts are uncertain, but considered SMALL in the absence of more quantitative data.
Socioeconomics	MODERATE	Construction impacts depend on location and how many plants are constructed at the location. Limestone County could experience loss of BFN tax base and employment. Impacts during operation of the natural gas plants would likely be SMALL. Transportation impacts would result from commuting workers.

Table 8-6. (contd)

Impact Category	Impact	Comment
Aesthetics	MODERATE to LARGE	Impact would depend on the site selected and the surrounding land features. Power block, exhaust stacks, cooling towers, and cooling tower plumes would be visible from nearby areas. If needed, new electric power transmission lines could have a significant aesthetic impact. Noise impact from plant operations and intermittent sources would be noticeable.
Historic and Archeological Resources	SMALL	New plant locations would necessitate cultural resource studies. Any potential impacts can likely be effectively managed.
Environmental Justice	SMALL to MODERATE	Impacts would vary depending on population distribution at the site. Impacts in Limestone County would be the same as those under the no-action alternative.

estimated that approximately 1500 ha (3600 ac) would be needed for a 1000-MW(e) plant (NRC 1996). Proportionately more land would be needed for a natural gas combined-cycle plant replacing the 3840-MW(e) uprated generating capacity of BFN.

Overall, land-use impacts for construction of seven 510-MW(e) natural gas combined-cycle plants are considered MODERATE to LARGE.

- **Ecology**

Ecological impacts would depend on the nature of the land converted for the plant and any new transmission lines or gas pipelines. Construction of a transmission line and a gas pipeline to serve the plant would be expected to have temporary ecological impacts. Ecological impacts to a plant site and utility easements could include impacts on threatened or endangered species, wildlife habitat loss and reduced productivity, habitat fragmentation, and a local reduction in biological diversity. Intake and discharge of makeup water for the cooling system could adversely affect aquatic resources. There could be impacts to terrestrial ecology from cooling tower drift. Overall, ecological impacts are considered MODERATE.

- **Water Use and Quality**

Construction would be expected to increase erosion and storm water runoff of suspended solids above existing levels, but this would be temporary and mitigable by the use of best management practices. Completion of a retention pond for the treatment of storm water runoff early in the construction phase would significantly reduce potential increased solids loading to local surface drainage waterways. Application of best management practices to control erosion during construction should mitigate construction impacts of transmission lines and pipelines (natural gas supply, potable water supply, process water supply, and waste water discharge). Impacts of constructing new intake and discharge structures on nearby waterways and/or reservoirs would be minimized by construction techniques to minimize disturbance of sediments and by the use of mitigation measures such as coffer dams, turbidity curtains, and selection of a construction time window (TVA 2003).

Waste water discharges would be regulated by the State or by EPA. Approximately 90 percent of the waste water discharge flow would be cooling tower blowdown. Other sources of waste water include steam cycle blowdown, water from inlet fogging, demineralizer rinse water, and miscellaneous low-volume waste water. This water would be treated onsite as necessary to meet regulatory requirements before being discharged to local waters (TVA 2003).

Storm water runoff during plant operation would be drained to a retention pond to allow sediments to settle out prior to discharge to local waterways. Rainwater that fell in secondary containment around oil-containing equipment would drain to an oil/water separator where the oil would be removed for disposal and the water would subsequently drain to the process water pond. Excavation and grading associated with construction of the plant or any of the ancillary features, such as the transmission lines, backup power, process and potable water pipelines, waste water discharge pipelines, and natural gas pipelines, would not be expected to cause adverse effects to groundwater. Excavations that penetrated the water table might require temporary construction dewatering. Any groundwater drawdown impacts associated with construction dewatering would be temporary. The long-term impact of these activities should be negligible because of the limited depth and relatively small area of disturbance. Structural damage to aquifer areas resulting from pipeline construction would not be anticipated because aquifers are not generally located within excavation depth (TVA 2003).

The impact on the surface water would depend on the discharge volume and the characteristics of the receiving body of water. Intake from and discharge to any surface body of water would be regulated by the State or EPA.

Water quality impacts from sedimentation during construction of a natural-gas-fired plant were characterized in the GEIS as small (NRC 1996). NRC staff also noted in the GEIS that operational water quality impacts would be similar to, or less than, those from other generating technologies.

Overall, water use and quality impacts would be SMALL to MODERATE.

- **Air Quality**

Natural gas is a relatively clean-burning fuel. The natural gas combined-cycle alternative would release similar types of emissions, but in lesser quantities than the coal-fired alternative.

A new natural gas combined-cycle generating plant would likely require a permit issued under the new source review procedures in Title I, Part C, of the Clean Air Act and an operating permit issued under Title V. A new natural gas combined-cycle 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_2, and NO_x.

The EPA has various regulatory requirements for visibility protection in 40 CFR Part 51, Subpart P, including a specific requirement for review of any new major stationary source in an area designated as attainment or unclassified under the Clean Air Act.

Section 169A of the Clean Air Act establishes a national goal of preventing future impairment and remedying existing impairment of visibility in mandatory Class I Federal areas when the impairment results from air pollution caused by human activities. In addition, EPA issued a new regional haze rule in 1999 (64 FR 35714). 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 new natural gas combined-cycle power plant were located close to a mandatory Class I area, additional air pollution control requirements could be imposed.

In 1998, EPA issued a rule requiring 22 eastern states, including Alabama, to revise their State implementation plans to reduce nitrogen oxide emissions. NO_x emissions contribute to violations of the national ambient air quality standard for ozone (40 CFR 50.9). The total amount of NO_x that can be emitted by each of the 22 states in the year 2007 ozone season (May 1 through September 30) is set out at 40 CFR 51.121(e). For Alabama, the amount is 156,597 MT (172,619 tons). Any new natural gas combined-cycle plant sited in Alabama would be subject to these limitations.

EPA issued the Clean Air Interstate Rule (CAIR) in 2005 (EPA 2005a). CAIR provides a Federal framework requiring certain states to reduce emissions of SO_2 and NO_x. EPA anticipates that states will achieve this reduction primarily by limiting emissions from the power generation sector. CAIR covers 28 eastern states and the District of Columbia. Any new fossil-fired power plant sited in Alabama would be subject to the CAIR limitations.

A natural gas combined-cycle power plant would also have unregulated carbon dioxide emissions that could contribute to global warming. TVA estimates that natural gas combined-cycle plants sufficient to replace the power generated at BFN would emit approximately 17.1 million MT/yr (18.9 million tons/yr) of carbon dioxide (TVA 2003).

The estimated annual emissions for natural gas combined-cycle plants sized to replace the power generated by BFN are shown in Table 8-6 (TVA 2003).

The combustion turbine portion of the combined-cycle plant would be subject to EPA's National Emission Standards for Hazardous Air Pollutants for Stationary Combustion Turbines at 40 CFR Part 63, Subpart YYYY, if the site is a major source of hazardous air pollutants. Major sources have the potential to emit 9.1 MT (10 tons) per year or more of any single hazardous air pollutant or 22.7 MT (25 tons) or more per year of any combination of hazardous air pollutants (40 CFR 63.6085(b)).

Construction activities would result in temporary fugitive dust. Exhaust emissions would also come from vehicles and motorized equipment used during the construction process.

Overall, the air quality impacts of new natural gas combined-cycle plants sized to replace the BFN capacity are estimated to be MODERATE.

- **Waste**

In the GEIS the staff concluded that waste generation from natural gas-fired technology would be minimal (NRC 1996). The only significant solid waste generated at a new natural gas combined-cycle plant would be spent SCR catalyst. The SCR catalyst is used to control NO_x emissions. The spent catalyst would be regenerated or disposed offsite. Other than spent SCR catalyst, waste generation at an operating natural gas combined-cycle plant would be largely limited to typical office wastes; 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, the solid waste impacts associated with natural gas combined-cycle plants sized to replace the BFN capacity would likely be SMALL.

- **Human Health**

Potential accidents related to plant operations include the possible rupture of natural gas pipelines both onsite and offsite, and the possible release of ammonia (TVA 2003). Ammonia is used in the SCR process for control of NO_x emissions. Both events are considered very low probability.

In the GEIS, the staff identified cancer and emphysema as potential health risks from natural gas-fired plants (NRC 1996). The risk may be attributable to NO_x emissions that contribute to ozone formation, which in turn contributes to health risks. NO_x emissions from any plant would be regulated by the State or EPA. For a plant sited in Alabama, NO_x emissions would be regulated by the Alabama Department of Environmental Management. Human health effects are not expected to be detectable or would be sufficiently minor that they would neither destabilize nor noticeably alter any important attribute of the resource. Overall, the impacts on human health of newly constructed natural gas combined-cycle plants are considered SMALL.

- **Socioeconomics**

Construction of a 510-MW(e) natural gas combined-cycle plant would take approximately 22 months (TVA 2003). Peak employment would be approximately 420 workers. Employment would exceed 200 workers for approximately 6 months (TVA 2003). During construction, the communities immediately surrounding each plant site would experience demands on housing and public services that could have noticeable impacts. These impacts would be tempered by construction workers commuting to the sites from more distant cities. After construction, the communities would be impacted by the loss of jobs. The operating workforce at each 510-MW(e) plant would be approximately 40 persons (TVA 2003). The BFN workforce would decline through a decommissioning period to a minimal maintenance size. The new natural gas combined-cycle plants would provide a new tax base through TVA's in-lieu-of-tax payments, at their respective locations.

Jobs related to pipeline construction and to transmission/distribution line upgrades would not be centralized at one location for any significant period of time and, therefore, would have no important impact on the local economy or on community and government services.

In the GEIS, the staff concluded that socioeconomic impacts from constructing a natural gas-fired plant would not be very noticeable and that the small operational workforce would have the lowest socioeconomic impacts of any nonrenewable technology (NRC 1996). Compared to the coal-fired and nuclear alternatives, the smaller size of the construction workforce, the shorter construction time frame, and the smaller size of the operations workforce would mitigate socioeconomic impacts.

The impacts of transportation related to commuting of plant operating personnel would depend on the population density and transportation infrastructure in the vicinity of the site, but are likely to be negligible. Impacts related to the commuting of plant construction personnel would be noticeable, temporary, but not destabilizing.

Overall, socioeconomic impacts resulting from construction and operation of natural gas combined-cycle plants can be characterized as MODERATE.

- **Aesthetics**

The natural gas combined-cycle plants would alter the visual landscape character at each location. The tallest structures would be the 46-m (150-ft)-high auxiliary boiler and two heat recovery steam generator stacks, as well as the 30-m (100-ft)-high steam turbine building (TVA 2003). Some portion of these structures would likely be visible for 2 km (1 mi) or more. Cooling tower plumes would also be visible. There would be more lighting visible across the night landscape, and sky brightness would increase somewhat. Noise from the plant would be detectable offsite.

If a new electric power transmission line is needed, the aesthetic impact could be significant. The gas pipeline compressors also would be visible. Aesthetic impacts would be mitigated if the plant were located in an industrial area adjacent to other power plants. Overall, the aesthetic impacts associated with replacement natural gas combined-cycle plants are categorized as MODERATE to LARGE, with site-specific factors determining the final categorization.

- **Historic and Archaeological Resources**

Before construction at any 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 lines, pipelines, or other rights-of-way). Impacts to cultural resources can be effectively managed under current laws and regulations and kept SMALL.

- **Environmental Justice**

Environmental justice impacts would depend upon the sites chosen for the natural gas combined-cycle power plants and the nearby population distribution. Construction activities would offer new employment possibilities, but could have negative impacts on the availability and cost of housing, which could disproportionately affect minority and low-income populations.

Impacts in Limestone County would be the same as those under the no-action alternative assuming no construction of natural gas combined-cycle plants at the BFN site. Overall, environmental justice impacts would likely be SMALL to MODERATE.

8.2.3.2 Once-Through Cooling System

The environmental impacts of constructing and operating a natural gas combined-cycle generating plant using a once-through cooling system are essentially the same as the impacts for a plant using closed-cycle cooling with wet cooling towers. However, there are some environmental differences between the closed-cycle and once-through cooling systems. Table 8-7 summarizes the incremental differences.

Table 8-7. Summary of Environmental Impacts of a Natural Gas Combined-Cycle Plant with Once-Through Cooling

Impact Category	Change in Impacts from Closed-Cycle Cooling System
Land Use	Less land required because cooling towers and associated infrastructure are not needed.
Ecology	Impacts would depend on ecology at the site. No impacts to terrestrial ecology from cooling tower drift. Increased water withdrawal with possible greater impacts to aquatic ecology.
Surface Water Use and Quality	No discharge of cooling tower blowdown. Increased water withdrawal and more thermal load on receiving body of water.
Groundwater Use and Quality	No change
Air Quality	No change
Waste	No change
Human Health	No change
Socioeconomics	No change
Aesthetics	Less aesthetic impact because cooling towers would not be used.
Historic and Archaeological Resources	Less land impacted.
Environmental Justice	No change

8.2.4 Nuclear Power Generation

The TVA ER considers the feasibility of constructing and operating two Advanced Boiling Water Reactors (ABWRs) at the unfinished Bellefonte nuclear plant site (TVA 2003). The ABWR design is a light-water reactor that has been certified by the NRC (10 CFR Part 52, Appendix A).

Although construction of the original Bellefonte nuclear units has been halted, TVA still retains construction permits issued by NRC. Construction access routes are completed at the site, and basic support functions (electric power, potable water, sanitary waste disposal, office buildings, parking lots, railways, and barge unloading facility) are in place to support resumption of construction. Almost all the basic site preparation work, such as grading, has been completed, including where the ABWR units would be constructed (TVA 2003). DOE is cooperating with an industry team led by TVA to conduct a detailed study of the potential construction of a two-unit ABWR nuclear plant at the Bellefonte site (DOE 2004a).

Construction of two ABWR units at the Bellefonte site would likely make use of the existing site intake water pumping station, natural draft cooling towers, discharge water diffusers, and electrical transmission lines and switchyards, each with varying degrees of modification (TVA 2003). Some existing service facilities such as fire protection, temporary construction power, auxiliary boilers, office buildings and parking lots, environmental monitoring, outside lighting, diesel fuel storage tanks, telecommunications, and potable water and sanitary waste supply lines would be used wherever possible. Almost none of the existing unfinished nuclear units and their contiguous support systems would be used (TVA 2003). To supplement the existing natural draft cooling towers, two additional mechanical draft cooling towers might be built on land immediately adjacent to and just south of the existing cooling towers, between the existing cooling towers and the proposed ABWR plant (TVA 2003). A 3.6-ha (9-ac) cooling spray pond might also be constructed south of the ABWR plant to serve as the emergency core cooling ultimate heat sink for the two units. All this land has previously been cleared for other uses (TVA 2003).

The base or lowest expected power output is 1336 MW(e) per unit during summer, which would likely increase to 1380 MW(e) during winter months as the condenser inlet temperature (and consequently the condenser backpressure) was reduced (TVA 2003). Although some uprating of the ABWR units might be possible, an additional ABWR unit, probably constructed at another site, would likely be needed to fully replace the uprated 3840-MW(e) capacity of BFN.

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. The impacts shown in Table S–3 are for a 1000-MW(e) reactor and would need to be adjusted to reflect replacement of the uprated 3840-MW(e) capacity of BFN. 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 Part 51 Subpart A, Appendix B, is also relevant, although not directly applicable, for consideration of environmental impacts associated with the operation of a replacement nuclear power plant. Additional environmental impact information for a replacement nuclear power plant using closed-cycle cooling is presented in Section 8.2.4.1 and using once-through cooling in Section 8.2.4.2.

8.2.4.1 Closed-Cycle Cooling System

The overall impacts associated with the construction and operation of two ABWR generating units at the Bellefonte site are discussed in the following sections. The impacts are summarized in Table 8-8. Additional impacts would occur, probably at another site, to fully replace the 3840-MW(e) capacity at BFN. The impact categorizations for Table 8-8 are based on 3840 MW(e) of new ABWR generating capacity.

Table 8-8. Summary of Environmental Impacts of New ABWR Units Using Closed-Cycle Cooling

Impact Category	Impact	Comment
Land Use	SMALL to LARGE	Most of the construction would take place on already disturbed areas of the Bellefonte site. Construction of an ABWR at another site would require approximately 200 ha (500 ac) for the plant and possibly additional land if a new transmission line and/or rail spur were needed. Additional land-use impacts might occur for uranium mining.
Ecology	SMALL to LARGE	Impacts at the Bellefonte site would be SMALL to MODERATE. Impacts at another site could be LARGE and would depend on location and ecology of the site, surface water body used for intake and discharge, and electric power transmission line route; potential habitat loss and fragmentation; reduced productivity and biological diversity; and impacts to terrestrial ecology from cooling tower drift.
Water Use and Quality	SMALL to MODERATE	Impacts would depend on the volume of water withdrawn and discharged, the constituents in the discharge water, and the characteristics of the surface water body. Discharges at the Bellefonte site would be regulated by the State of Alabama.
Air Quality	SMALL	Air emissions from ABWR plants sized to fully replace BFN capacity would be approximately: Sulfur oxides – 12.7 MT/yr (14 tons/yr) Nitrogen oxides – 12.7 MT/yr (14 tons/yr) PM_{10} – 0.62 MT/yr (0.68 tons/yr) Carbon monoxide – 3.4 MT/yr (3.7 tons/yr)

Table 8-8. (contd)

Impact Category	Impact	Comment
		Approximately 4350 MT/yr (4800 tons/yr) of unregulated carbon dioxide would be discharged.
Waste	SMALL	Radioactive waste generated at an ABWR would be less than a conventional boiling water reactor (BWR). Debris would be generated and removed during the construction process.
Human Health	SMALL	Impacts are uncertain, but considered SMALL in the absence of more quantitative data. ABWR units are expected to have a lower human health impact than existing BWR units.
Socioeconomics	MODERATE to LARGE	Peak construction employment at the Bellefonte site would be approximately 3100 workers. The operating workforce would be approximately 900. Limestone County could experience loss of BFN tax base and employment. Impacts at an alternate rural site could be LARGE.
Aesthetics	MODERATE to LARGE	At the Bellefonte site, a new off-gas stack would be needed. Cooling tower plumes would be visible for 16 km (10 mi) or more. At an alternative site, a new transmission line might be needed, which could have a LARGE impact.
Historic and Archeological Resources	SMALL	The Bellefonte site has had previous surveys for historic and archeological resources. Any potential impacts could likely be effectively managed.
Environmental Justice	SMALL to MODERATE	Impacts would vary depending on population distribution and makeup water at the site. Impacts in Limestone County would be the same as those under the no-action alternative.

- **Land Use**

Twin ABWR units would be constructed adjacent to and directly south of the existing cooling towers (TVA 2003). A construction laydown space is planned for the area bordered by the existing cooling towers, the existing 500-kV transmission line, and the ABWR plant. Almost all the ABWR construction activities would take place on land that has already been disturbed for the original Bellefonte construction. There are no buried structures that cannot be removed or transferred (TVA 2003).

Including wind effect, the maximum flood level of the Bellefonte site is 191.3 m (627.7 ft) above mean sea level, which is higher than the 189-m (620-ft) average grade for the planned construction area. Keeping the finished grade above the maximum flood level would require adding about 3 m (10 ft) of fill soil to the construction area, increasing its elevation to 192 m (630 ft) (TVA 2003). The grading soil would most likely be taken from hills to the east or southwest of the construction area.

Compared to a fossil-fueled power plant, which would involve either long fuel pipelines or large fuel and combustion product storage areas, the impacts on land use and soils would be minimal for completing a relatively compact nuclear plant on the previously disturbed Bellefonte site.

Land-use impacts would likely be SMALL at the Bellefonte site, and MODERATE to LARGE if an additional site were needed to fully replace the power generated by BFN. At another site, approximately 200 ha (500 ac) would be needed for the plant and possibly additional land needed for construction of a transmission line and/or rail spur. Additional land-use impacts might occur for uranium mining.

- **Ecology**

At the Bellefonte site there are no Federally or State-listed threatened or endangered plant species (TVA 2003). There are no caves at the site that support the Federally endangered Indiana and gray bats, but they are known to forage along the Guntersville Lake shoreline. However, the immediate area near the site has an extensive network of similar wooded shoreline and shallow lagoon habitats.

The intake channel at the site has not been maintained and would require dredging, both initially and periodically throughout the life of the plant. Surveys have found no toxic sediments and a low average density of mussels in the area. It is expected that the dredge material would be disposed on land (TVA 2003). Because water intake demand would be small compared to the total water mass flowing past the Bellefonte site, there is little potential for significant entrainment/impingement impacts. The existing water intake structure at the site would be used; this intake system entrains water through a 7.6-m (25-ft)-wide trench connected to the original river channel and is designed such that 85 percent of the intake demand would be withdrawn from the river channel and 15 percent from the more productive upstream overbank habitat. The greatest impacts of entrainment and impingement would result from water withdrawn from the upstream productive overbank, although losses to the lake fish community should be minimal because of the large amounts of similar habitat near the plant and in other areas of the lake (TVA 2003). There could be impacts to terrestrial ecology from cooling tower drift.

Overall, siting of two ABWR units at the Bellefonte site would have a SMALL to MODERATE ecological impact.

At an alternate site, there would be construction impacts and new incremental operational impacts. Even assuming siting at a previously disturbed area, the impacts would alter the ecology. Impacts could include wildlife habitat loss, reduced productivity, habitat fragmentation, and a local reduction in biological diversity. Use of cooling water from a nearby surface water body could have adverse aquatic resource impacts. If needed, construction and maintenance of the transmission line would have ecological impacts. Overall, the ecological impacts at an alternate site would be MODERATE to LARGE.

- **Water Use and Quality**

Raw water for construction and operation would be obtained from the Tennessee River. The quantities needed would be unlikely to have a significant effect on the river. Both existing closed-cycle natural draft cooling towers on the Bellefonte site would likely be used. The existing intake channel at the site has not been periodically maintained and might require some dredging (TVA 2003).

No significant construction-related impacts to surface water resources would be expected as a result of the project. The majority of the power plant and associated facilities would be constructed on land that has been previously altered because of construction activities related to the uncompleted Bellefonte nuclear plant. Construction of new facilities and overall site reclamation activities would affect surface hydrology, but extensive site excavation, filling, or grading would not be needed. The primary surface water impact during construction would be soil erosion, which could be kept low by the use of best management practices. To minimize the impacts of storm water flow during construction, a storm water retention pond would be designed to retain storm water from the 25-year, 24-hour rainfall event, in compliance with regulatory requirements (TVA 2003).

The surface water resources within the areas of the proposed development at the Bellefonte site are currently monitored under an NPDES permit issued by the Alabama Department of Environmental Management.

Potable water is supplied to the Bellefonte site by the City of Hollywood, which receives its water from the City of Scottsboro. The Bellefonte site is connected to the Hollywood municipal sewage system treatment plant located adjacent to the south side of the site. The sewage treatment plant serves the Bellefonte site and residential customers in the area, but currently it does not have sufficient capacity to handle the increased demand of a large construction force and would have to be enlarged (TVA 2003).

It is expected that water impacts at the Bellefonte site would be sufficiently minor that they would not noticeably alter any important attribute of the resource.

For alternate sites, the impact on the surface water would depend on the discharge volume and the characteristics of the receiving body of water. Intake from and discharge to any surface body of water would be regulated by the State or by EPA.

A nuclear power plant sited at an alternate site may use groundwater. Groundwater withdrawal at an alternate site would likely require a permit.

Overall, water-use and quality impacts are estimated to be SMALL to MODERATE.

- **Air Quality**

Annual emission rate estimates for operating ABWR units sized to fully replace the power generated by BFN are shown in Table 8-8 (TVA 2003). The only combustion sources to produce carbon dioxide are the small auxiliary heating boilers, emergency power generators (usually diesel-driven but sometimes combustion turbines), service vehicles, some portable self-powered devices such as pumps and generators, and some types of welding and heat treatment gear (TVA 2003).

There would be fugitive emissions during the construction process. Exhaust emissions would also come from vehicles and motorized equipment used during the construction process.

Overall, plant emissions and associated impacts are considered SMALL.

- **Waste**

The waste impacts associated with operation of pressurized-water reactor (PWR) and boiling water reactor (BWR) nuclear power plants are set out in Table B-1 of 10 CFR 51 Subpart A, Appendix B. Similar to conventional BWRs, during operation the ABWR produces spent resins from the condensate filters and demineralizers and dry active wastes from maintenance operations, typically gloves, plastic sheeting, mops, rags, wood, paper, metal, and plastic scraps. Based on experience with LLW generated at both conventional and advanced BWRs in Japan, TVA expects that the LLW generated at the ABWR units would be less than 15 percent of the LLW currently generated at BFN BWR units (TVA 2003). The reasons for the reduction in LLW for the ABWR include lower regeneration requirements for condensate demineralizers; non-precoat, hollow-fiber filters for the condensate filters; and less required maintenance and inspection overall. As an alternative means of disposal for solid and liquid LLW waste, TVA would explore the feasibility of shipping it to offsite contractors for processing (incineration, compaction, etc.) prior to permanent disposal at a licensed facility, similar to what is currently done for radioactive wastes generated at BFN (TVA 2003).

In addition to the impacts shown in Table B-1, construction-related debris would be generated during construction activities, which would be disposed in landfills. During construction, some modifications to the existing cooling towers at the Bellefonte site might be necessary to increase their cooling capacity (TVA 2003). Modifications could include replacing the present asbestos fill. In this case, proper disposal of the asbestos fill in an offsite permitted landfill would be required. Much of the waste generated during construction would be typical construction/ demolition waste (e.g., broken concrete, rock, asphalt, scrap lumber and metal, etc.) generated by the modification/removal of existing buildings such as old warehouses and the building of the new plant. There is enough space available on the Bellefonte site for a landfill to receive construction/demolition waste, but it may prove more economical to use any of several existing landfills within 80 km (50 mi) of Bellefonte that have adequate storage capacity and life expectancy (TVA 2003).

Waste impacts associated with construction of ABWR units at another site are unlikely to exceed those associated with construction at the Bellefonte site. Overall, waste impacts are considered SMALL.

- **Human Health**

Human health impacts for operating PWR and BWR nuclear power plants are set out in 10 CFR 51 Subpart A, Appendix B, Table B-1.

The total worker radiation exposure for an operating two-unit ABWR is projected to be about 0.62 man-Sieverts/yr, based on experience from the first 5 years of commercial operation for two comparable ABWR units in Japan and adjusted to projected steady-state conditions (TVA 2003). For three ABWR units to fully replace BFN capacity, total worker radiation exposure would be about 0.93 man-Sieverts/yr. For comparison, the median U.S. annual exposure for (two-unit) BWRs is 2.88 man-Sieverts/yr (TVA 2003). The reasons for the reduced occupational exposure include less piping, particularly in containment, and therefore less in-service inspection; larger maneuvering space for maintenance work inside containment; improved design requiring less maintenance of reactor components such as control rod drives; and shortened durations of refueling and maintenance outages due to expanded use of automated systems and design improvements such as split-type control rod drive housings. Approximately half of the radiation exposure is accumulated during outages. Experience with the prototype ABWR plants in Japan has shown that radiation exposure during outages has decreased steadily with time, reflecting lessons learned through operating experience (TVA 2003).

Overall, human health impacts for siting of new ABWR units at the Bellefonte site or at alternative sites are considered SMALL.

- **Socioeconomics**

Based on Japanese ABWR construction experience, TVA expects that the construction period for two new ABWR units at the Bellefonte site would be 34 months (TVA 2003). This abbreviated schedule reflects a high degree of modularization, requiring the use of large cranes; expansion of the work scope, which can proceed in parallel; and a number of improvements in field productivity through innovations such as increased use of automatic welding machines. Peak employment during construction of the two units is estimated to be 3115 workers, of which 2885 workers would be craft workers and craft work supervisors (TVA 2003). Approximately 230 workers would be construction and pre-operational turnover engineers and technical advisors supplied by an architectural/engineering company with ABWR construction experience. TVA estimates that approximately one-third of the crafts workers would move into the local area, with the rest commuting from longer distances. TVA expects that less than half of those moving into the local area would buy or rent houses. Of those workers who do move to the area, TVA estimates that more than two-thirds would bring their families. TVA expects that few, if any, of the architectural/engineering personnel would buy houses in the local area (TVA 2003). TVA estimates that approximately 720 new students would attend the Scottsboro and Jackson county schools temporarily during the construction period (TVA 2003).

The total projected employment during operation for the two-unit ABWR plant is 906 workers (TVA 2003). For comparison, there are currently 1297 workers at BFN Units 2 and 3 (TVA 2003). TVA projects that the total population impact on Jackson County attributable to the new ABWR units would be approximately 1200 to 1400 workers. The total annual employment generated in Jackson County is estimated by TVA to be approximately 1600 workers, and the total annual income generated to be more than $78 million (TVA 2003). The impacts from plant operation on housing, schools, and services such as fire protection would be less than those of peak construction and should, therefore, be accommodated without difficulty.

The new ABWR units would likely provide an increase in the in-lieu-of-tax payments received by Jackson County or any other county where new units are constructed by TVA. In-lieu-of-tax payments in Limestone County would likely decrease if the BFN OLs are not renewed. Employment in Limestone County would decrease if the BFN OLs are not renewed.

Construction of new ABWR units at a site other than Bellefonte would relocate some socioeconomic impacts, but would not eliminate them. Assuming the new units were not built at the BFN site, the communities around the BFN site would experience the impact of operational job loss and the loss of tax base. The communities around the new site would have to absorb the impacts of a large, temporary workforce and a permanent operating workforce. In the GEIS, the staff noted that socioeconomic impacts at a rural site would be larger than at an urban site because more of the peak construction workforce would need to move to the area to work (NRC 1996). Alternate sites would need to be analyzed on a case-by-case basis. Socioeconomic impacts at a rural site could be LARGE. Transportation-related impacts associated with commuting construction workers at an alternate site are site dependent. Transportation impacts related to commuting of plant operating personnel would also be site-dependent.

Overall, the socioeconomic impacts associated with constructing and operating new ABWR units sized to replace BFN capacity are considered MODERATE to LARGE.

- **Aesthetics**

The Bellefonte site is seen most frequently by passing motorists from various points along U.S. Highway 72. The on-ground plant facilities such as roads, parking lots, and office buildings are screened for the most part by low rolling terrain in the foreground. The Bellefonte site is buffered from the main Tennessee River channel by a wooded ridgeline, which rises approximately 60 m (200 ft) above the lake surface. Distant views of the 145-m (477-ft)-high cooling towers and the reactor domes can be seen in excess of 8 km (5 mi) away. The only new ABWR construction that would rise to a height comparable to the existing cooling towers would be an off-gas stack, which would have no associated visible plume (TVA 2003). Vapor fog from the cooling towers could be visible from distances of 16 km (10 mi) or more. There is an existing 39.9-km (24.8-mi) 500-kV transmission line to the Bellefonte site that is not energized (TVA 2003).

Noise from operation of a replacement nuclear power plant would potentially be audible offsite in calm wind conditions or when the wind was blowing in the direction of the listener. Mitigation measures, such as reduced or no use of outside loudspeakers, could be employed to reduce noise level.

At an alternate site, there would be an aesthetic impact from the buildings. There would also be a significant aesthetic impact if a new transmission line were needed. Noise and light from the plant would be detectable offsite. The impact of noise and light would be mitigated if the plant was located in an industrial area adjacent to other power plants. Overall, the aesthetic impacts associated with locating new ABWR units at Bellefonte or at an alternative site can be categorized as MODERATE to LARGE.

- **Historic and Archaeological Resources**

A 1972 archaeological survey of the Bellefonte site identified five historic sites, none of which are within proposed construction zones (TVA 2003). The original Town of Bellefonte was located just offsite and determined in 1974 to be eligible for placement on the National Register of Historic Places. Prior to the initiation of construction of the uncompleted Bellefonte nuclear plant, the Alabama State Historic Preservation Office determined that no mitigation would be required. Since that time all structures have been removed by landowners (TVA 2003).

Before construction at an alternative 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 rights-of-way where new construction would occur (e.g., roads, transmission lines, rail lines, or other rights-of-way). Historic and archaeological resource impacts can generally be effectively managed and would likely be SMALL at either the Bellefonte or an alternative site.

- **Environmental Justice**

Environmental justice impacts would depend upon the population distribution around the Bellefonte site or other alternate sites. Construction activities would offer new employment possibilities, but could have negative impacts on the availability and cost of housing, which could disproportionately affect minority and low-income populations. Impacts in Limestone County would be the same as those under the no-action alternative. Overall, environmental justice impacts would likely be SMALL to MODERATE.

8.2.4.2 Once-Through Cooling System

The environmental impacts of constructing and operating new ABWR units using once-through cooling are essentially the same as the impacts for a plant using closed cycle-cooling with wet cooling towers. However, there are some environmental differences between the closed-cycle and once-through cooling systems. Table 8-9 summarizes the incremental differences.

Table 8-9. Summary of Environmental Impacts of a New Nuclear Plant with Once-Through Cooling

Impact Category	Change in Impacts from Closed-Cycle Cooling System
Land Use	Less land required because cooling towers and associated infrastructure are not needed.
Ecology	Impacts would depend on ecology at the site. No impacts to terrestrial ecology from cooling tower drift. Increased water withdrawal with possible greater impact to aquatic ecology.
Surface Water Use and Quality	No discharge of cooling tower blowdown. Increased water withdrawal and more thermal load on receiving body of water.
Groundwater Use and Quality	No change
Air Quality	No change
Waste	No change
Human Health	No change

Table 8-9. (contd)

Impact Category	Change in Impacts from Closed-Cycle Cooling System
Socioeconomics	No change
Aesthetics	Less aesthetic impact because cooling towers would not be used.
Historic and Archaeological Resources	Less land impacted.
Environmental Justice	No change

8.2.5 Purchased Electrical Power

If available, purchased power from other sources could obviate the need to renew the BFN OLs. TVA currently purchases electric power from other generators (TVA 2003). However, some power purchase activities implemented by TVA have not performed as intended in delivering reliable power to TVA customers. TVA has issued several requests for proposals in recent years with the goal of obtaining additional peaking and baseload power (TVA 2003). Some of the responses have either not met stated conditions and requirements, or the entities submitting the proposals could not deliver power by the needed dates. Consequently, the projected power hoped for from the requests for proposals has not fully materialized (TVA 2003).

Current regional reserve margins[a] in the TVA service area are estimated to be approximately 30 percent; however, projections suggest that this surplus will be exhausted before the current BFN OLs expire (TVA 2003).

If power to replace the capacity of BFN were to be purchased from sources within the United States or from a foreign country, the generating technology likely would be one of those described in this SEIS and in the GEIS (probably coal, natural gas, or nuclear). The descriptions of the environmental impacts of other technologies in Chapter 8 of the GEIS and in Chapter 8 of this SEIS are representative of the environmental impacts associated with the purchased electrical power alternative to renewal of the BFN OLs. Under the purchased power alternative, the environmental impacts of imported power would still occur, but would be located elsewhere within the region, the United States, or another country.

(a) Reserve margin is the amount of unused available capability of an electric power system (at peak load) as a percentage of total capability.

8.2.6 Other Alternatives

Other generation technologies are discussed in the following subsections.

8.2.6.1 Oil-Fired Generation

EIA projects that oil-fired plants will account for no new generation capacity in the United States through the year 2025, except for limited industrial combined heat and power applications, because of higher fuel costs and lower efficiencies (DOE/EIA 2004). Oil-fired operation is more expensive than nuclear or coal-fired operation. In addition, future increases in oil prices are expected to make oil-fired generation increasingly more expensive than coal-fired generation. The high cost of oil has resulted in a decline in its use for electricity generation. In Section 8.3.11 of the GEIS, the staff estimated that construction of a 1000-MW(e) oil-fired plant would require about 49 ha (120 ac) (NRC 1996). Operation of oil-fired plants would have environmental impacts (including impacts on the aquatic environment and air) that would be similar to those from a coal-fired plant.

8.2.6.2 Wind Power

Most of Alabama, Mississippi, and western Tennessee are in a wind power Class 1 region (average wind speeds less than 5.6 m/s) (DOE 2004b). Class 1 has the lowest potential for wind energy generation (DOE 2004b). Alabama does not have sufficient wind resources to use large-scale wind turbines (DOE 2004c).

Aside from the coastal areas and exposed mountains and ridges of the Appalachian Mountains, there is little wind energy potential in the East Central region of the United States for current wind turbine applications (Elliott et al. 1987). Moreover, wind turbines typically operate at a 25 to 35 percent capacity factor compared to 90 to 95 percent for a baseload plant (NWPPC 2000).

Therefore, the staff concludes that locating a wind-energy facility on or near BFN or offshore as a replacement for BFN generating capacity would not be economically feasible given the current state of wind-energy generation technology.

8.2.6.3 Solar Power

Solar technologies use the sun's energy to provide heat and cooling, light, hot water, and electricity for homes, businesses, and industry. Solar power technologies (both photovoltaic and thermal) cannot currently compete with conventional nuclear and fossil-fueled technologies in grid-connected applications because of higher capital costs per kilowatt of capacity. Energy storage requirements also limit the use of solar-energy systems as baseload electricity supply. The average capacity factor of photovoltaic cells is about 25 percent (NRC 1996), and the capacity factor for solar thermal systems is about 25 to 40 percent (NRC 1996).

There are substantial impacts to natural resources (wildlife habitat, land use, and aesthetic impacts) from construction of solar-generating facilities. As stated in the GEIS, land requirements are high – 142 km^2 (55 mi^2) per 1000 MW(e) for photovoltaic (NRC 1996) and approximately 57 km^2 (22 mi^2) per 1000 MW(e) for solar thermal systems (NRC 1996). Neither type of solar electric system would fit at the BFN site, and both would have large environmental impacts at an alternate site.

The BFN site receives approximately 4500 to 5000 Wh/m^2 per day that can be used for flat-plate solar systems and 3500 to 4000 Wh/m^2 per day that can be used for solar concentrating systems. This is in comparison to areas in the southwestern United States that receive up to 7500 Wh/m^2 per day (DOE 2004d). For solar concentrating collectors, Alabama only has a useful resource in the southeastern portion of the state. The solar resource in Alabama can be used for water heating or photovoltaic systems, but not large concentrating solar thermal utility systems (DOE 2004d).

Because of the natural resource impacts (land and ecological), the area's relatively low rate of solar radiation, and high cost, solar power is not deemed a feasible baseload alternative to renewal of the BFN OLs. Some onsite generated solar power (e.g., from rooftop photovoltaic applications) may substitute for electric power from the grid. Implementation of solar generation on a scale large enough to replace BFN would likely result in LARGE environmental impacts.

8.2.6.4 Hydropower

Alabama has an estimated 363 MW[a] of developable hydroelectric resources (INEEL 1998). Tennessee has an estimated 138 MW of developable hydroelectric resources (INEEL 1997). This total amount is significantly less than needed to replace the 3840-MW(e) uprated capacity of BFN. As stated in *Section* 8.3.4 of the GEIS, 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. In the GEIS, the staff estimated that land requirements for hydroelectric power are approximately 400,000 ha (1 million ac) per 1000 MW(e) (NRC 1996). Because of the relatively low amount of undeveloped hydropower resource in Alabama and Tennessee and the large land-use and related environmental and ecological resource impacts associated with

(a) One megawatt (MW) represents one million watts of electricity.

siting hydroelectric facilities large enough to replace BFN, the staff concludes that local hydropower is not a feasible alternative to renewal of the BFN OLs. Any attempts to site hydroelectric facilities large enough to replace the BFN would result in LARGE environmental impacts.

8.2.6.5 Geothermal Energy

Geothermal energy technologies have an average capacity factor of 90 percent and can be used for baseload power where available. However, geothermal technology is not widely used for 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. Alabama has low-to-moderate geothermal resources that can be tapped for direct heat or for geothermal heat pumps. However, electrical generation is not possible with these resources (DOE 2004e). There is no practical eastern location for geothermal capacity to serve as an alternative to BFN. The staff concludes that geothermal energy is not a feasible alternative to renewal of the BFN OLs.

8.2.6.6 Wood Waste

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). 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 are only 40 to 50 MW(e) in size. Estimates in the GEIS suggest that the overall level of construction impact per MW of installed capacity should be approximately the same as that for a coal-fired plant, although facilities using wood waste for fuel would be built at smaller scales (NRC 1996). Like coal-fired plants, wood-waste plants require large areas for fuel storage and processing and involve the same type of combustion equipment.

Because of uncertainties associated with obtaining sufficient wood and wood waste to fuel a baseload generating facility, ecological impacts of large-scale timber cutting (e.g., soil erosion and loss of wildlife habitat), and low efficiency, the staff determined that wood waste is not a feasible alternative to renewing the BFN OLs.

8.2.6.7 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 (EPA 2004). Municipal waste combustors use three basic types of technologies: mass burn, modular, and refuse-derived fuel (DOE/EIA 2001). Mass burning technologies are most commonly used in the United States. This group of technologies process raw municipal solid waste "as is," with little or no sizing, shredding, or separation before combustion. The initial capital costs for municipal solid-waste plants are greater than for comparable steam-turbine technology at wood-waste facilities. This is caused by the need for specialized waste-separation/handling equipment for municipal solid waste (NRC 1996).

Growth in the municipal waste combustion industry slowed dramatically during the 1990s after rapid growth during the 1980s. The slower growth was due to three primary factors: (1) the Tax Reform Act of 1986, which made capital-intensive projects such as municipal waste combustion facilities more expensive relative to less capital-intensive waste disposal alternative such as landfills; (2) the 1994 Supreme Court decision (*C&A Carbone, Inc. v. Town of Clarkstown*, 511 U.S. 383(1994)), 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, operate, and maintain municipal waste combustion facilities (DOE/EIA 2001).

Municipal solid waste combustors generate an ash residue that is buried in landfills. The ash residue is composed of bottom ash and fly ash. Bottom ash refers to that portion of the unburned waste that falls to the bottom of the grate or furnace. Fly ash represents the small particles that rise from the furnace during the combustion process. Fly ash is generally removed from flue gases using fabric filters and/or scrubbers (DOE/EIA 2001).

Currently there are approximately 89 waste-to-energy plants operating in the United States. These plants generate approximately 2500 MW(e), or an average of approximately 28 MW(e) per plant (Integrated Waste Services Association 2004). The staff concludes that generating electricity from municipal solid waste would not be a feasible alternative to replace the uprated 3840-MW(e) baseload capacity of BFN and, consequently, would not be a feasible alternative to renewal of the BFN OLs.

8.2.6.8 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 stated that none of these technologies has progressed to the point of being competitive on a large scale or of being reliable enough to replace a large baseload plant such as BFN (NRC 1996). For these reasons, such fuels do not offer a feasible alternative to renewal of the BFN OLs.

8.2.6.9 Fuel Cells

Fuel cells work without combustion and its environmental side effects. Power is produced electrochemically by passing a hydrogen-rich fuel over an anode and air over a cathode. Activated by a catalyst, hydrogen atoms separate into protons and electrons, which take different paths to the cathode. The electrons go through an external circuit, creating a flow of electricity. The only by-products are heat, water, and carbon dioxide. Hydrogen fuel can come from a variety of hydrocarbon resources by subjecting them to steam under pressure. Natural gas is typically used as the source of hydrogen.

Phosphoric acid fuel cells are generally considered first-generation technology. Higher temperature second-generation fuel cells achieve higher fuel-to-electricity conversions 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.

During the past three decades, significant efforts have been made to develop more practical and affordable fuel cell designs for stationary power applications, but progress has been slow (DOE 2004e). Today, the most widely marketed fuel cells cost about $4500 per kW of installed capacity; by contrast, a diesel generator costs $800 to $1500 per kilowatt, and a natural gas turbine can be even less (DOE 2004f).

DOE has launched an initiative – the Solid State Energy Conversion Alliance – to bring about dramatic reductions in fuel cell costs. DOE's goal is to cut costs to as low as $400 per kW of installed capacity by the end of this decade, which would make fuel cells competitive for virtually every type of power application (DOE 2004f).

The staff concludes that at the present time fuel cells are not economically or technologically competitive with other alternatives for baseload electricity generation. Future gains in cost competitiveness for fuels cells compared to other fuels are speculative. Fuel cells are, consequently, currently not a feasible alternative to renewal of the BFN OLs.

8.2.6.10 Delayed Retirement

It is conceptually possible that delayed retirement of other TVA generating units could replace the power generated by BFN. At the present time, however, TVA has no plans for retiring any of its generating units. TVA is adding environmental controls and maintaining existing generating units as necessary to keep them operational and in compliance with environmental requirements. The staff therefore concluded that delayed retirement of other TVA generating units could not replace the power supplied by BFN Units 1, 2, and 3 and would not be a feasible alternative to renewing the OLs for BFN Units 1, 2, and 3.

8.2.6.11 Utility-Sponsored Conservation

The utility-sponsored conservation alternative refers to a situation with the following three conditions: (1) BFN ceases to operate, (2) no new generation is brought online to meet the lost generation, and (3) the lost generation is instead replaced by more efficient use of electricity brought about by DSM programs.

DSM programs consist of the planning, implementing, and monitoring activities of electric utilities that are designed to encourage consumers to modify their level and pattern of electricity usage. DSM programs have been part of TVA's energy portfolio since the 1970s. They were initiated in response to the rising cost of energy and the rising cost of building new electric generating units that began in the mid 1970s. By 1988, TVA DSM programs were credited with saving more than 2.3 billion kilowatt-hours per year and cutting system demand by 1200 MW (TVA 2003). Of these savings, 960 MW came from the residential sector after weatherization measures were installed in 631,000 homes in the Tennessee Valley. DSM initiatives (such as energy-right home electrical efficiency, direct load control, industrial customer products and services, and firm buy-back agreements) continue to be implemented through TVA power distributors with an estimated 154 MW of capacity added from 1995 through 1999, and an additional 264 MW from 2000 to 2002 (TVA 2003). TVA's energy savings attributable to DSM are part of its long-range plan for meeting projected demand, and thus are not available offsets for the generating capacity of BFN.

Current residential DSM programs offered by TVA include a new homes plan, a heat pump plan, a water heater plan, and a new manufactured home plan. Current commercial DSM programs offered by TVA include onsite operations support to aid the achievement of energy savings, support to industrial power users to improve energy efficiency, and an initiative to encourage use of groundwater heat pumps.

Although DSM programs are an important part of TVA's energy portfolio, the staff concludes that additional DSM, by itself, would not be sufficient to replace the uprated 3840-MW(e) capacity of BFN and that it is not a reasonable substitute for renewing the OLs.

8.2.7 Combination of Alternatives

Even though individual alternatives might not be sufficient on their own to replace the BFN generating capacity because of the small size of the resource or lack of cost-effective opportunities, it is conceivable that a combination of alternatives might be cost-effective.

BFN is projected to have an uprated capacity of 3840 MW(e). There are many possible combinations of alternatives to replace this capacity. Table 8-10 contains a summary of the environmental impacts of an assumed combination of alternatives consisting of 3060-MW(e) (six 510-MW[e]) plants of natural gas combined-cycle generation using mechanical draft cooling towers, 400 MW purchased from other generators, and 380 MW gained from additional DSM measures. The impacts associated with the natural gas combined-cycle units are based on the discussion in Section 8.2.3, adjusted for the reduced generating capacity. While the DSM measures would have few environmental impacts, operation of the new natural gas combined-cycle plants would result in increased emissions and other environmental impacts. The environmental impacts associated with power purchased from other generators would still occur, but would be located elsewhere within the region as discussed in Section 8.2.4. The environmental impacts associated with purchased power are not shown in Table 8-10. The staff concludes that it is very unlikely that the environmental impacts of any reasonable combination of generating and conservation options could be reduced to the level of impacts associated with renewal of the BFN OLs.

Table 8-10. Summary of Environmental Impacts of an Assumed Combination of Generation and Acquisition Alternatives

Impact Category	Impact	Comment
Land Use	MODERATE to LARGE	Approximately 80 ha (200 ac) for each 510-MW(e) plant. Additional site-specific impacts for natural gas pipeline, electric power transmission lines, rail spurs, and cooling water intake and discharge pipelines.
Ecology	MODERATE	Impacts depend on location and ecology of the site, surface water body used for intake and discharge, and electric power transmission line and natural gas pipeline routes; potential habitat loss and fragmentation; reduced productivity and biological diversity; and impacts to terrestrial ecology from cooling tower drift.
Water Use and Quality	SMALL to MODERATE	Impacts would depend on the volume of water withdrawn and discharged, the constituents in the discharge water, and the characteristics of the surface water body. Discharges would be regulated by the State or EPA.

Table 8-10. (contd)

Impact Category	Impact	Comment
Air Quality	MODERATE	Air emissions would be approximately: Sulfur oxides – 57 MT/yr (63 tons/yr) Nitrogen oxides – 1110 MT/yr (1220 tons/yr) PM_{10} – 1000 MT/yr (1120 tons/yr) Carbon monoxide – 4230 MT/yr (4670 tons/yr) Small amounts of hazardous air pollutants would be emitted along with 13.7 million MT/yr (15.1 million tons/yr) of unregulated carbon dioxide.
Waste	SMALL	The only significant waste would be spent catalyst from the SCR process used to control NO_x emissions.
Human Health	SMALL	Impacts are uncertain, but considered SMALL in the absence of more quantitative data.
Socioeconomics	MODERATE	Construction impacts depend on location and how many plants are constructed at the location. Limestone County could experience loss of BFN tax base and employment. Impacts related to the operation of the gas plants would be minor. Transportation impacts would result from commuting workers.
Aesthetics	MODERATE to LARGE	Impacts would depend on the site selected and the surrounding land features. Power block, exhaust stacks, cooling towers, and cooling tower plumes would be visible from nearby areas. If needed, new electric power transmission lines could have a LARGE aesthetic impact. Noise impacts from plant operations and intermittent sources would be noticeable.
Historic and Archeological Resources	SMALL	New plant locations would necessitate cultural resource studies. Any potential impacts can likely be effectively managed.
Environmental Justice	SMALL to MODERATE	Impacts would vary depending on population distribution and makeup water at the site. Impacts in Limestone County would be the same as those under the no-action alternative.

8.3 Summary of Alternatives Considered

As discussed in Chapter 4, the environmental impacts of the proposed action, renewal of the BFN OLs, are SMALL for all impact categories, except for collective offsite radiological impacts from the fuel cycle and from HLW and spent fuel disposal. Collective offsite 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 acceptable. The following alternative actions were considered: the no-action alternative (discussed in Section 8.1); new generation alternatives from pulverized coal, coal gasification, natural gas combined-cycle, and new nuclear (discussed in Sections 8.2.1 through 8.2.4, respectively); purchased electrical power (discussed in Section 8.2.5); alternative technologies (discussed in Section 8.2.6); and the combination of alternatives (discussed in Section 8.2.7).

The no-action alternative would require (1) replacing electrical generating capacity by (1) DSM and energy conservation, (2) purchasing power from other electricity providers, (3) generating alternatives other than BFN, or (4) some combination of these options, and would result in decommissioning BFN. For each of the new generation alternatives (pulverized coal, coal gasification, natural gas combined-cycle, and new nuclear), the environmental impacts would not be less 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 BFN. The impacts of purchased electrical power would still occur, but would occur elsewhere. Alternative technologies are not considered feasible at this time, and it is 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 BFN OLs.

The staff concludes that the alternative actions, including the no-action alternative, may have environmental effects in at least some impact categories that reach MODERATE or LARGE significance.

8.4 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."

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

40 CFR Part 63. Code of Federal Regulations, Title 40, *Protection of the Environment*, Part 63, "National Emissions Standards for Hazardous Air Pollutants for Source Categories."

40 CFR Part 125, Subpart I. Code of Federal Regulations, Title 40, *Protection of the Environment*, Part 125, Subpart I, "Requirements Applicable to Cooling Water Intake Structures for New Facilities Under Section 316(b) of the Act."

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9.0 Summary and Conclusions

By letter dated December 31, 2003, the Tennessee Valley Authority (TVA) submitted an application to the U.S. Nuclear Regulatory Commission (NRC) to renew the operating licenses (OLs) for Browns Ferry Nuclear Power Plant, Units 1, 2, and 3 (BFN) for an additional 20-year period (TVA 2003a). If the OLs are renewed, State regulatory agencies and TVA 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 OLs are not renewed, then the plants must be shut down at or before the expiration of the current OLs, which expire on December 20, 2013, for Unit 1, June 28, 2014, for Unit 2, and July 2, 2016, for Unit 3.

Section 102 of the National Environmental Policy Act of 1969 (NEPA) (42 USC 4321) directs that an environmental impact statement (EIS) is required for major Federal actions that significantly affect the quality of the human environment. The NRC has implemented Section 102 of NEPA in Title 10 of the Code of Federal Regulations (CFR) Part 51. Part 51 identifies licensing and regulatory actions that require an EIS. In 10 CFR 51.20(b)(2), the Commission requires preparation of an EIS or a supplement to an EIS 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 TVA application, 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 on March 10, 2004 (69 FR11462). The staff visited the BFN site in March 2004 and held public scoping meetings on April 1, 2004, in Athens, Alabama (NRC 2004). The staff reviewed the TVA Environmental Report (ER) (TVA 2003b) and other TVA environmentally related documents and compared them to the GEIS, consulted and discussed the application 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 BFN. The public comments received during the scoping process that were considered to be within the scope of the environmental review are provided in Appendix A, Part 1, of this SEIS.

The draft SEIS was published and distributed for public comment on December 3, 2004. The staff held two public meetings in Athens, Alabama, in January 2005, to describe the results of

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

the NRC environmental review, answer questions, and to provide members of the public with information to assist them in formulating their comments on this SEIS. The comment period ended on March 2, 2005. Comments made during the 75-day comment period, including those made at the two public meetings, are presented in Part 2 of Appendix A 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, and mitigation measures available for reducing or avoiding adverse effects. It also includes the staff's recommendation regarding the proposed action.

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

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

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

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

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

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

> The supplemental environmental impact statement for license renewal is not required to include discussion of need for power or the economic costs and economic benefits of the proposed action or of alternatives to the proposed action except insofar as such benefits and costs are either essential for a determination regarding the inclusion of an alternative in the range of alternatives considered or relevant to mitigation. In addition, the supplemental environmental impact statement prepared at the license renewal stage need not discuss other issues not related to the environmental effects of the proposed

action and the alternatives, or any aspect of the storage of spent fuel for the facility within the scope of the generic determination in § 51.23(a) and in accordance with § 51.23(b).[a]

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

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

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

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

For 69 of the 92 issues considered in the GEIS, the staff analysis in the GEIS shows the following:

(1) The environmental impacts associated with the issue have been determined to apply either to all plants or, for some issues, to plants having a specific type of cooling system or other specified plant or site 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.

(a) The title of 10 CFR 51.23 is "Temporary storage of spent fuel after cessation of reactor operations-generic determination of no significant environmental impact."

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

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

This SEIS documents the staff's consideration of all 92 environmental issues identified in the GEIS. The staff considered the environmental impacts associated with alternatives to license renewal and compared the environmental impacts of license renewal and the alternatives. The alternatives to license renewal that were considered include the no-action alternative (not renewing the OLs for BFN) and alternative methods of power generation. These alternatives were evaluated assuming that the replacement power generation plant is located at either the BFN site, at the unfinished Bellefonte nuclear plant site, or at other locations.

9.1 Environmental Impacts of the Proposed Action – License Renewal

TVA and the NRC staff have established independent processes for identifying and evaluating the significance of any new information on the environmental impacts of license renewal. Neither TVA nor the NRC 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, TVA, nor the NRC staff has identified any new issue applicable to BFN 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 BFN.

TVA's license renewal application presents an analysis of the Category 2 issues that are applicable to BFN, plus environmental justice and chronic effects from electromagnetic fields. The staff has reviewed the TVA analysis for each issue and has conducted an independent review of each issue plus environmental justice and chronic effects from electromagnetic fields. Three Category 2 issues are not applicable because they are related to plant design features or site characteristics not found at BFN. Four Category 2 issues are not discussed in this SEIS because they are specifically related to refurbishment. TVA 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

BFN for the license renewal term (TVA 2003b). 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 the bounds of the plant operations evaluated in the TVA *Final Environmental Statement Related to the Operation of Browns Ferry Units 1, 2, and 3* (TVA 1972), which was adopted by the Atomic Energy Commission.

Fourteen Category 2 issues related to operational impacts and postulated accidents during the license renewal term, as well as environmental justice and chronic effects of electromagnetic fields, are discussed in detail in this SEIS. Four of the Category 2 issues and environmental justice apply to both refurbishment and to operation during the license renewal term and are only discussed in this SEIS in relation to operation during the license renewal term. For all 14 Category 2 issues and environmental justice, the staff concludes that the potential environmental effects are of SMALL significance in the context of the standards set forth in the GEIS. In addition, the staff determined that appropriate Federal health agencies have not reached a consensus on the existence of chronic adverse effects from electromagnetic fields. Therefore, no further evaluation of this issue is required. For severe accident mitigation alternatives (SAMAs), the staff concludes that a reasonable, comprehensive effort was made to identify and evaluate SAMAs. Based on its review of the SAMAs for BFN and the plant improvements already made, the staff concludes that none of the candidate SAMAs are cost-beneficial.

Mitigation measures were considered for each Category 2 issue. Current measures to mitigate the environmental impacts of plant operation were found to be adequate, and no additional mitigation measures were deemed sufficiently beneficial to be warranted. Cumulative impacts of past, present, and reasonably foreseeable future actions were considered, regardless of what agency (Federal or non-Federal) or person undertakes such other actions. For purposes of this analysis, where BFN license renewal impacts are deemed to be SMALL, the staff concluded that these impacts would not result in significant cumulative impacts on potentially affected resources.

The following sections discuss unavoidable adverse impacts, irreversible or irretrievable commitments of resources, and the relationship between local short-term use of the environment and long-term productivity.

9.1.1 Unavoidable Adverse Impacts

An environmental review conducted at the license renewal stage differs from the review conducted in support of a construction permit because the plant is in existence at the license renewal stage and has operated for a number of years. As a result, adverse impacts associated with the initial construction have been avoided, have been mitigated, or have already occurred. The environmental impacts to be evaluated for license renewal are those associated with refurbishment and continued operation during the license renewal term.

The adverse impacts of continued operation identified are considered to be of SMALL significance, and none warrants implementation of additional mitigation measures. The adverse impacts of likely alternatives if BFN ceases operation at or before the expiration of the current OLs will not be smaller than those associated with continued operation of these units, 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 BFN during the current license term was made when the plant was built. The resource commitments to be considered in this SEIS are associated with continued operation of the plant for an additional 20 years. These resources include materials and equipment required for plant maintenance and operation, the nuclear fuel used by the reactors, and ultimately, permanent offsite storage space for the spent fuel assemblies.

The most significant resource commitments related to operation during the license renewal term are the new fuel and the permanent storage space for the spent fuel. BFN currently replaces approximately 38 percent of the fuel assemblies in each unit during every refueling outage, which occurs on a 24-month cycle. With the planned extended power uprate, and a change to blended low-enriched uranium fuel assemblies, the proportion of the fuel assemblies replaced during each refueling cycle may increase to approximately 48 percent.

The likely power generation alternatives if BFN ceases operation on or before the expiration of the current OLs will require a commitment of resources for construction of the replacement plants as well as for fuel to operate the plants.

9.1.3 Short-Term Use Versus Long-Term Productivity

An initial balance between local short-term uses and the maintenance and enhancement of the long-term productivity of the environment at the BFN site was set when the plants were approved and construction began. That balance is now well established. Renewal of the OLs for BFN and continued operation of the plants will not alter the existing balance because the decision to use the BFN site to produce power has already been made, but may postpone the availability of the site for other uses. Denial of the application to renew the OLs will lead to shutdown of the plants and will alter the balance in a manner that depends on subsequent uses of the site. For example, the environmental consequences of turning the BFN site into a park or an industrial facility are quite different.

9.2 Relative Significance of the Environmental Impacts of License Renewal and Alternatives

The proposed action is renewal of the OLs for Units 1, 2, and 3 at BFN. Chapter 2 describes the site, the power plant, and interactions of the plant with the environment. As noted in Chapter 3, no refurbishment activities and therefore no refurbishment impacts are expected at BFN. Chapters 4 through 7 discuss environmental issues associated with renewal of the OLs. 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 OLs), the no-action alternative (denial of the application), alternatives involving coal-fired, or natural-gas-fired generation at the BFN site or other sites, and nuclear or coal gasification generation at the TVA-owned Bellefonte site, and a combination of alternatives are compared in Table 9-1. Continued use of a once-through cooling system with helper towers for BFN is assumed for Table 9-1.

Table 9-1 shows that the significance of the environmental effects of the proposed action are SMALL for all impact categories (except for collective offsite radiological impacts from the fuel cycle and from high-level waste and spent fuel disposal, for which a single significance level was not assigned [Chapter 6]). The alternative actions, including the no-action alternative, may have environmental effects in at least some impact categories that reach MODERATE or LARGE significance.

9.3 Staff Conclusions and Recommendations

Based on (1) the analysis and findings in the GEIS (NRC 1996, 1999); (2) the TVA Environmental Report (TVA 2003b); (3) consultation with Federal, State, and local agencies; (4) the staff's own independent review; and (5) the staff's consideration of public comments, the recommendation of the staff is that the Commission determine that the adverse environmental impacts of license renewal for Units 1, 2, and 3 at BFN 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 Closed-Cycle Cooling

Impact Category	Proposed Action (License Renewal)	No-Action Alternative (Denial of Renewal)	Pulverized Coal-Fired Generation	Coal Gasification[a]	Natural-Gas-Combined-Cycle Generation	New Nuclear Generation[a]	Combination of Energy Alternatives
Land Use	SMALL	SMALL	MODERATE to LARGE	MODERATE to LARGE	MODERATE to LARGE	SMALL to LARGE	MODERATE to LARGE
Ecology	SMALL	SMALL	MODERATE to LARGE	SMALL to LARGE	MODERATE	SMALL to LARGE	MODERATE
Water Use and Quality	SMALL	SMALL	SMALL to MODERATE	SMALL to MODERATE	SMALL to MODERATE	SMALL to MODERATE	SMALL tp MODERATE
Air Quality	SMALL	SMALL	MODERATE	MODERATE	MODERATE	SMALL	MODERATE
Waste	SMALL	SMALL	MODERATE	MODERATE	SMALL	SMALL	SMALL
Human Health	SMALL[b]	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL
Socioeconomics	SMALL	MODERATE	MODERATE	MODERATE	MODERATE	MODERATE to LARGE	MODERATE
Aesthetics	SMALL	SMALL	MODERATE to LARGE	MODERATE to LARGE	MODERATE to LARGE	MODERATE to LARGE	MODERATE to LARGE
Historic and Archaeological Resources	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL
Environmental Justice	SMALL	SMALL	SMALL to MODERATE	SMALL to MODERATE	SMALL to MODERATE	SMALL to MODERATE	SMALL to MODERATE

(a) This alternative assumes building at TVA's unfinished Bellefonte nuclear plant site.
(b) Except for collective offsite radiological impacts from the fuel cycle and from HLW 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."

69 FR 11462. "Notice of Intent To Prepare an Environmental Impact Statement and Conduct Scoping Process." *Federal Register.* Vol. 69, No. 47, March 10, 2004.

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

Tennessee Valley Authority (TVA). 1972. *Final Environmental Impact Statement Browns Ferry Nuclear Plant, Units 1, 2, and 3.* Tennessee Valley Authority, Office of Health & Environmental Science. Tennessee Valley Authority, Chattanooga, Tennessee.

Tennessee Valley Authority (TVA). 2003a. *Application for Renewed Operating Licenses, Browns Ferry Units 1, 2, and 3.* Tennessee Valley Authority, Knoxville, Tennessee.

Tennessee Valley Authority (TVA). 2003b. *Applicant's Environmental Report – Operating License Renewal Stage, Browns Ferry Units 1, 2, and 3.* Tennessee Valley Authority, Knoxville, Tennessee.

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

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

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

U.S. Nuclear Regulatory Commission (NRC). 2004. *Environmental Scoping: Summary Report – Brown Ferry Nuclear Plant, Units 1, 2, and 3. NRC,* Athens, Alabama.

Appendix A

Comments Received on the Environmental Review

Appendix A

Comments Received on the Environmental Review

Part I – Comments Received During Scoping

On March 10, 2004, the U.S. Nuclear Regulatory Commission (NRC) published a Notice of Intent in the Federal Register (69 FR 11462), to notify the public of the staff's intent to prepare a plant-specific supplement to the *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (GEIS), NUREG-1437, Volumes 1 and 2, to support the renewal application for the Browns Ferry operating licenses and to conduct scoping. The plant-specific supplement to the GEIS has been prepared in accordance with the National Environmental Policy Act of 1969 (NEPA), Council on Environmental Quality (CEQ) guidance, and Title 10 of the Code of Federal Regulations (CFR) Part 51. As outlined by NEPA, the NRC initiated the scoping process with the issuance of the Federal Register Notice. The NRC invited the applicant; Federal, State, and local government agencies; Native American tribal organizations; 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 May 9, 2004. The deadline for filing comments was subsequently extended to June 4, 2004 (69 FR 30338).

The scoping process included two public scoping meetings, which were held at Athens State University in Athens, Alabama on April 1, 2004. Approximately 40 members of the public attended each meeting. Both sessions began with NRC staff members providing a brief overview of the license renewal process and the NEPA process. After the NRC's prepared statements, the meetings were open for public comments. Seven attendees provided oral statements that were recorded and transcribed by a certified court reporter and written statements that were appended to the transcript. The meeting transcripts are an attachment to the April 1, 2004, Scoping Meeting Summary dated May 14, 2004. The meeting summary is available electronically for public inspection in the NRC's Agencywide Documents Access Management System (ADAMS) at http://www.nrc.gov/reading-rm/adams.html under accession number ML041390581. In addition to the comments received during the public meetings, four comment letters and two e-mail messages were received by the NRC in response to the Notice of Intent.

The NRC received a letter dated May 19, 2004, from Mr. Larry Goldman of the U.S. Fish and Wildlife Service (FWS) providing comments on the environmental review. These comments were not included in the scoping summary report. However, the staff did consider the comments from the May 19 FWS letter in the preparation of this supplemental environmental impact statement (SEIS).

At the conclusion of the scoping period, the NRC staff and its contractor(s) reviewed the transcripts and all written material to identify specific comments and issues. Each set of comments from a given commenter was given a unique identifier (Commenter ID), so that each set of comments from a commenter could be traced back to the transcript or letter by which the comments were submitted. Specific comments were numbered sequentially within each comment set. One commenter submitted comments through multiple sources (e.g., afternoon and evening scoping meetings). All of the comments received and the staff responses are included in the Environmental Scoping Summary Report dated July 2004.

Table A-1 identifies the individuals who provided comments applicable to the environmental review and the Commenter ID associated with each person's set(s) of comments. The individuals are listed in the order in which they spoke at the public meeting, and in alphabetical order for the comments received by letter or e-mail. To maintain consistency with the Scoping Summary Report, the unique identifier used in that report for each set of comments is retained in this appendix.

Specific comments were categorized and consolidated by topic. Comments with similar specific objectives were combined to capture the common essential issues raised by the commenters. The comments fall into one of the following general groups:

- Specific comments that address environmental issues within the purview of the NRC environmental regulations related to license renewal. These comments address Category 1 or Category 2 issues or issues that were not addressed in the GEIS. They also address alternatives and related Federal actions.

- General comments (1) in support of or opposed to nuclear power or license renewal or (2) on the renewal process, the NRC's regulations, and the regulatory process. These comments may or may not be specifically related to the Browns Ferry license renewal application.

- Questions that do not provide new information.

- Specific comments that address issues that do not fall within or are specifically excluded from the purview of NRC environmental regulations related to license renewal. These comments typically address issues such as the need for power, emergency preparedness, security, current operational safety issues, and safety issues related to operation during the license renewal term.

Table A-1. Individuals Providing Comments During Scoping Comment Period

Commenter ID	Commenter	Affiliation (If Stated)	Comment Source and Accession Number:
BF-A	Stewart Horn		Afternoon Scoping Meeting ML041350407
BF-B	Dr. Lane Price		Afternoon Scoping Meeting ML041350407
BF-C	Ann Harris	We the People, Inc.	Afternoon Scoping Meeting ML041350407
BF-D	Stewart Ward		Afternoon Scoping Meeting ML041350407
BF-E	Chuck Wilson	Tennessee Valley Authority	Afternoon Scoping Meeting ML041350407
BF-F	Nancy Muse		Evening Scoping Meeting ML041350459
BF-G	Jeff North		Evening Scoping Meeting ML041350459
BF-H	Chuck Wilson	Tennessee Valley Authority	Evening Scoping Meeting ML041350459
BF-I	Zola		Email ML041250405
BF-J	Michael Bolt	Eastern Band of Cherokee Indians	Email ML0415540361
BF-K	Michelle Hamilton	Eastern Band of Cherokee Indians	Comment Letter ML041490083
BF-L	Sara Barczak and David Ritter	Southern Alliance for Clean Air and Public Citizen's Critical Mass Energy and Environmental Program	Comment Letter ML041340245
BF-M	Anoatubby	Chickasaw Nation	Comment Letter ML041410044
BF-N	Frances Lamberts	Tennessee League of Women Voters	Comment Letter ML041600095

Comments applicable to this environmental review and the staff's responses are summarized in this appendix. The specific alpha-numeric identifier (marker) after each comment refers to the comment set (Commenter ID) and the comment number. This information, which was extracted from the Browns Ferry Scoping Summary Report, is provided for the convenience of those interested in the scoping comments applicable to this environmental review. The comments that are general or outside the scope of the environmental review for Browns Ferry are not included here. More detail regarding the disposition of general or inapplicable comments can be found in the summary report. The Scoping Summary Report is available electronically for public inspection in ADAMS. ADAMS is accessible at http://www.nrc.gov/reading-rm/adams.html. The ADAMS accession number for the Scoping Summary Report is ML041970736.

Comments in this section are grouped in the following categories:

A.1.1 Aquatic Ecology Issues
A.1.2 Threatened and Endangered Species
A.1.3 Air Quality Issues
A.1.4 Human Health Issues
A.1.5 Cultural Resources Issues
A.1.6 Alternative Energy Sources
A.1.7 Surface-Water Quality, Hydrology, and Use
A.1.8 Postulated Accidents
A.1.9 Uranium Fuel Cycle

Part I. Comments Received During Scoping

A.1 Comments and Responses

The comments and suggestions received as part of scoping are discussed below. Parenthetical numbers after each comment refer to the commenter's ID letter and the comment number. Comments can be tracked to the commenter and the source document through the ID letter and comment number listed in Table A-1.

A.1.1 Comments Concerning Aquatic Ecology Issues

Comment: I don't understand the terminology impingement and entrainment. I don't know how to comment on that without understanding what it is. (BF-F-6)

Comment: Through impingement and entrainment, and through thermal alteration of returned water they cause damage to aquatic life, including great fishery and related recreational losses along river systems on which they are located. (BF-N-15)

Response: *Impingement occurs when fish or shellfish are pulled onto the intake screens that are part of the cooling water systems associated with nuclear power plants. Entrainment occurs when fish, shellfish, or larvae that are too small to be impinged on the screen are* *entrained in the flow through the plant, traversing the plant cooling system. Impingement and entrainment, as well as other aquatic ecology issues, will be discussed in Chapter 2 and Chapter 4 of the SEIS.*

Comment: The EIS should include (3) analysis of aquatic wildlife and terrestrial species impacts, with extensive involvement of the Federal and State agencies charged with natural resource protection. (BF-N-23)

Response: *Impacts to aquatic and terrestrial species will be discussed in Chapter 4 of the SEIS.*

A.1.2 Comments Concerning Threatened and Endangered Species

Comment: New data on the status of Federally and State-listed endangered or threatened terrestrial animal, aquatic, and plant species should be required and studied as to the impacts of an additional 20 years of operations per reactor. (BF-L-13)

Comment: Proper notification to, along with creation of working relationships with, state agencies, Fish and Wildlife Service, and National Marine Fisheries Service should occur. (BF-L-14)

Response: *During the analysis and preparation of the draft SEIS for license renewal, the NRC staff consults with appropriate Federal agencies. The NRC usually contacts directly the U.S. Fish and Wildlife Service (Department of the Interior) and the National Marine Fisheries Service (Department of Commerce) for environmental issues related to the impact on any threatened or endangered species that may be in the vicinity of the plant or to any critical habitat. If other agencies have actions or jurisdiction over areas directly related to the review, they would also be contacted directly by the NRC.*

In addition to NRC coordinated consultation, after a draft SEIS is published, it is also reviewed by various Federal agencies at their discretion. For example, at the Federal level, the draft SEIS for license renewal is most commonly reviewed by the U.S. Environmental Protection Agency and the Department of the Interior. The comments from these agencies are considered and included in the final SEIS as appropriate.

Potential impacts of renewing the operating licenses for Browns Ferry Nuclear Plant, Units 1, 2, and 3 on threatened or endangered species will be evaluated in Chapter 2 and Chapter 4 of the SEIS.

A.1.3 Comments Concerning Air Quality

Comment: We note that Limestone County is not evaluated as having bad air quality and that the annual quantity of emissions released into the atmosphere is normal for a nuclear plant. In an ideal situation it would not be necessary for us to make comment on air quality, however the air quality situation is far from ideal in the Great Smoky Mountains. Because air flows from Alabama frequently move towards our mountains we would like to encourage the exploration of reducing emissions at Browns Ferry. (BF-J-1)

Response: *Air quality impacts from plant operations were evaluated in the GEIS and found to be minimal. Air emissions are regulated by the U.S. Environmental Protection Agency and the State of Alabama. Air quality will be discussed in Chapter 2 of the SEIS.*

A.1.4 Comments Concerning Human Health

Comment: I'm also concerned about the level of radioactive substances that are effluent. If and what they are, and where can we get that information. Is that on the web site of the NRC? Radioactivity that is released into the environment in any way. (BF-F-7)

Comment: Could you specifically address the effluent from Browns Ferry. What do you all actually put into the river, itself? (BF-B-1)

Comment: I want to know whether the Millie is per what or per person. What it meant when you gave that answer, when you said equal to a dose of ... Is that what a person can get by being in the water at the point of the – at the pipes? (BF-D-1)

Response: *NRC is a regulatory agency charged with assuring public health and safety. NRC does this by providing the industry with regulations as well as conducting plant inspections. The licensee is allowed to release gaseous and liquid effluents to the environment, but the releases must be monitored and meet the requirements of 10 CFR Part 20, Appendix B, Table 2; therefore, contaminants may be present and detectable offsite. However, the release limits have been designed and proven to be protective of the health and safety of the public and environment. NRC sets limits on radiological effluents, requires monitoring of effluents and foodstuffs to ensure those limits are met, and has set dose limits to regulate the release of radioactive material from nuclear power facilities. The regulations are intentionally conservative and provide adequate protection for the public including the most radiosensitive members of the population. TVA monitors its effluent and calculates an offsite annual dose caused by radioactive liquid and gaseous effluents. These calculations are performed to demonstrate the licensee's compliance with its technical specifications and NRC regulations.*

NRC publishes two annual reports for Browns Ferry regarding environmental monitoring and environmental effluents. The "Annual Radiological Environmental Operating Report (AREOR)" and the "Annual Radiological Effluent Release (ARER) Report" are available to the public through NRC's Public Document Room in Rockville, Maryland, or from NRC's Electronic Reading Room available online at http://www.nrc.gov/reading-rm.html. The comments did not provide new and significant information; therefore, they will not be evaluated further.

A.1.5 Comments Concerning Cultural Resources

Comment: According to the information you provided, the EBCI's THPO has determined that the proposed activities will not have an effect on any known cultural resources significant to our Tribe. (BF-K-1)

Comment: We have also determined the undertaking will not have an effect on known cultural resources listed on or eligible for the National Register of Historic Places provided that archaeological site 1Li535 is avoided as stated in the BFN License Renewal Final Supplemental EIS. (BF-K-2)

Response: *The comments refer to historic and archaeological resources near Browns Ferry. These issues will be addressed in Chapter 2 and Chapter 4 of the SEIS.*

A.1.6 Comments Concerning Alternative Energy Sources

Comment: In our experience, the relicensing process has generally provided an inadequate analysis of energy alternatives. (BF-L-15)

Comment: In addition, other electricity generating technologies, such as solar, wind, and biomass should be investigated. (BF-L-17)

Comment: The League believes that an emphasis on conserving energy and using energy-efficient technologies is by far the wisest and safest course of action for our nation and state. (BF-N-3)

Comment: The League also believes that predominant reliance should be placed on production of energy from renewable sources. (BF-N-5)

Comment: We have applauded and strongly support the TVA's initiation of a Green Power Switch program whose wind, solar, and methane gas installations now produce electric power for more than seven thousand residential and business users. At this time, however, TVA's generational capacity under this program makes up less than one percent of its capacity from the two, now operating Browns Ferry units. For ecological and other reasons, the strongest market trends in the energy field, around the world favor energy production from renewable sources and weight of public opinion is on the side of expansion of these sources, at least within the Tennessee part of the Agency service area. (BF-N-6)

Response: *The GEIS included an extensive discussion of alternative energy sources. Environmental impacts associated with various reasonable alternatives to renewal of the operating licenses for Browns Ferry will be discussed in Chapter 8 of the SEIS. The comments did not provide new and significant information; therefore, they will not be evaluated further.*

Comment: It should thoroughly assess and clearly delineate (2) the alternative options and their economic, environmental and social benefits and costs. Delineation of alternatives should include optimization of energy efficiency technologies, energy conservation, and Green-Power-Switch program maximization. (BF-N-22)

Comment: It should also include comprehensive assessment and comparison of normal (4) safety-related costs for nuclear plants relative to alternative, renewable-source generation options. (BF-N-24)

Comment: The NRC must review in every respect these safety implications and costs of nuclear-power sources as against the societal and environmental advantages which renewable and substantially risk-free generation sources offer. (BF-N-27)

Response: *NRC determined that an applicant for license renewal need not provide an analysis of the economic costs or economic benefits of the proposed or alterative actions. The comments did not provide new and significant information; therefore, they will not be evaluated further.*

A.1.7 Comments Concerning Surface-Water Quality, Hydrology, and Use

Comment: I will only focus on the high discharge temperature that will occur when all three units are operating at 3952 megawatts thermal. The existing five cooling towers are unable to cool the water at peak summer conditions without derating an operating unit. (BF-I-1)

Comment: There is no concerted effort to built back cooling tower #4 or build additional cooling towers to allow operation at 100 percent of Extended Power Uprate (EPU) without derating all three units or having to take one off-line. Studies have been conducted by TVA's Norris labs to validate this assertion. (BF-I-2)

Comment: I believe there is a planned effort to allow Unit 1 to continue in its effort to restart with paying for the adequate cooling to meet the discharge limits. This is being driven by a fervent desire to hold the restart costs down and not impact schedule dates. (BF-I-3)

Response: *These comments refer to surface-water quality issues. These issues will be addressed in Chapters 2 and 4 of the SEIS.*

Comment: NRC should evaluate the impacts of extended generation from a regional perspective and should investigate state-level political concerns that may affect that ability to dedicate large water resources for extremely long periods of time. (BF-L-9)

Comment: NRC should require updated water use information for the region on current water needs, as in what industries and municipalities are currently using and are projected to use in the future as population centers continue to grow. (BF-L-12)

Comment: Since construction of the Brown's Ferry plant some four decades ago, Tennessee and the region have experienced enormous growth in population, with corresponding demands on water–our most important and life-necessary natural resource. (BF-N-16)

Comment: Since Unit 1 has not operated since 1985, and all of the reactors came online for a time in the mid-to-late 1970s, thorough water withdrawal and water consumption analyses, along with fish and vegetation studies, must be done using updated data (not referring back to original operating license information). (BF-L-10)

Comment: Further, the impact of the water withdrawn and its effect on the flow of the Tennessee River should be evaluated not during just "normal" conditions but in times of drought, which have impacted the region when Browns Ferry Unit 1 was not even operating. (BF-L-11)

Comment: We have strong concerns regarding nuclear power plant impacts on the region's water resources. Reactors like those at Browns Ferry consume through evaporation about 20,000 gallons per minute; their flow-through rate exceeds 600,000 gallons per minute and their direct and indirect cost to the water resource exceeds 50 gallons per each kilowatt hour of electricity they generate. (BF-N-14)

Comment: Given their huge withdrawal demands, it is imperative that the NRC consider the water impacts from the Browns Ferry reactors in a comprehensive way and from the perspective of all human and wildlife needs and all competing uses over the longer-term future. (BF-N-17)

Comment: We believe, therefore, that committing to electricity generation such large water withdrawals as are needed for safe operation of the Browns Ferry reactors, for more than three decades hence, may not be wise when generation options which have no or minimal impacts (e.g., from renewable sources), are available. (BF-N-19)

Response: *These comments refer to water use and water use conflicts. These issues will be addressed in Chapter 4 of the SEIS.*

Comment: Possible threats to water security in the region under various climate-change scenarios must also be considered in this context. (BF-N-18)

Response: *While climate change is a legitimate concern, the specific impacts of climate change within a particular region or watershed are still highly speculative, and are therefore beyond the scope of a NEPA review for reactor license renewal. Furthermore, any changes in watershed characteristics would likely be gradual, allowing water use conflicts to be resolved as needed. The comment did not provide new and significant information; therefore, it will not be evaluated further.*

A.1.8 Comments Concerning Postulated Accidents

Comment: Directly relevant to Browns Ferry Unit 1 concerns about restart and the subsequent operating extension are the accident projections from the Brookhaven National Laboratory Study in 1997 for a closed BWR for an area within 50 miles of the plant: population dose of 38 million rem, 15, 300 latent fatalities, 140 square miles of condemned land, and a cost of $48 billion (NUREG/CR-6451, April 1997). (BF-L-4)

Comment: I believe that the people of the Tennessee Valley may be in real danger from a major nuclear accident if these concerns prove to be accurate. (BF-A-4)

Response: *The effects of accidents are considered in both environmental and safety reviews for license renewal. Postulated accidents, including design-basis and severe accidents, will be addressed in Section 5.0 and Appendix G of the SEIS.*

A.1.9 Comments Concerning Uranium Fuel Cycle

Comment: Further, spent fuel casks, both for onsite storage and for transportation, have not undergone adequate testing to demonstrate thorough safety and containment of radiation, both during normal usage and during various accident scenarios. (BF-L-22)

Comment: Again, the industry's inclination to take every opportunity to cut costs (in attempting to make nuclear energy appear remotely viable, economically) creates a disturbing tension here, with nuclear utilities gravitating towards the casks that are cheapest and the least tested. (BF-L-23)

Response: *NRC is committed to preventing detrimental health impacts to the public. NRC has regulations covering the long-term storage of spent fuel onsite as well as packaging and transport of radioactive material. These regulations regarding packaging and transport of radioactive material are found at 10 CFR Part 71. NRC regulations related to exposure to the public are found at 10 CFR Part 20. In addition, the Department of Transportation and the U.S. Environmental Protection Agency have regulations to protect the public from health effects associated with radiation. Department of Transportation regulations related to transportation of radioactive material are found at 49 CFR Part 173, and Environmental Protection Agency regulations related to radiation are found at 40 CFR Parts 190 through 194.*

The safety and environmental effects of long-term storage of spent fuel onsite has been evaluated by NRC, and as set forth in the Waste Confidence Rule, the NRC has generically determined that such storage can be accomplished without significant environmental impact. In the Waste Confidence Rule, the Commission determined that spent fuel can be safely stored onsite for at least 30 years beyond the licensed operating life, which may include the term of a renewed license. NRC has a certification process for casks, regulated by 10 CFR Part 72. Such wastes are under continual licensing control. The comments did not provide new and significant information; therefore, they will not be evaluated further.

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 Browns Ferry Nuclear Power Plant, Units 1, 2, and 3, Draft Report for Comment* (NUREG-1437, Supplement 21, referred to as the draft SEIS) to Federal, State, Native American Tribal, and local government agencies as well as interested members of the public. As part of the process to solicit public comments on the draft SEIS, the staff:

- placed a copy of the draft SEIS in the NRC's electronic Public Document Room, its license renewal website, and at the Athens Limestone Public Library in Athens, Alabama,

- sent copies of the draft SEIS to the applicant, members of the public who requested copies, and certain Federal, State, Native American Tribal, and local agencies,

- published a notice of availability of the draft SEIS in the *Federal Register* on December 10, 2004 (69 FR 71855),

- issued public announcements, such as advertisements in local newspapers and postings in public places, of the availability of the draft SEIS,

- announced and held public meetings in Athens, Alabama, on January 25, 2005, to describe the results of the environmental review- and answer-related questions,

- issued public service announcements and press releases announcing the issuance of the draft SEIS, the public meetings, and instructions on how to comment on the draft SEIS,

- established an e-mail address to receive comments on the draft SEIS through the Internet.

During the draft SEIS comment period, the staff received a total of six comment letters. Several commenters 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 number for the public meeting summary, which includes the complete meeting transcripts, is ML050620210. Appendix A, Part II, Section A.2, contains a summary of the comments and the staff's responses. Appendix A, Part II, Section A.3, contains copies of the public meetings transcripts and the comment letters.

Each comment identified by the staff was assigned a specific alpha-numeric identifier (marker). That identifier is typed in the margin of the letter at the beginning of the discussion of the comment. A cross-reference of the alpha-numeric identifiers, the author of the comment, the page where the comment can be found, and the section(s) of this report in which the comment is addressed is provided in Table A-2. The six written comment letters are identified by the letters K through P. The accession number is provided for the written comments after the letter date to facilitate access to the document through ADAMS.

Table A-2. Comments Received on the Draft SEIS

Commenter ID	Commenter	Comment Source and ADAMS Accession Number	Page of Comment	Section(s) Where Addressed
BF-D-A-1	Ann Harris, Sierra Club	Afternoon Transcript, ML050620210	A-89	A.2.22
BF-D-A-2	Ann Harris, Sierra Club	Afternoon Transcript, ML050620210	A-99	A.2.5
BF-D-A-3	Ann Harris, Sierra Club	Afternoon Transcript, ML050620210	A-99	A.2.22
BF-D-A-4	Ann Harris, Sierra Club	Afternoon Transcript, ML050620210	A-99	A.2.22
BF-D-A-5	Ann Harris, Sierra Club	Afternoon Transcript, ML050620210	A-99	A.2.22
BF-D-A-6	Ann Harris, Sierra Club	Afternoon Transcript, ML050620210	A-100	A.2.22
BF-D-A-7	Ann Harris, Sierra Club	Afternoon Transcript, ML050620210	A-100	A.2.6
BF-D-A-8	Ann Harris, Sierra Club	Afternoon Transcript, ML050620210	A-100	A.2.22
BF-D-A-9	Ann Harris, Sierra Club	Afternoon Transcript, ML050620210	A-100	A.2.6
BF-D-A-10	Ann Harris, Sierra Club	Afternoon Transcript, ML050620210	A-100	A.2.6
BF-D-A-11	Ann Harris, Sierra Club	Afternoon Transcript, ML050620210	A-100	A.2.6
BF-D-A-12	Ann Harris, Sierra Club	Afternoon Transcript, ML050620210	A-100	A.2.6
BF-D-A-13	Ann Harris, Sierra Club	Afternoon Transcript, ML050620210	A-101	A.2.22
BF-D-A-14	Ann Harris, Sierra Club	Afternoon Transcript, ML050620210	A-101	A.2.6
BF-D-A-15	Ann Harris, Sierra Club	Afternoon Transcript, ML050620210	A-101	A.2.5
BF-D-A-16	Ann Harris, Sierra Club	Afternoon Transcript, ML050620210	A-101	A.2.22
BF-D-A-17	Ann Harris, Sierra Club	Afternoon Transcript, ML050620210	A-101	A.2.22
BF-D-A-18	Ann Harris, Sierra Club	Afternoon Transcript, ML050620210	A-101	A.2.5
BF-D-A-19	Ann Harris, Sierra Club	Afternoon Transcript, ML050620210	A-107	A.2.22

Table A-2. (contd)

Commenter ID	Commenter	Comment Source and ADAMS Accession Number	Page of Comment	Section(s) Where Addressed
BF-D-B-1	Chuck Wilson, TVA	Afternoon Transcript, ML050620210	A-94	A.2.1
BF-D-B-2	Chuck Wilson, TVA	Afternoon Transcript, ML050620210	A-94	A.2.1
BF-D-C-1	James Speegle	Afternoon Transcript, ML050620210	A-95	A.2.22
BF-D-C-2	James Speegle	Afternoon Transcript, ML050620210	A-95	A.2.2
BF-D-C-3	James Speegle	Afternoon Transcript, ML050620210	A-95	A.2.22
BF-D-C-4	James Speegle	Afternoon Transcript, ML050620210	A-95	A.2.18
BF-D-C-5	James Speegle	Afternoon Transcript, ML050620210	A-95	A.2.22
BF-D-C-6	James Speegle	Afternoon Transcript, ML050620210	A-96	A.2.22
BF-D-C-7	James Speegle	Afternoon Transcript, ML050620210	A-96	A.2.22
BF-D-C-8	James Speegle	Afternoon Transcript, ML050620210	A-96	A.2.1
BF-D-C-9	James Speegle	Afternoon Transcript, ML050620210	A-96	A.2.22
BF-D-C-10	James Speegle	Afternoon Transcript, ML050620210	A-96	A.2.17
BF-D-C-11	James Speegle	Afternoon Transcript, ML050620210	A-96	A.2.22
BF-D-C-12	James Speegle	Afternoon Transcript, ML050620210	A-96	A.2.22
BF-D-C-13	James Speegle	Afternoon Transcript, ML050620210	A-97	A.2.22
BF-D-C-14	James Speegle	Afternoon Transcript, ML050620210	A-97	A.2.22
BF-D-C-15	James Speegle	Afternoon Transcript, ML050620210	A-97	A.2.22
BF-D-C-16	James Speegle	Afternoon Transcript, ML050620210	A-97	A.2.22
BF-D-C-17	James Speegle	Afternoon Transcript, ML050620210	A-98	A.2.22

Table A-2. (contd)

Commenter ID	Commenter	Comment Source and ADAMS Accession Number	Page of Comment	Section(s) Where Addressed
BF-D-C-18	James Speegle	Afternoon Transcript, ML050620210	A-98	A.2.22
BF-D-D-1	Dawn Knox	Afternoon Transcript, ML050620210	A-102	A.2.22
BF-D-D-2	Dawn Knox	Afternoon Transcript, ML050620210	A-102	A.2.22
BF-D-D-3	Dawn Knox	Afternoon Transcript, ML050620210	A-102	A.2.20
BF-D-E-1	Stewart Horn	Afternoon Transcript, ML050620210	A-103	A.2.22
BF-D-E-2	Stewart Horn	Afternoon Transcript, ML050620210	A-103	A.2.22
BF-D-E-3	Stewart Horn	Afternoon Transcript, ML050620210	A-103	A.2.22
BF-D-E-4	Stewart Horn	Afternoon Transcript, ML050620210	A-104	A.2.6
BF-D-E-5	Stewart Horn	Afternoon Transcript, ML050620210	A-104	A.2.10
BF-D-E-6	Stewart Horn	Afternoon Transcript, ML050620210	A-104	A.2.6
BF-D-E-7	Stewart Horn	Afternoon Transcript, ML050620210	A-104	A.2.22
BF-D-E-8	Stewart Horn	Afternoon Transcript, ML050620210	A-104	A.2.22
BF-D-E-9	Stewart Horn	Afternoon Transcript, ML050620210	A-104	A.2.22
BF-D-E-10	Stewart Horn	Afternoon Transcript, ML050620210	A-104	A.2.22
BF-D-E-11	Stewart Horn	Afternoon Transcript, ML050620210	A-105	A.2.6
BF-D-F-1	Ralph Timberlake	Afternoon Transcript, ML050620210	A-105	A.2.6
BF-D-F-2	Ralph Timberlake	Afternoon Transcript, ML050620210	A-105	A.2.4
BF-D-F-3	Ralph Timberlake	Afternoon Transcript, ML050620210	A-105	A.2.22

Table A-2. (contd)

Commenter ID	Commenter	Comment Source and ADAMS Accession Number	Page of Comment	Section(s) Where Addressed
BF-D-F-5	Ralph Timberlake	Afternoon Transcript, ML050620210	A-105	A.2.4
BF-D-F-6	Ralph Timberlake	Afternoon Transcript, ML050620210	A-106	A.2.3
BF-D-F-7	Ralph Timberlake	Afternoon Transcript, ML050620210	A-106	A.2.17
BF-D-F-8	Ralph Timberlake	Afternoon Transcript, ML050620210	A-106	A.2.9
BF-D-F-9	Ralph Timberlake	Afternoon Transcript, ML050620210	A-106	A.2.3
BF-D-F-10	Ralph Timberlake	Afternoon Transcript, ML050620210	A-106	A.2.6
BF-D-F-11	Ralph Timberlake	Afternoon Transcript, ML050620210	A-107	A.2.4
BF-D-G-1	Nancy Muse	Evening Transcript, ML050620210	A-121	A.2.18
BF-D-G-2	Nancy Muse	Evening Transcript, ML050620210	A-126	A.2.22
BF-D-G-3	Nancy Muse	Evening Transcript, ML050620210	A-126	A.2.4
BF-D-G-4	Nancy Muse	Evening Transcript, ML050620210	A-127	A.2.19
BF-D-G-5	Nancy Muse	Evening Transcript, ML050620210	A-127	A.2.22
BF-D-G-6	Nancy Muse	Evening Transcript, ML050620210	A-127	A.2.3
BF-D-G-7	Nancy Muse	Evening Transcript, ML050620210	A-128	A.2.19
BF-D-G-8	Nancy Muse	Evening Transcript, ML050620210	A-128	A.2.19
BF-D-G-9	Nancy Muse	Evening Transcript, ML050620210	A-132	A.2.17
BF-D-G-10	Nancy Muse	Evening Transcript, ML050620210	A-132	A.2.17
BF-D-G-11	Nancy Muse	Evening Transcript, ML050620210	A-133	A.2.3
BF-D-G-12	Nancy Muse	Evening Transcript, ML050620210	A-134	A.2.20

Table A-2. (contd)

Commenter ID	Commenter	Comment Source and ADAMS Accession Number	Page of Comment	Section(s) Where Addressed
BF-D-H-1	Jackie Tipper	Evening Transcript, ML050620210	A-129	A.2.19
BF-D-H-2	Jackie Tipper	Evening Transcript, ML050620210	A-129	A.2.22
BF-D-H-3	Jackie Tipper	Evening Transcript, ML050620210	A-129	A.2.16
BF-D-H-4	Jackie Tipper	Evening Transcript, ML050620210	A-129	A.2.22
BF-D-H-5	Jackie Tipper	Evening Transcript, ML050620210	A-130	A.2.20
BF-D-H-6	Jackie Tipper	Evening Transcript, ML050620210	A-131	A.2.19
BF-D-H-7	Jackie Tipper	Evening Transcript, ML050620210	A-131	A.2.18
BF-D-H-8	Jackie Tipper	Evening Transcript, ML050620210	A-131	A.2.20
BF-D-H-9	Jackie Tipper	Evening Transcript, ML050620210	A-131	A.2.22
BF-D-H-10	Jackie Tipper	Evening Transcript, ML050620210	A-131	A.2.19
BF-D-H-11	Jackie Tipper	Evening Transcript, ML050620210	A-132	A.2.22
BF-D-I-1	Chuck Wilson, TVA	Evening Transcript, ML050620210	A-131	A.2.1
BF-D-I-2	Chuck Wilson, TVA	Evening Transcript, ML050620210	A-131	A.2.1
BF-D-J-1	Grant Dasney	Evening Transcript, ML050620210	A-133	A.2.22
BF-D-K-1	Stewart Horn	Letter, ML050620210	A-109	A.2.22
BF-D-K-2	Stewart Horn	Letter, ML050620210	A-109	A.2.22
BF-D-K-3	Stewart Horn	Letter, ML050620210	A-109	A.2.22
BF-D-K-4	Stewart Horn	Letter, ML050620210	A-109	A.2.6
BF-D-K-5	Stewart Horn	Letter, ML050620210	A-109	A.2.22
BF-D-K-6	Stewart Horn	Letter, ML050620210	A-109	A.2.6
BF-D-K-7	Stewart Horn	Letter, ML050620210	A-109	A.2.22
BF-D-K-8	Stewart Horn	Letter, ML050620210	A-110	A.2.22
BF-D-K-9	Stewart Horn	Letter, ML050620210	A-110	A.2.22
BF-D-K-10	Stewart Horn	Letter, ML050620210	A-110	A.2.22

Table A-2. (contd)

Commenter ID	Commenter	Comment Source and ADAMS Accession Number	Page of Comment	Section(s) Where Addressed
BF-D-K-11	Stewart Horn	Letter, ML050620210	A-110	A.2.6
BF-D-L-1	Ann Harris, Sierra Club	Letter, ML050620210	A-111	A.2.5
BF-D-L-2	Ann Harris, Sierra Club	Letter, ML050620210	A-111	A.2.22
BF-D-L-3	Ann Harris, Sierra Club	Letter, ML050620210	A-111	A.2.22
BF-D-L-4	Ann Harris, Sierra Club	Letter, ML050620210	A-111	A.2.22
BF-D-L-5	Ann Harris, Sierra Club	Letter, ML050620210	A-111	A.2.22
BF-D-L-6	Ann Harris, Sierra Club	Letter, ML050620210	A-111	A.2.6
BF-D-L-7	Ann Harris, Sierra Club	Letter, ML050620210	A-111	A.2.22
BF-D-L-8	Ann Harris, Sierra Club	Letter, ML050620210	A-111	A.2.6
BF-D-L-9	Ann Harris, Sierra Club	Letter, ML050620210	A-111	A.2.6
BF-D-M-1	John Formicola, TVA	Letter, ML050630390	A-136	A.2.20
BF-D-M-2	John Formicola, TVA	Letter, ML050630390	A-136	A.2.7
BF-D-M-3	John Formicola, TVA	Letter, ML050630390	A-136	A.2.21
BF-D-M-4	John Formicola, TVA	Letter, ML050630390	A-136	A.2.21
BF-D-M-5	John Formicola, TVA	Letter, ML050630390	A-136	A.2.21
BF-D-M-6	John Formicola, TVA	Letter, ML050630390	A-136	A.2.21
BF-D-M-7	John Formicola, TVA	Letter, ML050630390	A-137	A.2.21
BF-D-M-8	John Formicola, TVA	Letter, ML050630390	A-137	A.2.13
BF-D-M-9	John Formicola, TVA	Letter, ML050630390	A-137	A.2.13
BF-D-M-10	John Formicola, TVA	Letter, ML050630390	A-137	A.2.11
BF-D-M-11	John Formicola, TVA	Letter, ML050630390	A-137	A.2.21
BF-D-M-12	John Formicola, TVA	Letter, ML050630390	A-137	A.2.10
BF-D-M-13	John Formicola, TVA	Letter, ML050630390	A-138	A.2.21
BF-D-M-14	John Formicola, TVA	Letter, ML050630390	A-138	A.2.21
BF-D-M-15	John Formicola, TVA	Letter, ML050630390	A-138	A.2.21
BF-D-M-16	John Formicola, TVA	Letter, ML050630390	A-138	A.2.21
BF-D-M-17	John Formicola, TVA	Letter, ML050630390	A-138	A.2.21
BF-D-M-18	John Formicola, TVA	Letter, ML050630390	A-138	A.2.21
BF-D-M-19	John Formicola, TVA	Letter, ML050630390	A-138	A.2.21
BF-D-M-20	John Formicola, TVA	Letter, ML050630390	A-138	A.2.11
BF-D-M-21	John Formicola, TVA	Letter, ML050630390	A-138	A.2.11
BF-D-M-22	John Formicola, TVA	Letter, ML050630390	A-138	A.2.11
BF-D-M-23	John Formicola, TVA	Letter, ML050630390	A-138	A.2.11
BF-D-M-24	John Formicola, TVA	Letter, ML050630390	A-138	A.2.11
BF-D-M-25	John Formicola, TVA	Letter, ML050630390	A-139	A.2.17
BF-D-M-26	John Formicola, TVA	Letter, ML050630390	A-139	A.2.16

Table A-2. (contd)

Commenter ID	Commenter	Comment Source and ADAMS Accession Number	Page of Comment	Section(s) Where Addressed
BF-D-M-27	John Formicola, TVA	Letter, ML050630390	A-139	A.2.19
BF-D-M-28	John Formicola, TVA	Letter, ML050630390	A-139	A.2.14
BF-D-M-29	John Formicola, TVA	Letter, ML050630390	A-139	A.2.16
BF-D-M-30	John Formicola, TVA	Letter, ML050630390	A-139	A.2.16
BF-D-M-31	John Formicola, TVA	Letter, ML050630390	A-140	A.2.16
BF-D-M-32	John Formicola, TVA	Letter, ML050630390	A-140	A.2.16
BF-D-M-33	John Formicola, TVA	Letter, ML050630390	A-140	A.2.16
BF-D-M-34	John Formicola, TVA	Letter, ML050630390	A-140	A.2.16
BF-D-M-35	John Formicola, TVA	Letter, ML050630390	A-140	A.2.13
BF-D-M-36	John Formicola, TVA	Letter, ML050630390	A-140	A.2.9
BF-D-M-37	John Formicola, TVA	Letter, ML050630390	A-141	A.2.21
BF-D-M-38	John Formicola, TVA	Letter, ML050630390	A-141	A.2.10
BF-D-M-39	John Formicola, TVA	Letter, ML050630390	A-141	A.2.10
BF-D-M-40	John Formicola, TVA	Letter, ML050630390	A-141	A.2.16
BF-D-M-41	John Formicola, TVA	Letter, ML050630390	A-141	A.2.16
BF-D-M-42	John Formicola, TVA	Letter, ML050630390	A-141	A.2.16
BF-D-M-43	John Formicola, TVA	Letter, ML050630390	A-141	A.2.16
BF-D-M-44	John Formicola, TVA	Letter, ML050630390	A-141	A.2.15
BF-D-M-45	John Formicola, TVA	Letter, ML050630390	A-141	A.2.21
BF-D-M-46	John Formicola, TVA	Letter, ML050630390	A-142	A.2.21
BF-D-M-47	John Formicola, TVA	Letter, ML050630390	A-142	A.2.10
BF-D-M-48	John Formicola, TVA	Letter, ML050630390	A-143	A.2.10
BF-D-M-49	John Formicola, TVA	Letter, ML050630390	A-143	A.2.21
BF-D-M-50	John Formicola, TVA	Letter, ML050630390	A-143	A.2.13
BF-D-M-51	John Formicola, TVA	Letter, ML050630390	A-143	A.2.21
BF-D-M-52	John Formicola, TVA	Letter, ML050630390	A-143	A.2.13
BF-D-M-53	John Formicola, TVA	Letter, ML050630390	A-144	A.2.13
BF-D-M-54	John Formicola, TVA	Letter, ML050630390	A-144	A.2.13
BF-D-M-55	John Formicola, TVA	Letter, ML050630390	A-144	A.2.20
BF-D-M-56	John Formicola, TVA	Letter, ML050630390	A-144	A.2.16
BF-D-M-57	John Formicola, TVA	Letter, ML050630390	A-144	A.2.16
BF-D-M-58	John Formicola, TVA	Letter, ML050630390	A-144	A.2.20
BF-D-M-60	John Formicola, TVA	Letter, ML050630390	A-145	A.2.21
BF-D-M-61	John Formicola, TVA	Letter, ML050630390	A-145	A.2.21
BF-D-M-62	John Formicola, TVA	Letter, ML050630390	A-145	A.2.21
BF-D-M-63	John Formicola, TVA	Letter, ML050630390	A-145	A.2.21

Table A-2. (contd)

Commenter ID	Commenter	Comment Source and ADAMS Accession Number	Page of Comment	Section(s) Where Addressed
BF-D-M-64	John Formicola, TVA	Letter, ML050630390	A-145	A.2.20
BF-D-M-65	John Formicola, TVA	Letter, ML050630390	A-145	A.2.20
BF-D-M-66	John Formicola, TVA	Letter, ML050630390	A-145	A.2.21
BF-D-M-67	John Formicola, TVA	Letter, ML050630390	A-146	A.2.20
BF-D-M-68	John Formicola, TVA	Letter, ML050630390	A-146	A.2.10
BF-D-M-69	John Formicola, TVA	Letter, ML050630390	A-146	A.2.10
BF-D-M-71	John Formicola, TVA	Letter, ML050630390	A-146	A.2.12
BF-D-M-72	John Formicola, TVA	Letter, ML050630390	A-146	A.2.21
BF-D-N-1	Gregory Hogue, U.S. Department of Interior	Letter, ML050630415	A-148	A.2.9
BF-D-N-2	Gregory Hogue, U.S. Department of Interior	Letter, ML050630415	A-148	A.2.13
BF-D-N-3	Gregory Hogue, U.S. Department of Interior	Letter, ML050630415	A-149	A.2.9
BF-D-N-4	Gregory Hogue, U.S. Department of Interior	Letter, ML050630415	A-149	A.2.9
BF-D-N-5	Gregory Hogue, U.S. Department of Interior	Letter, ML050630415	A-149	A.2.9
BF-D-N-6	Gregory Hogue, U.S. Department of Interior	Letter, ML050630415	A-149	A.2.9
BF-D-N-7	Gregory Hogue, U.S. Department of Interior	Letter, ML050630415	A-150	A.2.9
BF-D-N-8	Gregory Hogue, U.S. Department of Interior	Letter, ML050630415	A-150	A.2.9
BF-D-N-9	Gregory Hogue, U.S. Department of Interior	Letter, ML050630415	A-151	A.2.9
BF-D-N-10	Gregory Hogue, U.S. Department of Interior	Letter, ML050630415	A-152	A.2.11
BF-D-N-11	Gregory Hogue, U.S. Department of Interior	Letter, ML050630415	A-152	A.2.9
BF-D-N-12	Gregory Hogue, U.S. Department of Interior	Letter, ML050630415	A-153	A.2.9
BF-D-N-13	Gregory Hogue, U.S. Department of Interior	Letter, ML050630415	A-153	A.2.13
BF-D-N-14	Gregory Hogue, U.S. Department of Interior	Letter, ML050630415	A-153	A.2.10
BF-D-N-15	Gregory Hogue, U.S. Department of Interior	Letter, ML050630415	A-153	A.2.13

Table A-2. (contd)

Commenter ID	Commenter	Comment Source and ADAMS Accession Number	Page of Comment	Section(s) Where Addressed
BF-D-N-16	Gregory Hogue, U.S. Department of Interior	Letter, ML050630415	A-153	A.2.9
BF-D-N-17	Gregory Hogue, U.S. Department of Interior	Letter, ML050630415	A-153	A.2.9
BF-D-N-18	Gregory Hogue, U.S. Department of Interior	Letter, ML050630415	A-153	A.2.9
BF-D-N-19	Gregory Hogue, U.S. Department of Interior	Letter, ML050630415	A-153	A.2.13
BF-D-N-20	Gregory Hogue, U.S. Department of Interior	Letter, ML050630415	A-153	A.2.10
BF-D-N-21	Gregory Hogue, U.S. Department of Interior	Letter, ML050630415	A-153	A.2.11
BF-D-O-1	Michele Boyd, Public Citizen, and Sara Barczak, Southern Alliance for Clean Energy	Letter, ML050630419	A-159	A.2.22
BF-D-O-2	Michele Boyd, Public Citizen, and Sara Barczak, Southern Alliance for Clean Energy	Letter, ML050630419	A-159	A.2.22
BF-D-O-3	Michele Boyd, Public Citizen, and Sara Barczak, Southern Alliance for Clean Energy	Letter, ML050630419	A-160	A.2.22
BF-D-O-4	Michele Boyd, Public Citizen, and Sara Barczak, Southern Alliance for Clean Energy	Letter, ML050630419	A-161	A.2.8
BF-D-O-5	Michele Boyd, Public Citizen, and Sara Barczak, Southern Alliance for Clean Energy	Letter, ML050630419	A-161	A.2.13
BF-D-O-6	Michele Boyd, Public Citizen, and Sara Barczak, Southern Alliance for Clean Energy	Letter, ML050630419	A-161	A.2.22

Table A-2. (contd)

Commenter ID	Commenter	Comment Source and ADAMS Accession Number	Page of Comment	Section(s) Where Addressed
BF-D-O-7	Michele Boyd, Public Citizen, and Sara Barczak, Southern Alliance for Clean Energy	Letter, ML050630419	A-161	A.2.20
BF-D-O-8	Michele Boyd, Public Citizen, and Sara Barczak, Southern Alliance for Clean Energy	Letter, ML050630419	A-160	A.2.19
BF-D-O-9	Michele Boyd, Public Citizen, and Sara Barczak, Southern Alliance for Clean Energy	Letter, ML050630419	A-162	A.2.20
BF-D-P-1	Heinz Mueller, U.S. Environmental Protection Agency	Letter, ML050700107	A-156	A.2.19
BF-D-P-2	Heinz Mueller, U.S. Environmental Protection Agency	Letter, ML050700107	A-156	A.2.13
BF-D-P-3	Heinz Mueller, U.S. Environmental Protection Agency	Letter, ML050700107	A-157	A.2.1

A.2 Comments and Responses

Comments in this section are grouped in the following categories:

A.2.1 General Comments in Support of License Renewal at Browns Ferry Nuclear Plant
A.2.2 General Comments in Support of Nuclear Power
A.2.3 General Comments in Opposition to License Renewal at Browns Ferry Nuclear Plant
A.2.4 General Comments in Opposition to Nuclear Power
A.2.5 General Comments in Opposition to NRC's License Renewal Process
A.2.6 Comments Concerning NRC's Administrative Process
A.2.7 Comment Concerning National Environmental Policy Act of 1969 (NEPA) Compliance
A.2.8 Comments Concerning Decommissioning
A.2.9 Comments Concerning Aquatic Ecology
A.2.10 Comments Concerning Terrestrial Ecology
A.2.11 Comments Concerning Threatened or Endangered Species
A.2.12 Comments Concerning Groundwater Use and Quality
A.2.13 Comments Concerning Surface-Water Use and Quality
A.2.14 Comments Concerning Land Use
A.2.15 Comments Concerning Cultural Resources
A.2.16 Comments Concerning Socioeconomics
A.2.17 Comments Concerning Human Health and Radiological Impact
A.2.18 Comments Concerning Postulated Accidents
A.2.19 Comments Concerning the Uranium Fuel Cycle and Waste Management
A.2.20 Comments Concerning Alternatives
A.2.21 Editorial Comments
A.2.22 Comments Concerning Issues Outside the Scope of the Environmental Review for License Renewal: Aging Management, Blended Low Enriched Uranium Fuel, Cost of Power, Operational Safety, Restart of Browns Ferry Unit 1, and Safeguards and Security

A.2.1 General Comments in Support of License Renewal at Browns Ferry Nuclear Plant

Comment: Browns Ferry Unit 2 and 3 run efficient. They run clean; they run good. BF-D-C-8

Comment: Being a Federal agency, in the spring of 2002 TVA prepared its own environmental impact statement addressing Browns Ferry License Renewal, and Browns Ferry Unit 1 restart. There were no significant environmental impacts, and license renewal was found to allow power production without greenhouse gases, which is consistent with TVA's clean air initiatives. It also maximizes use of existing assets and avoids the impacts of new site construction. So, our overall conclusion at that time that it was an environmentally sound thing to do. BF-D-B-2

Comment: TVA agrees with NRC's overall conclusion that the environmental impacts of Browns Ferry License Renewal are minimal. BF-D-B-1

Comment: TVA agrees with NRC's basic overall conclusion that the environmental impacts of Browns Ferry License Renewal are minimal. BF-D-I-1

Comment: In the spring of 2002 we completed our own environmental impact statement, which addressed Browns Ferry License Renewal and Browns Ferry Unit 1 restart. There were no significant environmental impacts, and we did find that, in general, license renewal allows power production without greenhouse gases, which is consistent with TVA's clean air initiatives that you hear so much about. License renewal also maximizes use of existing assets and it avoids the impacts of new site construction. So, in general, we fully supported renewing the licenses of Browns Ferry as a good thing to do. BF-D-I-2

Comment: In conclusion, the document states that the OL renewal would result in fewer environmental impacts than the feasible alternatives for generating power, and the NRC considers impacts of OL renewal to be small. Overall, the impacts as defined in the DGSEIS appear to be within acceptable limits. BF-D-P-3

Response: *The comments are supportive of license renewal at Browns Ferry and are general in nature. The comments provide no new and significant information; therefore, no changes were made to the SEIS text.*

A.2.2 General Comments in Support of Nuclear Power

Comment: And nobody needs to sit here and think I'm against nuclear power. I'm not. We got to have it. We got to have energy. BF-D-C-2

Response: *The comment is supportive of nuclear power and is general in nature. The comment provides no new and significant information; therefore, no change was made to the SEIS text.*

A.2.3 General Comments in Opposition to License Renewal at Browns Ferry Nuclear Power Plant

Comment: And I'm not blaming any one person in this room because you're doing your job. The technology is here. We did not invent it; we're dealing with it. But I think it is time to phase it out and I would like for everyone in this room to please consider looking at options to restarting these plants. BF-D-G-6

Comment: Hopefully, the pristine area that we reside in here will be maintained. Though we are in an agrarian area, per se, except for probably Redstone, we would like to retain that. We would like to believe that we are going to have these pristine trees, we're going to have viable fisheries and other means of transportation to which these two reactor – this reactor which you are talking about today could have a severe impact and, then, we are going to be back discussing probably again Bellefonte, if that's going to have an impact. BF-D-F-9

Comment: I would like to say that given the fact that information is very difficult to obtain through the bureaucracy that this license renewal should be withheld. I do not think that the track record of TVA warrants us a renewal, based on not unequivocal answers. BF-D-F-6

Comment: I'm against TVA's future commitment, or present commitment also, to the nuclear program, regardless of the specific information within the environmental assessment and/or environmental impact statement. BF-D-G-11

Response: *The comments oppose license renewal at Browns Ferry and are general in nature. The comments do not provide new and significant information; therefore, no changes were made to the SEIS text.*

A.2.4 General Comments in Opposition to Nuclear Power

Comment: We have politicians who are unopposed to nuclear energy and nuclear power who suppress the stark, cold reality (static). BF-D-G-3

Comment: We need peace in this valley, and that nuclear plant out there is not only a target for everything else, it is the source of contention right now. BF-D-F-11

Comment: Nuclear power, though we should not be afraid, is not something that we can control. We do not fully understand it. We're talking about 20,000 years before it is fully decayed and, then, we don't know if it is going to be safe. It is all speculation. BF-D-F-5

Comment: I'm a proponent being against nuclear power. BF-D-F-2

Response: *The comments oppose nuclear power and are general in nature. The comments provide no new and significant information; therefore, no changes were made to the SEIS text.*

A.2.5 General Comments in Opposition to NRC's License Renewal Process

Comment: I am here today because I find that the NRC staff does not have a low that they will stop at to bend over for the nuclear industry. BF-D-L-1 and BF-D-A-2

Comment: In my 21 years of dealing with you boys, I still cannot trust you with public health and safety. How sad you are. BF-D-A-18

Comment: All the time and words in the world will never heal the continued incompetence of the NRC staff and Commission. Your continued refusal to perform your jobs is a clear indicator that the NRC will continue to put public health and safety below industry financial support. The time will soon come when your actions will come to hit you in the seat of the pants as you leave a nuclear site. BF-D-A-15

Response: *The comments oppose NRC's license renewal process and are general in nature. The comments provide no new and significant information; therefore, no changes were made to the SEIS text.*

A.2.6 Comments Concerning NRC's Administrative Processes

Comment: I went to the Athens Library to try to determine how many automatic shutdowns had occurred at Browns Ferry. The historical NRC Browns Ferry files are no longer there. I called NRC. They told me that the information would be available through the online NRC public documentation system. I struggled to try to find the data online, but eventually gave up after suffering severe frustration. I then called NRC and requested that someone there find the data for me, but I never received any information. BF-D-E-4 and BF-D-K-4

Response: *Information from NRC's document system, the Agencywide Documents Access and Management System (ADAMS), is accessible from the NRC Web site at http://www.nrc.gov/reading-rm/adams.html. ADAMS is an information system that provides access to all image and text documents that the NRC has made public since November 1, 1999, as well as bibliographic records (some with abstracts and full text) that the NRC made public before November 1999. There is a fee to have materials copied and shipped. Information regarding fees and turnaround times can be found at http://www.nrc.gov/reading-rm/pdr/copy-service.html. Additionally, staff at the Public Document Room will provide assistance in locating or obtaining documents in ADAMS. They can be reached at PDR@nrc.gov or by phone at 1-800-397-4209 or 301-415-4737, by fax at 301-415-3548, by mail at NRC, PDR, O1F13, Washington, DC 20555. The comment provides no new and significant information; therefore, no change was made to the SEIS text.*

Comment: Have you already renewed the operating license of this reactor, or have you informed TVA that approval of license renewal is guaranteed? The TVA has spent $885,000,000 on this project, and it is beyond belief that they would have done such a thing if there may be the remotest possibility that approval might not be forthcoming. If approval has not already been granted or is not guaranteed, has the NRC encouraged the TVA to initiate work on this project under these circumstances? BF-D-E-11 and BF-D-K-11

Response: *The NRC makes the decision to grant or deny a license renewal based on whether the applicant has demonstrated that the environmental and safety requirements in the NRC's regulations can be met during the license renewal term. If the applicant meets the requirements given in the regulations, then the NRC can be expected to approve renewal of the license. The NRC can deny an applicant's request to renew a license; however, the process to renew a license is an iterative process, such that if the applicant did not provide appropriate or adequate information in its initial application, the NRC would identify the deficiencies and the applicant would be allowed to resubmit the application. This process could continue, and has continued, until the NRC concludes that the application is sufficient to complete the review. Furthermore, if it appeared to the applicant that the NRC might deny the request for license renewal, the applicant would likely withdraw the request in advance of the formal denial. The comment provides no new and significant information; therefore, no change was made to the SEIS text.*

Comment: If we can somehow restore the public trust in our officials, if we cannot trust our officials, which seems from the comment earlier, we cannot, something needs to be done. I would entreat you to take the time, those that are in authority and those that are receiving our trust and our funds from our taxes, would take time to try to restore public confidence and trust in you. If we don't trust you, it is going to be a problem. And, then, surely reprisals should be a horror to all of us sitting here. If the people, which we are a people-driven government, let us understand that – you cannot be everywhere at one time. If the eyes and ears of those that are willing to put their families and lives on the line are not rewarded, is not appreciated, we do ourselves and our posterity a great and horrendous disservice. So I beg you, beseech you that you somehow take time to look at these matters and do not be afraid for the sake of money 'cause no amount of money is worth the life of one single person. BF-D-F-10

Comment: It is with great sadness that I stand before you hearing such appalling reports that our citizens have laid against you, right or wrong. However, TVA, I know is an agency that has a very thick skin. No matter how much you tell them the truth, they seem to find ways to spin it differently. BF-D-F-1

Comment: I have recently taught adults at the junior college level and I cannot imagine having one of your written decisions given to me to grade. Let me tell you, you have failed my classes, since I have put forth a decision for class work on how not to do research and what failures you are on ethics, language and your responsibilities as government employees. BF-D-A-10 and BF-D-L-9

Comment: Somehow I will find a way to ask my U.S. Congressman to retrieve your salaries because of malfeasance in office. For the uneducated, it means intentional wrong doing. How can you deny your incompetence and continual actions that promote you as a laughing stock of the entire U.S.? Are you so incompetent that you can't find jobs elsewhere rather than become snake oil salesmen? I'm amazed. BF-D-A-11

Comment: I give you further examples of your continued malfeasance...In the seventies, you were advised and carried a load of embarrassment into congressional hearings during the eighties about the abuse of employees by TVA management in direct violation of federal law. Now here we are today with the same boiler plate statement that TVA does not condone abuse over public health and safety. BF-D-A-12

Comment: I understand you boys are not concerned about money since your salaries will be paid regardless of whatever remarkably bad decision you produce. BF-D-A-7 and BF-D-L-6

Comment: And I pay particular attention to the so-called "official record" of the last meeting we had down here. Where you erased the part about how you would address the fuel issue that I questioned you on if you had the knowledge. Boys, it is time that you found new dictionaries and begin to read. The NRC takes its mission of protecting public health and safety and protection of the environment very seriously. BF-D-A-9 and BF-D-L-8

Response: *The NRC reviews applications and performs safety inspections in accordance with its regulations that are intended to protect public health and safety and the environment. The NRC takes its mission of protecting public health and safety and the environment very seriously. The NRC's Office of the Inspector General (OIG) was established as an independent and objective organization to detect fraud, waste, abuse, and mismanagement, and to promote economy, efficiency, and effectiveness in NRC programs and operations. The OIG Hotline (1-800-233-3497) is a convenient means of reporting specific incidents of waste, fraud, and malfeasance. The criticism is general in nature and provides no new and significant information; therefore, no changes were made to the SEIS text.*

Comment: I was told that the safety review meetings would be conducted in Washington, and I was not able to attend these. BF-D-E-6 and BF-D-K-6

Response: *All public meetings are announced in the Federal Register and on the NRC's website at http://www.nrc.gov/public-involve/public-meetings/index.cfm. Some technical meetings are held at NRC's headquarters near Washington, D.C., to best use limited agency resources. The NRC staff also conducts several safety inspections as part of its review of license renewal applications. Exit meetings regarding these safety inspections are typically held near the applicant's site and are open to the public. The comment provides no new and significant information; therefore, no change was made to the SEIS text.*

Comment: In 1993, when I found the infamous Memorandum of Understanding between TVA and NRC stating that the NRC would turn over to TVA management names of those raising safety issues to the NRC, I was embarrassed for you guys. And here we all are 12 years later and the practice in that agreement is still being carried out. Don't correct me. I know you cancelled the MOU, but you forgot to stop the practice. Do you boys here today know that TVA's record at the Department of Labor is the largest in the nation? And did you know that you have never been able to stop that abuse because of your refusal to do your job? BF-D-A-14

Response: *NRC treats TVA as it does any other licensee regarding safety allegations and individuals making safety allegations. The names of individuals are not disclosed unless the individual agrees that his name can be released. In some cases the name of the individual must be revealed to the licensee if the NRC is to pursue the allegation, abuse, and/or employee or management misconduct (for instance, if a person claims that a particular fitness for duty case was mishandled, the licensee may need to know the particular case in order to provide the appropriate information). In such cases the individual is asked to give their approval if the NRC is to go forward with the investigation. The comment provides no new and significant information; therefore, no change was made to the SEIS text.*

A.2.7 Comment Concerning National Environmental Policy Act (NEPA) Compliance

Comment: Page 1-5, paragraph beginning Line 39: This paragraph makes no mention of how TVA, being a federal agency, fulfilled its own NEPA obligations by preparing a supplemental Environmental Impact Statement for Browns Ferry License Renewal. As explained in a letter dated June 4, 2004, to NRC from TVA's Mark Burzynski, Manager of Nuclear Licensing, each of the 92 license renewal environmental issues listed in NRC's GEIS and summarized in 10 CFR 51, Subpart A, Appendix B, Table B-1, were reviewed by TVA's various subject matter experts that were involved in preparing TVA's SEIS and the subsequent Environmental Report submitted by TVA as part of its application for BFN license renewal. BF-D-M-2

Response: *The text in Section 1.2.2 has been changed to indicate that TVA prepared its own EIS, and the preparation of that document contributed to the process of identifying new and significant information. The comment provides no new and significant information; therefore, no change was made to the SEIS text.*

A.2.8 Comments Concerning Decommissioning

Comment: The NRC should evaluate the decommissioning trust fund balances for TVA's Browns Ferry units and how decommissioning will be impacted by extending the operating licenses of all three units. The NRC should also ensure that sufficient decommissioning funds would be in place in order to protect utility ratepayers and taxpayers. According to a General Accounting Office (GAO) report in 2003, all of TVA's nuclear power plants were found to be below the benchmark of sufficiency for decommissioning trust fund balances with the Browns Ferry units being among nuclear plants with the poorest decommissioning fund status. This is extremely problematic. BF-D-O-4

Response: *The Commission has determined the status of the decommissioning trust fund is outside the scope of the environmental analysis for license renewal. However, in response to the comment, the regulations in 10 CFR 50.75 establish the requirements for reporting the* *status of the licensees' decommissioning trust fund. On March 30, 2005, TVA submitted its most recent biannual decommissioning trust fund status report for BFN which is available online from ADAMS at http://www.nrc.gov/reading-rm/adams.html. The accession number for the status report is ML050940222. The TVA submittal will be reviewed by NRC staff for compliance with 10 CFR 50.75. NRC decommissioning cost-estimate formulas provided in 10 CFR 50.75(c) estimate that $1.37 billion would be required for radiological decommissioning. As of the end of 2004, TVA had $533 million in the decommissioning trust fund for BFN, which complies with the projected trust fund balance for this facility. Environmental impacts related to decommissioning are discussed in Section 7.0 of this SEIS. The comment provides no new and significant information; therefore, no change was made to the SEIS text.*

A.2.9 Comments Concerning Aquatic Ecology

Comment: In addition to an examination of general conditions at individual sample sites, the detailed assessment should include an analysis of any episodically poor water-quality conditions and specific conditions in bottom waters. For instance, if dissolved oxygen levels drop for extended periods of time at, or near the stream bottom in the reservoir within, adjacent to, or within the mixing zone downstream of the effluent/diffuser site; benthic-dwelling species, such as mussels, could be severely impacted or killed. If a toxic substance was released through the diffusers in the reservoir, benthic species near, downstream, or within the mixing zone of BFN would likely be adversely affected. These are the conditions, although sometimes short-lived, which may, nonetheless, exert profound effects on aquatic organisms' health and viability, particularly of non-mobile species such as mussels and other invertebrate fauna. BF-D-N-3

Response: *Plant operation is not expected to contribute to a reduction in dissolved oxygen levels at or near the bottom of the reservoir. Not only has this not been observed at BFN or at other nuclear power facilities, but no mechanism for the reduction of dissolved oxygen in a large volume of water near the reservoir bottom has been postulated. In any case, the applicant would be required to meet ADEM regulatory limits established in the NPDES permit. As addressed in Section 2.2.3, the permit specifies effluent limits for pH, total residual chlorine, oil, grease, biological oxygen demand, fecal coliforms, total suspended solids, temperature, naphthalene, and BTEX (i.e., benzene, ethyl benzene, toluene, and xylene isomers). Therefore, cooling water discharges through the diffusers would not be expected to adversely impact aquatic biota, even during episodic periods of low water quality within Wheeler Reservoir. Furthermore, the plume is buoyant and not near the bottom; therefore, there would be little or no impact to benthic organisms. Because they are able to close or clam-up, mussels tend to be tolerant of episodic events related to poor water quality. The ADEM also has the authority to modify the NPDES permit if it determines, through biological and/or water-quality monitoring, that more stringent limitations are necessary to ensure the protection and propagation of aquatic life in the Tennessee River. The comment provides no new and significant information; therefore, no change was made to the SEIS text.*

Comment: Quantify the diversity and abundance of organisms entrained by water withdrawal at all intake pipes and evaluate screening mesh size, low velocity intake, and other techniques to minimize entrainment. Quantification should occur at least monthly for the year of the study and for the year following screen changes. BF-D-N-12

Comment: We are concerned about uptake of aquatic organisms into the boiler reactor (sic) water by entrainment, including larvae and early life stages of federally protected mussels (if present), as well as other mussels, fish), phytoplankton, and zooplankton. Opportunities to divert fish from entrainment (e.g., strobe lights) and use of angled trash racks with sluiceways, and appropriate screens may mitigate for increased entrainment of larger fish and invertebrates, if incorporated into design plans. There may also be methods to minimize entrainment depending on depth of water withdrawal and location of water withdrawal structures. BF-D-N-4

Response: *Reducing the screen mesh size or reducing the intake velocity does not necessarily decrease the level of entrainment because most of the entrained organisms are small, passive creatures in the water column and would be entrained anyway. Additionally, decreasing the mesh size tends to increase the rate of impingement on the screens. The discussion on entrainment impacts presented in Section 4.1.2 is partly based on entrainment studies conducted at BFN from 1974 through 1979. During those years, entrainment samples were generally collected on a weekly basis between mid-March to late August (the period when fish eggs and larvae would be most abundant). Presentation of that information on a monthly basis would not have altered the conclusion presented in the SEIS that entrainment losses from the operation of BFN do not have a significant impact on the fish populations of Wheeler Reservoir. The permitting authority (ADEM) has determined that the current design is adequate and no mitigation is required. Any entrainment studies or design modification that may be required in the future to demonstrate compliance with EPA's Phase II performance standards (40 CFR Part 125, Subpart J) for intake structures at existing facilities would be under the review of ADEM, which has regulatory authority for the NPDES permit. The comment provides no new and significant information; therefore, no change was made to the SEIS text.*

Comment: Page 4-25, Lines 5 B 8: What is stated is correct, but it begs for an explanation of why the diffuser discharge temperature could be 0.3°F warmer for two-unit operation than for three-unit operation (both at EPU), even though three units obviously generate 50 percent more heat than two units. Although this is true, the maximum temperatures in the analyses correspond to open mode conditions creating a temperature of 90°F at the downstream end of the mixing zone (i.e., the NPDES limit). Since the plant releases less heat with two units than it does with three units, it can operate at higher ambient river temperatures (and thus a higher diffuser discharge temperature) with two units and still stay within the downstream mixing zone limit of 90°F. BF-D-M-36

Response: *The comment is noted, and text has been added in Section 4.1.5 to provide further explanation.*

Comment: These ratings can be deceptive, however, giving the impression that the mussels and other invertebrates found at these locations are the desirable, native fauna. As mentioned in the draft GEIS, Asiatic clams, an introduced exotic species, can dominate benthic environments, competing for food, nutrients, and space with native benthic organisms and may feed directly on native, unionid sperm, glochidia, and newly metamorphosed juvenile mussels. Since its first detection in the Tennessee River system in the early 1960s, the Asiatic clam has increased in number and spread throughout the entire Tennessee River system. These data should be reanalyzed to determine if TVA's assessment is an accurate measure of conditions for the native aquatic biota, or native Federally or State-listed species in or adjacent to these sampling sites. BF-D-N-1

Response: *The presentation of benthic macroinvertebrate monitoring scores (part of the Vital Signs Monitoring Program conducted by TVA) was only one component of the information presented in the SEIS that described the status of the aquatic biota within the Wheeler Reservoir area. The Vital Signs Monitoring Program evaluated the potential aquatic impacts from the operation of BFN that could be evaluated in an appropriate context with other perturbations to which native biota are exposed (e.g., impoundments and introduced species). The remainder of Section 2.2.5, the cumulative impacts discussion in Section 4.8 (particularly Sections 4.8.1 and 4.8.6), and the biological assessment (Appendix E) fully address the impact that both introduced species and impoundment of the Tennessee River, as well as other stressors, have had upon the native biota of the Tennessee River. The comment provides no new and significant information; therefore, no change was made to the SEIS text.*

Comment: If you raise the water temperature in the water, in the rivers and other stream, it can have an impact, a severe and negative impact upon the wildlife that deals with this water, and the fishery and all the other animals and mammals that is within that water. How far down stream that's going to affect, no one took the time to deal with. BF-D-F-8

Response: *The allowable discharge temperatures are regulated under the BFN NPDES permit issued by ADEM. The State specifies an area of the river called "the mixing zone" that defines a region of elevated temperature. Outside the mixing zone, temperatures are not expected to be detrimental to aquatic organisms. The maximum size of the mixing zone for BFN is approximately 117 ac (47 ha) and extends about 732 m (2400 ft) downstream from the discharge pipes. The potential impacts of discharge water temperatures on fish and wildlife were thoroughly evaluated in Section 4.1.4. This comment provided no new and significant information, therefore, no change was made to the SEIS text.*

Comment: Reinitiate the ichthyoplankton characterization study done between the years of 1974 and 1979, prior to startup of BFN and continue a similar type study during the initial years of operations of the proposed up-rate of BFN's Units 1, 2, and 3. BF-D-N-11

Response: *The licensee will be required to demonstrate compliance with the new 316(b) Phase II performance standards (40 CFR Part 125, Subpart J) at the time of renewal of its* *current NPDES permit. TVA may be required to modify portions of the BFN intake structure or cooling system, modify station operations, or take other mitigative measures as a result of these new regulations as part of the NPDES permit renewal. Presumably, TVA may also be required to initiate an ichtyoplankton monitoring program to demonstrate that entrainment losses are reduced to the applicable performance standards. The facility-specific requirements will be determined by ADEM at the time of NPDES renewal. Any future mitigation required by ADEM would likely reduce the impact of BFN on aquatic organisms. The comment provided no new and significant information; therefore, no change was made to the SEIS text.*

Comment: Boiler reactor (sic) water is subject to intense pressure, heat, and biocide treatment. The raw water intake for BFN is treated biannually with a molluscicide to control bio-fouling by zebra mussels and Asiatic clams. Raw water samples are taken biweekly during the months of April to September and analyzed for zebra mussels larvae as an early detection system aimed at reducing the potential bio-fouling of BFN's raw water intake structure. Without adequate screening and fish rack sluiceways, aquatic organisms taken up by entrainment into the intake pipe and subjected to such environment will be killed by these treatments. BF-D-N-5

Response: *Use of biocides to control zebra mussels and other bio-fouling organisms is minimized at BFN. The primary means of preventing bio-fouling in the cooling system is via the continuous recirculation of small sponge rubber balls that scrub the piping and condenser tubes.*

The intake structure is adequately screened to prevent the entrainment of fish and any other organisms larger than 0.95 cm (3/8 in.) from entering plant cooling systems. The effects of plant operation on the entrainment of fish and shellfish in early life stages, discussed in Section 4.1.2, were found to be a small impact even assuming 100 percent mortality of entrained organisms. The comment provides no new and significant information; therefore, no change was made to the SEIS text.

Comment: Hydrazine has been used to scavenge oxygen during blowdowns of cooling towers in an effort to help reduce oxidation from occurring in the towers. Discharges of this potential toxicant into the Tennessee River may cause more than detrimental effects to Federally listed mussels, if present, as well as many other aquatic organisms. The rate of degradation of hydrazine in water is highly dependent on factors such as pH, temperature, oxygen content, alkalinity, hardness, and the presence of organic material and metal ions. The toxicity of hydrazine increased for guppies in soft water (at pH<7.0) compared with the toxicity in hard water at pH ~8.0 (Slonim 1977), indicating increased persistence of hydrazine in soft, non-alkaline water such as that of Wheeler Reservoir (TVA 1971). Increased water temperature also enhances the toxicity of the compound for bluegills (Hunt et al. 1981) (htpp://www.inchem.org/documents.ehc/ehc/ehc68.htm#SectionNumbers:5.1). Because the Tennessee River at BFN's point of discharge is expected to have low alkalinity and elevated in-stream water temperatures due to BFN's thermal discharge, these conditions raise our concerns for the toxicity of hydrazine in the discharge, and its potential adverse effects on aquatic biota. BF-D-N-8

Comment: If hydrazine is determined to pose a risk to aquatic species (particularly mussels), eliminate discharge of hydrazine by designing a system for separating and containing hydrazine from all discharges to the Tennessee River/Wheeler Reservoir. BF-D-N-16

Response: *Hydrazine is currently used at BFN to control dissolved oxygen and thereby limit corrosion in two closed-loop systems: (1) in the auxiliary boilers, and (2) in the turbine building closed cooling water system (building heat). The only time the hydrazine can leave a closed system is during blowdown (i.e., a controlled release of pressurized hot water to allow replacement with clean water) or as the result of occasional leakage. However, hydrazine in the hot water system reacts very rapidly with the dissolved oxygen in the receiving turbine building sumps. Water from the sumps is processed by either the Thermex system or the Waste Filter/Waste Demineralizer prior to being routed to a monitored station outfall (DSN 001). During a past five-year period of monitoring, as required by a previous NPDES permit, no hydrazine was detected in the discharge from DSN 001, and the requirement to monitor releases for hydrazine was subsequently dropped from the current NPDES permit (issued February 1, 2001; expires January 31, 2006). The comments did not provide new and significant information; therefore, no changes were made to the SEIS text.*

Comment: If copper in bottom sediments appears to occur at concentrations above ecological risk levels, implement a plan to replace copper components at the plant with brass, titanium, or other typical replacement parts used by other nuclear power facilities to reduce copper. BF-D-N-17

Response: *The only significant source of copper in bottom sediments from nuclear plants is from brass cooling water condenser tubing. The original BFN Units 2 and 3 condenser tubing contained copper and has been replaced with stainless steel. The tubing in Unit 1 will have been replaced with stainless steel prior to the start of the license renewal term. The comment did not provide any new and significant information; therefore, no change ws made to the SEIS text.*

Comment: The toxicity of chlorine to aquatic life is a function of total residual chlorine (TRC), which includes both free chlorine and chloramines (Flora et al. 1984). Monitoring of free chlorine does not serve as an adequate indicator of the potential toxicity of facility effluents nor does it provide adequate data to avoid toxic effects to listed mussels. Therefore, TRC should be measured rather than free chlorine. BF-D-N-7

Comment: We are not sure what biocides are utilized at BFN; however, chlorine is often used in biocides. Chlorine is extremely toxic to a wide variety of freshwater organisms (Hunn and Schnick 1990). Safe concentrations (i.e., those that do not produce any lethal or sublethal effects) are likely much lower, especially considering the relatively sessile nature and long life span of mussels relative to these short-term test exposures. Under longer-term exposures (>96 hours), lethality to fish and aquatic invertebrates has been documented at chlorine concentrations between 3.4 and 26 ug/L (EPA 1985). Because chlorine extreme toxicity, the EPA established a Federal ambient water quality criterion maximum concentration of 0.019 mg/L and a continuous concentration (CCC) of 0.011 mg/L for chlorine, respectively, to protect aquatic life (EPA 2002). Studies have shown that mussels are very similar in sensitivity to other sensitive aquatic organisms and that 0.019 mg/L is likely protective (Ingersoll 2003). To meet these limits, a dechlorination unit or use of alternatives such as UV or ozonation could be utilized. Alternatively, high flow rate velocity flushes, ultrasound, or robotic mechanical cleaning devices could occur on influent and effluent pipes. BF-D-N-6

Comment: Reduce or eliminate discharge of chlorine to the Tennessee River through use of a dechlorination unit for removal of chlorine before discharge. If there is a discharge of chlorine, then at least monitor TRC daily. To provide adequate protection of aquatic life, the permit should establish EPA criterion chronic concentrations of 0.011 mg of TRC per liter as a permit limitation for continuous discharges and monitor it daily. If chlorine treatments are intermittent, the criterion for protection of aquatic life from acute toxicity can be substituted. Mechanical cleaning (e.g., robotic) and flushing controls should be considered as an alternative to chlorine. BF-D-N-18

Response: *The primary means of preventing bio-fouling in the cooling system is via the continuous recirculation of small sponge rubber balls that scrub the piping and condenser tubes. Chlorine is not used in the main cooling water system, but it is used in some of the much smaller service water systems. The resulting discharge chlorine levels are within applicable NPDES limits, which are protective of aquatic organisms. The comments provided no new and significant information; therefore, no changes were made to the SEIS text.*

A.2.10 Comments Concerning Terrestrial Ecology

Comment: Page 2-44, Paragraph beginning Line 37: To be more accurate, the second sentence should be revised to state, "There are numerous invasive plants in the area (TVA 2003a), of which TVA has identified 19 as high priority, including Chinese privet, Japanese honeysuckle, Japanese knotweed, and Nepal grass." Also, the scientific name is included parenthetically for some plants in this sentence but not for others, which is inconsistent. BF-D-M-12

Response: *The text in Section 2.2.6 has been changed based on the information on invasive species provided in this comment. Following the standard convention, the scientific name of a species is provided in parenthesis after the first use of the common name in each section. Several species listed in the paragraph were called out in the previous paragraph and the scientific name was not repeated.*

Comment: Mowing should be timed to avoid periods of nesting ground birds. BF-D-N-14

Response: *TVA removes low-growth vegetation on the transmission line corridors through bushhogging. TVA recognizes that this vegetation offers excellent nesting, brooding, escape, and shelter for various species of wildlife, including ground-nesting birds. Thus, scheduling is carefully designed for bushhogging activities to minimize impacts to species that might be using these areas. TVA maintains a policy of scheduling bushhogging activities before March 15 or after August 15. The comment provided no new and significant information; therefore, no change was made to the SEIS text.*

Comment: If herbicides are used, use Roundup Custom or Accord or similar low-toxicity, low-solubility herbicide, together with a low-toxicity surfactant such as LI700 or Agri-Dex in strict adherence to the label. Near streams and other water bodies, evaluate toxicity based on toxicity to aquatic species. BF-D-N-19

Response: *TVA selects herbicides based on the particular situation where it is needed, and is likely to vary depending on factors such as target species, and other considerations such as proximity to water bodies. All herbicide applications are performed under the supervision of licensed applicators, and product label instructions and use restrictions are carefully followed. The comment provided no new and significant information; therefore, no change was made to the SEIS text.*

Comment: Page 4-50, Sentence beginning Line 30: Clarification is needed. TVA does not work with its Right-of-Way (ROW) maintenance contractors to develop restrictions for the ROW contractors to follow; instead, TVA develops and establishes guidelines for the ROW contractors to follow. BF-D-M-48

Response: *The text in Section 4.6.2 has been changed based on the information provided in this comment.*

Comment: Periodically survey to determine if federally listed plant species have become established in rights-of-way. BF-D-N-20

Response: *TVA natural heritage staff regularly interact with natural heritage staff from all of the states within the TVA service area to identify new populations of rare or sensitive species within the TVA transmission line rights-of-way. The TVA natural heritage staff works with the TVA transmission line right-of-way maintenance organization to develop measures that will be protective of all of the unique or sensitive elements within the transmission line corridors. The comment provided no new and significant information; therefore, no change was made to the SEIS text.*

Comment: Page E-29, Line 30: The statement that "There is no broadcast application of herbicides" is not correct. TVA does use and expects to continue using broadcast and/or aerial herbicides in sections of transmission line rights-of-way where appropriate. BF-D-M-69

Comment: Page 4-27, Line 2: The statement that "There is no broadcast application of herbicides" is incorrect. TVA does use and expects to continue using broadcast and/or aerial herbicides in sections of transmission line corridors where appropriate. BF-D-M-39

Response: *The text in Section 4.2 has been changed to clarify that no broadcast herbicide applications are performed in Class 1 or Class 2 sensitive areas. Broadcast application of herbicides is permitted in areas not classified as sensitive. Although the text in Appendix E could be changed in the same manner, the Biological Assessment (BA) has already been submitted to the FWS and, therefore, will not be changed at this time.*

Comment: Page E-29, Paragraph beginning Line 23: The restriction class definitions vary depending on the type of maintenance and resource area being considered and do not necessarily agree with the simplified statements made here (see table of Class Definitions, pages E-562 and E-563 of Attachment E-6, Transmission Line Corridor Environmental Analysis, of the BFN License Renewal Environmental Report). BF-D-M-68

Comment: Page 4-26, Paragraph beginning Line 36: The restriction class definitions vary depending on the type of maintenance and resource area being considered and do not necessarily agree with the simplified statements made here (see table of Class Definitions, pages E-562 and E-563 of Attachment E-6, Transmission Line Corridor Environmental Analysis, of the BFN License Renewal Environmental Report). BF-D-M-38

Response: *The text in Section 4.2 has been changed to clarify the sensitive area classification system. Although the text in Appendix E could be changed in the same manner, the BA has already been submitted to the FWS and, therefore, will not be changed at this time.*

Comment: Page 4-50, Paragraph beginning Line 17: The following information updates that previously provided by TVA for Natural Areas crossed by transmission corridors or within 0.5 mile of the corridors. For clarity, it is recommended that the text specify the five transmission line corridors that were reviewed and note the ones with no Natural Areas. Note in particular that for Lines 23 and 24, the Duck River State Wildlife Management Area, the Duck River Unit 1 Proposed Designated Critical Habitat, and Elk River and Richland Creek are not appropriate to the scope of this document because these sites are not on the line segments shown on page 2-16 (i.e., only the first 23 miles of the 87-mile-long Browns Ferry to Maury line are included as applicable, and the sites are all on the last segments of the line).

Browns Ferry-Maury 500-kV (L6060), Alabama
- Philadelphia Glade (within 0.5 mile)
- Swan Creek State Wildlife Management Area (within 0.5 mile)

Browns Ferry-Trinity 500-kV (L6078), Alabama
- This TL corridor does not cross any Natural Areas
- Mallard-Fox Creek State Wildlife Management Area (within 0.5 mile)

Browns Ferry-Trinity 161-kV (L5054), Alabama
- This TL corridor does not cross any Natural Areas
- Mallard-Fox Creek State Wildlife Management Area (within 0.5 mile)

Browns Ferry-Athens 161-kV (L5055), Alabama
- This TL corridor does not cross any Natural Areas.

Browns Ferry-Union 500-kV (L6091)
- Mississippi-Natchez Trace National Parkway
- Canal Section Wildlife Management Area
- TN-TOM Lock D Pool Reservoir Reservation
- East Fork Tombigbee Macro Site
- John Bell Williams State Wildlife Management Area
- TN-TOM Lock E Pool Reservoir Reservation
- TN-TOM Waterway-Foxtrap Creek Ravine Potential National Natural Landmark
- Bear Creek Unit 2 Proposed Designated Critical Habitat
- Lake Lamar Bruce State Fishing Lake (within 0.5 mile). BF-D-M-47

Response: *The text in Section 4.6.2 has been changed to include the information provided in this comment.*

A.2.11 Comments Concerning Threatened or Endangered Species

Comment: Page 2-55, Lines 7 and 8: Delete the portion of the sentence after "drainage canals" which discusses "forested habitats." Gray bats don't normally use forested habitats unless along a stream. BF-D-M-23

Comment: Page 2-55, Line 32: It is not accurate to refer to the Morgan County station for Hart's-tongue fern as being in the southern portion of its range. This fern is highly disjunct, and while it has been found as far south as Mexico, it occurs nowhere in between the few AL/TN stations and Michigan. BF-D-M-24

Response: *The text was changed in Section 2.2.6 based on the information provided in these comments.*

Comment: Page 2-54, Lines 20 and 29: The statements in these two paragraphs about species being listed in various counties are potentially misleading, because they are threatened or endangered throughout their ranges, not just in these counties. BF-D-M-20

Comment: Page 2-55, Lines 1, 2, 13, 14, 23, 37, 38: Similar to the above comment on Page 2-54, Lines 20 and 29, the species discussed are threatened or endangered throughout their ranges, not just in these counties. BF-D-M-22

Response: *The text in Section 2.2.6 was changed to clarify that the listings apply throughout the species ranges.*

Comment: Page 2-54, Lines 24 and 25: The statement that "there is no known nesting habitat within 5 km (3 mi) of the site" is misleading because there is nesting habitat along the shoreline. A more accurate description would be that "although there is nesting habitat along the shoreline in the area around BFN, there are no known nests." BF-D-M-21

Response: *The text in Section 2.2.6 has been changed based on the information provided in the comment.*

Comment: Page 2-41, Lines 19-22: The Alabama cave shrimp discussion should be moved to the federal endangered species section. BF-D-M-10

Response: *The Alabama cave shrimp should have been included in the discussion of Federal listed species. The text in Section 2.2.6 has been changed based on the information provided in the comment.*

Comment: We remain concerned about BFN's practice of controlling vegetation in the transmission line rights-of-way at stream crossings, using mowing and herbicide applications to reduce the cover to herbaceous species. This modification to the natural vegetative cover may lead to erosion and sedimentation of streams. We are particularly concerned about this practice at stream crossings where Federally listed mussels may occur, specifically Bear Creek, the designated critical habitat for the Federally listed mussel, Cumberlandian combshell, *Epioblasma brevidens.* BF-D-N-10

Comment: At all stream crossings, especially where Federally listed mussels are known to occur, maintain or plant stream riparian areas with native shrub species and ensure that BMPs are installed to control erosion. BF-D-N-21

Response: *TVA includes protection of streamside management zones (SMZs) in their best management practices (BMP) for transmission line rights-of-way construction and maintenance. These BMPs include limiting the removal of vegetation canopy in SMZs, using extra caution with selection and application of herbicides and fertilizers, storing fuels and materials and maintaining vehicles outside of the SMZs, and regular inspections to control erosion. The staff believes that the applicant's program is sufficiently comprehensive to protect water quality of streams crossed by the transmission lines rights-of-way. The comment provides no new and significant information; therefore, no change was made to the SEIS text.*

A.2.12 Comments Concerning Groundwater Use and Quality

Comment: Page F-2, Table F-1, first item: The statement that BFN uses <100 gpm of groundwater is potentially misleading because BFN does not use any groundwater. BF-D-M-71

Response: *Appendix F contains a listing of all GEIS Category 1 and 2 issues not applicable to Browns Ferry. This issue is appropriately listed in the table specifically because Browns Ferry does not use groundwater. The comment provides no new and significant information; however, the SEIS text was changed to state that no groundwater is used at BFN.*

A.2.13 Comments Concerning Surface Water Use and Quality

Comment: Page 2-20, Line 6: Without any statement about the frequency of low flow at the plant, the assertion that the intake water flow encompasses a significant fraction of the daily average river flow can be somewhat misleading. Based on historical data, daily average river flows as low as the intake water flow occur less than 0.3 percent of the time, and daily average flows as low as three times the intake water flow occur only about 10 percent of the time. More specific values are stated in Section 4.1.1, Page 4-13, lines 28 B 30 (7Q10 of 8700 cfs in NPDES permit rationale). BF-D-M-8

Comment: Page 4-68, Lines 32-33: As noted in the comments for Section 2.2.2 Water Use, the statement about what is a "significant fraction" lacks a definition, and should be accompanied by a statement regarding the frequency of occurrence. BF-D-M-53

Response: *The text in this part of Section 2.2.2 and in Section 4.8.1 has been revised to include a reference to the 7Q10 value of 8700 cfs. The sentence has been revised to eliminate the imprecise phrase* "significant fraction."

Comment: Page 4-67, Bottom Paragraph beginning Line 30: This paragraph discusses the TVA Reservoir Operations Study (ROS). On Line 37 it is stated that "for all alternatives the existing minimum flow past the plant could be maintained." The cited reference is a TVA fact sheet entitled "Wheeler Reservoir Operations under the ROS Preferred Alternative." Although it is true that existing minimum flow past the plant could be maintained, this was not explicitly stated in the cited reference; rather, it states that "flow requirements also would be used to protect water quality and aquatic resources." Elsewhere in the ROS EIS (Chapter 3), data are provided showing that target minimum flows will be maintained. As noted in the comments for Section 2.2.2 Water Use, the target minimum flows for BFN were slightly changed by the ROS, and in some months are now slightly higher compared to the pre-ROS values. BF-D-M-52

Comment: Page 2-20, Lines 9 through 12: The stated minimum daily average flows (if sufficient water is available) were implemented via TVA's Reservoir System Operation and Planning Review of 1990, and these target values were in place at the time of NRC's March 2004 site visit to gather environmental information. The target minimum river flows for BFN are now slightly different as a result of the ROD for the Reservoir Operations Study (May 19, 2004). The target minimum daily average flows now are 10,000 cfs July through September (same as before); 11,000 cfs December through March (higher than before); and 7,000 cfs otherwise (higher than before). BF-D-M-9

Response: *The text in Section 2.2.2 has been revised to include the updated target minimum flow rates from the 2004 River Operations Study. The text in Section 4.8.1 has also been revised to include the updated information presented in the comment.*

Comment: Page 4-71, Line 32: All BFN potable water comes from Athens Water Services, which has the Elk River (not the Tennessee River) as its principal source. BF-D-M-54

Response: *The text in Section 4.8.5 has been revised to include the information provided in the comment.*

Comment: These and similar monitoring/sampling efforts by TVA are critical to ensuring that BFN's National Pollutant Discharge Elimination System (NPDES) permit limits, state water quality standards, and other environmental permit requirements are followed. Taken separately, the data suggests that there are relatively low or insignificant impacts occurring further downstream of the BFN site; however, a more detailed assessment is clearly necessary to evaluate conditions immediately downstream of the BFN site. BF-D-N-2

Comment: Monitor temperature, dissolved oxygen, alkalinity, pH, TRC, copper, and hydrazine at the downstream end of the mixing zone on a monthly basis to determine if modeling has accurately predicted concentrations. Target bottom waters at those times of the year that have historically produced the lowest river flow and warmest river water temperatures. BF-D-N-13

Response: *TVA has an ongoing program to monitor liquid effluents from the BFN site to demonstrate compliance with its NPDES permit, and the results of this monitoring are regularly reported. Parameters monitored, sampling locations, and sampling frequency are prescribed in the NPDES permit issued by the ADEM and are considered adequate to ensure water quality. The staff does not believe that additional monitoring is warranted, and if it were, it would be prescribed under the Federal Water Pollution Control Act through the NPDES permitting process. The comment provides no new and significant information; therefore, no change was made to the SEIS text.*

Comment: Conduct a formal risk assessment using EPA methods to assess whether concentrations are protective of sensitive fish and invertebrates, particularly federally listed mussels, if present. Include low-flow, high-temperature conditions in the risk assessment. BF-D-N-15

Response: *TVA performs all monitoring required to maintain compliance with the facility's NPDES permit, which is issued by ADEM. The NPDES permit includes limitations on various contaminants, and these limits are set at levels that are thought to be protective of aquatic organisms in the vicinity of the BFN site. The comment provided no new and significant information; therefore, no change was made to the SEIS text.*

Comment: In addition, the DGSEIS does not include complete information regarding the facility's CWA/NPDES compliance status.

According to EPA's records, Browns Ferry Nuclear Plant has reported non-compliance regarding total suspended solids and coliform during the last two years. EPA's records also show that the facility was issued a letter of violation/warning by the State with regard to the Clean Water Act on February 17, 2004. However, page 2-8, line 22 mentions that "operations will continue to meet regulatory limits established in the existing NPDES Permit." Page 2-21 discusses the Plant's relationship with ADEM and the NPDES Permit, but does not mention the compliance status nor the letter of violation. The Final GSEIS needs to include information regarding how the facility has been addressing the non-compliance issues. BF-D-P-2

Response: *The applicant reported that there have been several incidents of NPDES non-compliance in the areas of total suspended solids and total coliform concentrations. These incidents appear to be related to the large number of workers onsite supporting the restart of Unit 1. TVA and ADEM have addressed these issues, and the NPDES levels were revised in October 2003. After an event in December 2003 (the source of the February 2004 Notice of Violation) TVA installed aerators in the sewage lagoons onsite to decrease the coliform counts. There have been no NPDES violations since these aerators were installed. Text was added in Section 2.2.3 that explains how TVA has been addressing the non-compliance issues.*

Comment: Nuclear power plants have a wide impact on water quantity and quality. Nuclear power plants release radioactive contaminants and hazardous chemicals into surrounding water resources, contribute greatly to thermal pollution, negatively impact aquatic life, and require enormous volumes of water in order to operate than any other traditional form of energy production and use significantly more water than renewable energy technologies. Browns Ferry itself uses a tremendous amount of water. The SEIS mentions that with Unit 1 back online, the total water withdrawal for all three reactors at Browns Ferry would be 3171 million gallons per day. That is staggering. We disagree with the assumption that only a small amount of water is lost due to evaporation. Though the reactors have limited use of cooling towers, water consumption does occur and should be quantified. Further, in order to reduce the negative impacts to water supplies, year-round use of cooling towers or the technology to install permanent-use cooling towers should be investigated and implemented. The NRC needs to further study this issue to help reduce Browns Ferry's negative impacts to surrounding water resources and provide a more thorough analysis of the benefits to water use and quality from renewable energy supplies than is currently addressed in the SEIS. BF-D-O-5

Response: *The staff acknowledges that BFN withdraws a large amount of water from Wheeler Reservoir. It is a maximum of 139 m^3/sec (4907 cfs). Other than the water that is lost through evaporation during helper mode operation, all of the remaining water is returned to Wheeler Reservoir. Based on estimates provided in the GEIS (NRC 1996), the consumptive water use for a facility with 3900 MW(e) capacity would be between 2.0 and 3.4 m^3/sec (72 and 120 cfs) depending on the proportion of water sent to the cooling towers. This represents on the order of 1 percent of the flow by the plant based on the 7Q10. In general, the more water directed through the cooling towers, the greater the consumption loss. The comment provides no new and significant information; therefore, no change was made to the SEIS text.*

Comment: Page 4-53, Lines 22 B 24: The cited reference (Hopping 2004) discussed discharge temperatures but not specifically thermal stratification. However, it can be concluded from the information given that thermal stratification will also increase. Actually, reservoir stratification locally will be disrupted by mixing from the diffusers. As the flow moves downstream, stratification will be reestablished as the heat accumulates at the surface. Due to the larger amount of heat, the stratification will be larger than that before EPU. Any excess heat will escape to the atmosphere, and the stratification will slowly approach natural conditions as the flow continues further downstream. Far-field modeling reported in the Environmental Report for the BFN License Renewal Application indicates that surface temperatures in the forebay of Wheeler Dam will be, on the average, about 0.3°F warmer for three units at EPU (compared with three units at the originally licensed thermal power). On average, the flow reaches Wheeler Dam before natural conditions are fully reestablished. BF-D-M-50

Response: *The text in Section 4.7 has been revised to acknowledge that the Hopping 2004 reference does not specifically address thermal stratification. However, the discharge temperatures will continue to be regulated through the NPDES permit process, and the staff's conclusion regarding the issues has not changed. The comment provided no new and significant information.*

Comment: Page 4-14, Lines 6 and 7: This section is focused on makeup water, but the volume of water "consumed" by BFN (82 cfs, as stated on Page 4-13, Line 34) is much too small to ever threaten other uses of the large volume of water in Wheeler Reservoir (as stated on Page 4-13, Lines 39-41). Consequently, TVA would never derate the plant to mitigate water use conflicts. The concluding sentence of this section should be changed to state, "The staff determined that water-use conflicts would be SMALL and further mitigation measures are not warranted." BF-D-M-35

Response: *The text in Section 4.1.1 has been revised. The applicant has proposed derating the plant for mitigation of thermal releases, but not for water-use conflicts.*

Comment: These average flows are targets determined by a computer model that has been given certain data sets or variables based on historic flow data. If these variables are inaccurate or erroneous, the model would produce an artificial reading of forecasted water quality conditions and aquatic organisms would bear the consequences. Our concern is for the welfare of the aquatic species located in, near, and downstream of BFN's effluent plume. We understand TVA has committed to complying with NPDES permit requirements at BFN. However, we find it difficult to understand how BFN can manage bringing Unit 1 back into service and up-rate the three units, when under current operations and during hot weather events, BFN has difficulty meeting NPDES water temperature limits on a consistent basis with Units 2 and 3. Although a sixth cooling tower would aid in reducing condenser circulating water temperatures, we fail to see how BFN could operate all three units at 120 percent power production capacity during these hot weather/high water temperature periods of the year without de-rating or without creating additional cooling systems to cool heated water. It is unclear how these units could be up-rated if cooling capacity at BFN is insufficient. De-rating seems to be the only valid option in this case. Again, we have difficulty understanding the reasoning behind up-rating when, generally, the highest power consumption by the public occurs during the hottest weather periods of the year (i.e., as air conditioning use increases). BF-D-N-9

During hot weather, high-demand periods in July or August, TVA would be forced to request waivers from ADEM to exceed water quality standards and limitations for temperature designed to protect aquatic life. Such episodic violations are highly likely to occur in the future, especially during low-flow, drought years in the Tennessee River. As mentioned earlier, these critical periods of the year create difficult environmental conditions on the aquatic biota in the Tennessee River. Mussels may be especially vulnerable since the July to August period is when mussel metabolism increases and when dissolved oxygen availability decreases. Careful consideration of environmental impacts would need to be made by TVA as these events occur. We believe TVA should closely re-examine opportunities for thermal water storage and/or for storage of excess uptake water during high-temperature, low-flow conditions to prevent episodic lethal conditions for fish (including potential fish host of listed mussels) and invertebrates during such periods of high water use, even if water must be pumped from offsite locations. During such periods, there could be significant population-level effects on aquatic invertebrates and fish both near the discharge and downstream. BF-D-N-9

Response: *TVA plans to replace the sixth cooling tower, which, as stated in the comment, would partially mitigate for the increased thermal loading due to restart of Unit 1. The staff recognizes that during hot summer conditions, the applicant may request a waiver from ADEM. The staff is confident that ADEM will give appropriate consideration to the impact on aquatic organisms prior to issuing any waivers to the NPDES permit. Additionally, TVA has indicated that it would derate the plants when necessary to comply with the thermal limits imposed by the NPDES permit. The comment offers no new and significant information; therefore, no changes were made to the SEIS text.*

A.2.14 Comments Concerning Land Use

Comment: Page 2-65, Paragraph beginning Line 27: The acreage for Mallard-Fox Creek State Wildlife Management Area (WMA) is 1483 (all land acres). The acreage for Swan Creek State WMA is 8870 (3045 acres land; 5825 acres water). Both WMAs are managed by the Alabama Department of Conservation and Natural Resources, Division of Wildlife & Freshwater Fisheries, and both WMAs are used for waterfowl and small game hunting. (Info corrected from BFN License Renewal Environmental Report.) BF-D-M-28

Response: *The text of the SEIS was modified to reflect the information provided in the comment.*

A.2.15 Comments Concerning Cultural Resources

Comment: Page 4-40, Sentence beginning in Line 10: License Renewal by itself changes nothing with regard to historic properties. BF-D-M-44

Response: *The text in Section 4.4.5 has been changed to indicate that continued operation during the license renewal term could affect cultural resources.*

A.2.16 Comments Concerning Socioeconomics

Comment: Page 8-5, Line 22: The total TVA payment to Limestone County was $4,544,825 in FY 2002 and $4,566,727 in FY 2003. Not all of this, however, is attributable to BFN. The BFN portion of this payment was $2,008,723 in FY 2002 and $2,015,210 in FY 2003. Total county revenues are variable, causing the share to vary considerably from year to year. However, in FY 2002, the BFN portion of TVA's payment was 6.5 percent of the total county revenues of $30,758,933; in FY 2003, they were 10.03 percent of county revenues of $20,082,621. The 5.88 percent value quoted at the bottom of page E-209 of the Environmental Report is not correct. BF-D-M-56

Comment: Page 8-5, Paragraph beginning Line 36: Per the above comment, the property tax revenue equivalent from BFN is approximately 10 percent or less of total Limestone County revenues. BF-D-M-57

Response: *The text in Section 8.1.7 was changed to include the information provided in these comments.*

Comment: Page 2-66, Line 29: The referenced statement from TVA's SEIS for BFN License Renewal (TVA 2002a) states that "There are no Federal, State of Alabama, or local municipal noise standards, regulations or ordinances that apply to the action alternatives evaluated in this SEIS." Suggest re-wording the sentence beginning Line 29 to "Currently, there are no Federal, State, or local municipal noise standards or regulations that apply to BFN license renewal alternatives" or the equivalent. BF-D-M-29

Response: *The text in Section 2.2.8.4 was changed as suggested in the comment.*

Comment: Page 2-66, paragraph beginning Line 29: The sound level values used in this paragraph do not include the planned sixth cooling tower. A suggested improvement is to use the 6-tower calculated results from Section 4.3.19 of TVA's FSEIS for BFN License Renewal as bounding values. BF-D-M-30

Response: *The sound levels discussed in this paragraph are based on real measurements of ambient sound levels, which the staff believes is preferable to modeled results. In the previous paragraph, it was pointed out that the addition of a sixth cooling tower is expected to increase* *ambient sound levels by 1 to 2 decibels, which is comparable to the noise modeling results in the comment. The comment is noted, and no change in the text is required.*

Comment: Page 2-61, beginning Line 33: The sentence beginning on this line should be clarified to state that the "approximately 1200 persons" is for the BFN non-outage operating staff, and does not include the Unit 1 recovery workers. For example, the sentence could be changed to read, "BFN, which is the primary traffic generator in the vicinity of the site, currently averages a daily site non-outage population of approximately 3600 persons; of this total, 1300 is for the total Unit 2/3 operating workforce, and 2300 is for Unit 1 recovery." The sentence beginning in Line 35 could also be changed to read, "The operating unit population currently peaks at approximately 2200 during outages, which occur every 24 months (per unit) for approximately 2 months." BF-D-M-26

Response: *The text in Section 2.2.8.2 "Transportation" was changed based on the data provided in the comment.*

Comment: Page 2-68, Line 1: The 2 percent growth per year value referenced from the BFN License Renewal Environmental Report (TVA 2003a) cannot be confirmed. The correct annual growth rate is 1.5 percent, not 2. BF-D-M-34

Response: *The value expressed for employment growth in Limestone County had been rounded to the nearest whole percentage. The text of Section 2.2.8.5 has been modified to state the actual 1.5 percent expected growth rate.*

Comment: Page 2-67, Line 5: Delete the reference to 10-mile ring increments; TVA estimated the population only for 20- and 50-mile rings. BF-D-M-31

Response: *The text was changed in Section 2.2.8.5 as suggested in the comment.*

Comment: Page 4-37, Sentence beginning Line 10: This sentence appears to contradict itself regarding the existence or absence of refurbishment activities. Also, the permanent plant staffing will increase for Unit 1 operations. BF-D-M-40

Response: *The text in Section 4.4.2 was corrected to remove the contradiction, BFN plans no refurbishment activities.*

Comment: Page 4-39, Line 21: The license renewal staff is in Chattanooga and is temporary; currently only one license renewal person is at the site. BF-D-M-42

Response: *The draft SEIS text was referring to new staff added to support plant operations during the license renewal term, based on an assumption in the GEIS for a bounding scenario. The text in Section 4.4.4 has been changed to clarify the basis for these bounding scenarios, and the expected impact on local roadways.*

Comment: Page 4-39, Line 25: The number 1810 assumes 210 more vehicles on each road. If the traffic divides equally as stated, there would be 70 more vehicles on each road. BF-D-M-43

Response: *The total vehicles per day numbers in Section 4.4.4 have been corrected based on the bounding scenario regarding the number of expected future permanent workers at BFN.*

Comment: People are losing their jobs and there are people considering – no people, whole areas that are considering not even using TVA power now. BF-D-H-3

Response: *The comment is noted. The comment is not specific and is outside the scope of license renewal. The comment provides no new and significant information; therefore, no change was made to the SEIS text.*

Comment: Page 2-67, sentence beginning Line 13: In contrast to this statement, the ER on Page E-34 states that the AL growth rate is projected to exceed that of Lauderdale and Morgan Counties from 2000 to 2015. BF-D-M-32

Response: *The text in Section 2.2.8.5 has been changed to indicate that the population growth in all four counties (Lauderdale, Limestone, Madison, and Morgan) is expected to increase by greater than 10 percent between 2000 and 2015.*

Comment: Page 2-67, Line 37: The 24.5 percent value for Limestone County population growth between 1990 and 2001 is not recognized. It might have been based on an earlier population estimate. The correct change is 23.6 percent based on the most recently released (2004) U.S. Census Bureau county population estimates. BF-D-M-33

Response: *The text in Section 2.2.8.5 has been changed as recommended in the comment.*

Comment: Page 4-37, Sentence beginning Line 14: The assumed numbers are not understood. Permanent plant staffing will increase by approximately 150 for Unit 1 operations. BF-D-M-41

Response: *The basis for the analysis presented in Section 4.4.2 has been changed from 100 new jobs to 150 based on the information presented in the comment.*

A.2.17 Comments Concerning Human Health and Radiological Impact

Comment: If I get some of that nuclear radiation in me, I cannot get it out. It will affect me and my children and all the way down the line. BF-D-F-7

Response: *The NRC sets limits on radiological effluents, requires monitoring of effluents and foodstuffs to ensure those limits are met, and has set dose limits to regulate the release of* *radioactive material from nuclear power facilities. The regulations are intentionally conservative and provide adequate protection for the public including the most radiosensitive members of the population. TVA monitors its effluent and calculates an offsite annual dose caused by radioactive liquid and gaseous effluents. These calculations are performed to demonstrate the licensee's compliance with NRC regulations. As discussed in Section 2.2.7 of this SEIS, the actual annual doses to the public from operation of BFN are a very small percentage of these limits.*

TVA submits two annual reports for Browns Ferry to the NRC regarding environmental monitoring and environmental effluents. The Annual Radiological Environmental Operating Report (AREOR) and the Annual Radiological Effluent Release (ARER) Report are available to the public through the NRC's Public Document Room in Rockville, Maryland or from the NRC's Electronic Reading Room available online at http://www.nrc.gov/reading-rm.html. The NRC staff finds that the health risk to a member of the public from radioactive releases from a nuclear power plant to be very small. The comments provide no new and significant information; therefore, no changes were made to the SEIS text.

Comment: This torus started out – and I do believe it was financial gain, and they throwed safety out the window to get there. We had a man to get internally contaminated in there by these people, by instructing him to do the things the wrong way. I stopped two other gentlemen from doing the job. They stuck him in. He done it the way they wanted; he got internally contaminated. He has yet to get a report from NRC as to why these people didn't get disciplined for sending him in there like that. Why? I mean did the report not be sent to NRC, or is it just not been finished yet to get back with him. It was over eight or nine – well, close to a year now that he was internally contaminated under instructions by people that are still in that plant doing things in this manner. BF-D-C-10

Comment: Now what really was totally immoral and absurd that this nuclear industry from the uranium mining all the way to the making of plutonium avoids any responsibility when workers in the mines, Native Americans, on down the line, pipefitters, get cancer. They always claim that it had nothing to do with the exposure of those workers, and somehow have gotten by with this. There was a lawyer from Tennessee that represented indigenous Native Americans back in, I guess, the 70s who had their skin falling off, who had worked in the uranium mines. The industry denied any wrongdoing or any responsibility to help these people. BF-D-G-10

Comment: He inhaled radioactive particles or particulates and I cannot envision exactly how it happened, but I believe it was radioactive water or steam escaped into the air and he happened to be there at the wrong time, and he inhaled it...And if this industry is going to take the responsibility of what may befall him. He's just one out of a thousand workers who have not been in the reports because it isn't very good for the industry to admit that these things have happened, and no responsibility has been taken by the industry. BF-D-G-9

Response: *Impacts to uranium miners is outside the scope of this SEIS. Impacts associated with occupational exposure are addressed in Section 4.3. Without more information on the inhalation incident described by the commenter the staff is unable to respond specifically to the alleged contamination event. The Staff can provide some general comment on occupational exposure. Although radiation may cause cancers at high doses and high dose rates, currently there are no data that unequivocally establish the occurrence of cancer following exposure to low doses and dose rates, below about 0.1 Sv (10 rem). However, radiation protection experts conservatively assume that any amount of radiation may pose some risk of causing cancer or a severe hereditary effect and that the risk is higher for higher radiation exposures. Therefore, a linear, no-threshold dose response relationship is used to describe the relationship between radiation dose and detriments such as cancer induction. Simply stated, any increase in dose, no matter how small, results in an incremental increase in health risk. This theory is accepted by the NRC as a conservative model for estimating health risks from radiation exposure, recognizing that the model probably over-estimates those risks. Based on this theory, the NRC conservatively established a limit of 0.05 Sv/yr (5 rem/yr) in 10 CFR Part 20 for radiation doses to people exposed to radiation as part of their job, such as operating personnel at nuclear power plants.*

Nuclear power plant radiation protection and dose monitoring programs are regularly inspected by NRC health physics experts. In addition, the doses received by workers are required to be reported to the NRC and to the individual worker, and any dose exceeding the limits of 10 CFR Part 20 would have been investigated by NRC.

Many studies have been performed on the biological effects of radiation. None of the scientifically valid studies show any radiation effects at acute doses less than 0.1 Sv (10 rem), and the average dose to a nuclear power plant worker is much less than 0.01 Sv/yr (1 rem/yr). The NRC finds that the health risk from occupational radiation exposure to nuclear power plant workers is very small. The comment provides no new and significant information; therefore, no change was made to the SEIS text.

Comment: Page 2-57, paragraph at top of page: For aquatic monitoring TVA does not currently sample invertebrates, and terrestrial monitoring includes food crops, soil, and milk if applicable. BF-D-M-25

Response: *The text in Section 2.2.7 was modified based on the information in this comment.*

A.2.18 Comments Concerning Postulated Accidents

Comment: I have a comment about the groundwater. If NEPA does not require the worse case scenario to be examined or outlined, it seems like it would be a very nice courtesy of NRC and TVA to provide us with information as to what would happen. Say, like, back in 1975 when a candle started a fire. What would have happened or what could have happened if we did have a meltdown to the groundwater? It would be a courtesy. It is not legally required but... BF-D-G-1

Comment: And the possibility of accidents, even though they might be very remote, would be so catastrophic that we're going with this. BF-D-H-7

Response: *An accident resulting in contamination of the groundwater, although highly unlikely, could happen. However, groundwater contamination is generally slow moving, and most radioactive contaminants quickly combine ionically with clay particles in the soil. Furthermore, technology exists to clean up groundwater contamination. The effects of accidents are considered in both the environmental and safety reviews for license renewal. Postulated accidents, including design-basis and severe accidents, are addressed in Chapter 5 of this SEIS. The comments provide no new and significant information; therefore, no change was made to the SEIS text.*

Comment: As someone alluded to earlier about the Chernobyl factor and the Three Mile Island, we have not successfully cleaned up those areas. Those areas have been lost to our grandchildren and generations past them. It is something for us to consider. BF-D-F-4

Comment: Eighty-two percent of the kids born in Chernobyl over where Chernobyl is at in Russia, is born with birth defects. Eighty-two percent. And some of it could have been prevented. Maybe some of this can be prevented up here. This is definitely a safety issue that needs to be addressed. BF-D-C-4

Response: *The design of nuclear power facilities, such as BFN, in the United States, is very different from the Chernobyl facility design. Partial cleanup of the Three Mile Island (TMI) Unit 2 site has been accomplished. The unit is in long term storage and final cleanup of the facility is deferred until TMI Unit 1 permanently ceases operation, at which time both units will be decommissioned simultaneously. Also, since the TMI accident, there have been significant improvements in the safety of nuclear power plants in the United States, and BFN meets the Commission's current safety goals. As discussed in Section 5.0 of the SEIS, the likelihood of a severe accident at BFN is very small. This comment provides no new and significant information; therefore, no change was made to the SEIS text.*

A.2.19 Comments Concerning the Uranium Fuel Cycle and Waste Management

Comment: In all likelihood, license renewal at Browns Ferry reactors would exacerbate existing space issues regarding onsite spent fuel, and create 20 years' worth of additional, dangerous high-level waste, with no practicable or thorough means of securing it. The draft SEIS fails to evaluate the environmental impacts and security threat of indefinitely storing the additional irradiated fuel that will be generated over the 20-year license extension. Each reactor will create annually between 100 and 150 metric tons of additional irradiated fuel to the site. Despite the NRC's Waste Confidence Decision, the only site under consideration, Yucca

Mountain in Nevada, is far from a done deal. Numerous scientific questions remain about whether the site can safely store waste. Moreover, the Department of Energy (DOE) has not yet submitted its license application to the NRC, although the statutory deadline was more than two years ago. DOE was supposed to begin accepting waste in 1998 and is highly unlikely to meet its revised goal of accepting waste by 2012. Even if Yucca Mountain is opened, the site cannot hold the high-level radioactive waste that will be generated by existing reactors after 2010. Therefore, in addition to the waste generated by existing reactors, waste created by the reactors over the 20-year extension would also have to remain onsite for an indefinite period of time. The environmental impacts of indefinite storage must be thoroughly evaluated in the final SEIS. BF-D-0-8

Comment: It goes against common sense to plunge forward with this technology when we've had years to find this permanent repository or depository for the spent fuel. Science is wonderful, but it doesn't compare with common sense then it's not very useful. If you have a toilet that's clogged up, you don't keep using the toilet. BF-D-G-7

Comment: It was wrong then and it is wrong now. You all can do your job the very best you can, but that waste is still going to be there. And we don't have faith in the human race, if this is the only way to go. We are too short sighted. Everybody maybe thinks that the world is going to end tomorrow, but we don't know. We're supposed to be stewards. We don't know this. BF-D-H-10

Comment: The major problem with nuclear power has to do with storage of the waste. I don't think anybody has really figured in how much this is going to cost. I don't think they can. That's what makes nuclear power totally unfeasible. BF-D-H-6

Comment: One of the things mentioned in the study has to do with the economic impact. Well, the half life of plutonium is – what is it(?) 240,000 years? That's going to have to be guarded for that long. How can we rationalize this to our children, to the future? We don't even have a place to put it right now. BF-D-H-1

Comment: Based on the review of the DGSEIS, the document received a rating of EC-1, meaning that environmental concerns exist regarding some aspects of the proposed project. Specifically, protecting the environment involves the continuing need for appropriate storage and ultimate disposition of radioactive wastes generated onsite... The DGSEIS acknowledges that OL renewal of the Browns Ferry Nuclear Plant will require continuing radiological monitoring of all plant effluents. Appropriate storage of spent fuel assemblies and radioactive wastes onsite is required, in order to prevent impacts. Page A-11 discusses the Waste Confidence Rule (10 CFR 51.23), in which the Commission generically determined that the spent fuel generated by any reactor can be safely stored onsite for at least 30 years beyond the licensed operating life of the reactor. Ultimately, long-term radioactive waste disposition will require transportation of wastes to a permitted repository site. We note the information on pages 6-4 through 6-6 of the document, regarding the expected availability of Yucca Mountain as a geological repository for spent nuclear fuel and high-level waste. BF-D-P-1

Response: *The Waste Confidence Rule, found in 10 CFR Part 51.23, states that "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 onside 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." Onsite spent fuel storage facilities, and the associated storage casks, are licensed by the NRC and must meet standards set forth in 10 CFR Part 72. The comments provide no new and significant information; therefore, no change was made to the SEIS text.*

Comment: I think more people would be here tonight if these kinds of issues were in the newspaper, if the politicians didn't stifle this information, which I know does happen. If you start talking about transporting this highly radioactive material across the country to Utah or out west to the Rocky Mountains, there are going to be people in those states that are going to not be happy. That's already been proven to be true. And they're going to see people very worried about the security of that transported waste. BF-D-G-8

Response: *Transportation of radioactive material across the country presently occurs on a daily basis. The regulations applying to transportation of radioactive materials are provided by the U.S. Department of Transportation and are found in 49 CFR Parts 171-177 and NRC regulations are found in 10 CFR Part 71. These regulations have been and will continue to be adequate to protect public health and safety and take into account public presence in the vicinity of waste shipments and the possibility of malevolent acts. The comment provides no new and significant information; therefore, no change was made to the SEIS text.*

Comment: Also, the issue of radioactive waste from this plant, I would like to have a history of where this waste has gone, what kind of waste has gone where, where is it going now, how much of it is still stored on the site. A lot of people don't understand that we have a nuclear waste ground right here in our back yard. And somebody are naive and oblivious to the realities of this technology. BF-D-G-4

Response: *Section 2.1.4.3 of this SEIS states that, "During the period from 1999 to 2002, generation rates for radioactive solid wastes from routine operation and maintenance activities at Units 2 and 3 ranged from 514 to 654 m^3 (18,200 to 23,100 ft^3) per year." The total amount of low-level radioactive solid waste generated in 2003 and 2004 was 594 m^3 (21,300 ft^3) and 460 m^3 (16,200 ft^3) respectively. During the period from 1999 to 2002, Units 2 and 3 made 133* *shipments of solid radioactive waste with a total activity of 3.0 x 10^{13} Bq (820 Ci). Dry active waste was sent to Envirocare in Utah; spent resins were sent to Barnwell, South Carolina."*

Based on a two-year refueling cycle at the proposed EPU power level, each unit will produce spent fuel waste that, if it could be formed into a cube, would have a total volume of approximately 4.3 m^3 (152 ft^3) per year, or approximately 1.6 m (5.2 ft) on a side. The spent fuel does require more volume for storage than this estimate because the fuel is contained in long fuel rods, and is currently stored in the spent fuel pools on site. TVA is currently constructing an Independent Spent Fuel Storage Installation (ISFSI) at BFN for dry storage of spent fuel until a permanent repository is available. The comment provides no new and significant information; therefore, no change was made to the SEIS text.

Comment: Page 2-62, Line 20: Since DOE (eventually) takes responsibility for spent fuel at the nuclear plant site boundary, TVA will not be involved in spent fuel shipments past that point. As a suggestion, the words "TVA plans to" could be changed to "DOE may." BF-D-M-27

Response: *The text in Section 2.2.8.2 was changed to indicate that the rail spur might be used for dry cask removal, without assigning those plans to TVA.*

A.2.20 Comments Concerning Alternatives

Comment: Aren't most people getting away from nuclear power? Renewable energy sources. If we had just put the money that we poured in to nuclear power toward renewable energy sources and conservation. We don't do squat with conservation. We could save billions and billions of dollars just with conservation. BF-D-H-5

Comment: There are alternatives. There are answers to clean air other than nuclear power. We have incentives for solar power and conservation. There's nothing out there now. Jimmy Carter had great programs going for getting people into renewable energy sources. We're not doing any of that now. We can come up with solutions that are safe that the generations ahead of us are not going to have to take care of and guard and be afraid of. This is what is just wrong. It is morally wrong what we're doing. BF-D-H-8

Comment: Are we moving over to a more efficient form of energy? BF-D-D-3

Comment: The problems associated with short- and long-term handling of storage of nuclear waste far outweigh the short-sighted continuation of this astronomically expensive and dangerous technology, when we should be committing money to renewable and sustainable alternative energy sources, such as photovoltaics and wind power. Which, when paired with conservation, is a much more logical solution to our energy needs. BF-D-G-12

Response: *The SEIS for BFN presents the staff's analysis of the environmental impacts of the proposed action (i.e., renewal of the operating licenses for Browns Ferry) and of reasonable* *alternatives. These impacts are presented in discrete resource areas so that environmental impacts can be compared between the proposed action and reasonable alternatives. The SEIS is not an evaluation of the best combination of energy generation sources for the Alabama area, or a determination regarding which combination would result in the least overall environmental impacts. The decisions regarding which generation sources to deploy are made by the applicant and State agencies, not the NRC. The viability of the various alternatives to renewal of the operating licenses for BFN is pertinent to the discussion of alternatives to the extent that an alternative is considered reasonable. However, the staff recognizes that although some alternative energy sources, when considered by themselves, may not be viable replacements for BFN, these alternatives could be part of a combination of generation sources that could replace BFN. The many possible combinations could include combined-cycle, gas-fired plants, clean-coal plants, renewable energy sources such as wind and solar power, and energy conservation. One possible combination is discussed in Section 8.2.7. The comments provide no new and significant information; therefore, no change was made to the SEIS text.*

Comment: Page xx, Line 15: The statement is made that power generation alternatives are evaluated assuming that the replacement power generation plant is located at either the BFN site or some other unspecified alternative location. In contrast, Chapter 8 follows material supplied in TVA's Environmental Report, which analyzes four different types of alternative power plants, all of which are analyzed at specified locations and none of which (for stated reasons) are at the BFN site. BF-D-M-1

Response: *The statement in the Executive Summary has been modified to be consistent with the analysis in Chapter 8.*

Comment: The SEIS does not provide a thorough review of energy alternatives or technologies. Some data appears out of date and should be revisited using the most current information from independent sources, not just directly from TVA. Further, it is hard to understand how renewable energy technologies, like biomass, solar, and wind, which are not likely to be targeted by terrorists nor have the capacity in terms of accidents to kill thousands of people or permanently contaminate large land areas, can be assessed by the NRC to have a large environmental impact while relicensing all the reactors at Browns Ferry is considered to have a small impact. This assessment flies in the face of common sense. BF-D-O-7

Response: *Alternative energy production technologies are evaluated in Chapter 8. None of the technologies listed in the comment were determined to be viable alternatives for replacement of all of the power generated by BFN, and therefore, the potential environmental impacts of these technologies were not fully evaluated. Furthermore, malevolent acts, such as terrorism, are beyond the scope of NEPA. The comment provides no new and significant information; therefore, no change was made to the SEIS text.*

Comment: According to a recent study by the Renewable Energy Policy Project, called Powering the South: A clean and affordable energy plan for the Southern United States, Alabama has the ability to significantly reduce electricity consumption through existing, affordable energy efficiency measures. If these measures were adopted, by 2020 Alabama could: save 29 MWh of electricity; reduce electricity demand by 23 percent; and reduce net electricity costs by $651 million. Reducing energy demand and use saves not only money but also precious water resources. Further, less nuclear waste would be generated. More recent energy efficiency and conservation measures should be studied and implemented before permitting the relicensing of Browns Ferry's three reactors or the restart of Unit 1. TVA has excellent wind resources within its service area. In fact, they have approximately 29 MW of wind currently installed. TVA should be encouraged to invest more in developing this clean, safe energy resource instead of spending billions of dollars on the costs of restarting Unit 1 and extended operation of all three nuclear reactors. There is also potential for biomass energy production in Alabama and TVA's service territory. Clean forms of biomass represent a homegrown energy source that can provide local jobs to rural areas that would also support farmers and the region's economy, while helping expand renewable energy technologies. The use of solar technologies, such as photovoltaics and solar thermal systems, are not as cumbersome or difficult as reflected in the SEIS. The Rancho Seco nuclear plant, which is now closed, provides an example of the land availability at existing nuclear plants. There was minimal information in the SEIS on these options. BF-D-0-9

Response: *The alternative energy production technologies discussed in this comment are evaluated in Chapter 8 of the SEIS. Although these technologies are worthy of consideration, and are valuable parts of the overall electrical power production system in the United States, none was determined to be a viable replacement for the power generated by three BFN reactors. The 29 MW of wind-turbine power referenced in the comment represents less than 1 percent of the BFN electrical power production. Replacing all of the BFN electrical power with wind generation would require many thousands of acres for turbine placement and transmission lines. The other technologies mentioned also would result in significant land disturbance, or other adverse effects if developed to fully replace the power generated by BFN. The comment provided no new and significant information; therefore, no change was made to the SEIS text.*

Comment: Page 8-6, bottom paragraph: These potential negative and disproportionate impacts could apply to secondary job losses (such as retail, services, etc.) but not to direct BFN job losses. BF-D-M-58

Response: *The text in Section 8.1.10 has been changed to reflect this comment.*

Comment: Page 8-40, Table 8-8, Impact Category of Land Use: The "Impact" is listed as MEDIUM to LARGE and the "Comment" statement is made that "additional land-use impacts would occur for uranium mining." Currently, BFN has fuel contracts to use blended-down surplus highly enriched uranium; these do not involve any uranium mining, and it is likely that an ABWR at Bellefonte could use the same fuel, especially if BFN was discontinued. BF-D-M-64

Response: *The statement in Table 8-8 under Land Use has been changed from "would occur" to "might occur." The same change to the text was made under Land Use in Section 8.2.4.*

Comment: The paragraph on Delayed Retirement is not consistent with the following statements made by TVA in a May 27, 2004 letter to NRC transmitting additional Information for "License Renewal Environmental Review" from Mark Burzynski, Manager of Nuclear Licensing: "TVA has no schedule for retiring current generating units. TVA is adding environmental controls and maintaining the existing units as necessary to keep them running. TVA has no retired fossil units that would be considered for restarting." Please delete all references to TVA fossil plants being slated for retirement. BF-D-M-65

Response: *The SEIS text in Section 8.2.6.10 has been modified to reflect the statement made in the May 27, 2004, letter.*

Comment: Page 8-2, Paragraph beginning Line 7: Suggest re-ordering these options, from the most likely to the least likely, which would be (3), (2), (1), or (4). Spelled out, this would be as follows: Under the no-action alternative, replacement of BFN electricity generation capacity would be met by (1) TVA generating alternatives other than BFN, (2) power purchased from other electricity providers, (3) demand-side management (DSM), or (4) some combination of these options. BF-D-M-55

Response: *The text in Section 8.1 has been modified to reflect this comment.*

Comment: Page 8-54, Table 8-10, Impact Category on Air Quality: The air emissions values listed are approximately 80 percent of the values listed in Table 8-6, which were the values stated by TVA for seven 510 MW units. BF-D-M-67

Response: *The values in Table 8-10 have been corrected, and they are based on six natural gas, combined-cycle power plants.*

A.2.21 Editorial Comments

Comment: Page 2-4, Line 26: The sentence beginning on this line would be clarified if it was changed to read, "Each unit was originally licensed for an output." BF-D-M-4

Comment: Page 2-7, Line 7: Please check the number 8.75; this should possibly be 8.66. BF-D-M-5

Comment: Page 4-26, Sentence beginning Line 15: Change "will be required if the proposed action" to "will be required whether or not the proposed action." BF-D-M-37

Comment: Page 4-66, Line 12: The word "municipal" on this line appears to be an error; the intended word may be "industrial." BF-D-M-51

Comment: Page 2-46, Table 2-3, Line 10: The table caption would be more accurate as "Federally Listed Terrestrial Species Reported from Counties Associated with the Browns Ferry Nuclear Plant Site and its Transmission Line Corridors." BF-D-M-14

Comment: Page 2-53, Table 2-5, Line 1: The specific epithet for white walnut is *cinerea.* BF-D-M-19

Comment: Page 2-49, Table 2-4, Line 29: The specific epithet for dwarf filmy fern is *petersii.* BF-D-M-16

Comment: Page 2-50, Table 2-4, Line 3: The specific epithet for prairie trillium is *recurvatum.* BF-D-M-17

Comment: Page 2-50, Table 2-5, Line 10: The table caption would be accurate as "Mississippi State-Listed Terrestrial Species Reported from the Vicinity of the Browns Ferry Nuclear Plant and Associated Transmission Line Corridors." BD-D-M-18

Comment: Page 2-47, Table 2-4, Line 5: The table caption would be more accurate as "Alabama State-Listed Terrestrial Species Reported from the Vicinity of the Browns Ferry Nuclear Plant and Associated Transmission Line Corridors." BF-D-M-15

Response: *The text of the SEIS has been modified.*

Comment: Page E-25, Line 36: As noted earlier, the use of the word "committed" could invite confusion with regulatory commitments. A more accurate characterization would be as follows: "As reflected in the Record of Decision for the TVA Final Environmental Impact Statement for BFN License Renewal (Federal Register Vol. 67, No. 117, pp. 41565-41569, June 18, 2002), TVA's decision was to adopt the agency-preferred alternative to refurbish and restart BFN Unit 1, to proceed with NRC license extensions for all three units at BFN, and to construct a single 20-cell linear mechanical draft cooling tower in the currently vacant position (tower 4) where a tower that was destroyed by an accidental fire in 1986 was never replaced. Regardless of the schedule for power uprates on any unit, the 6th tower is scheduled for completion prior to the first summer following Unit 1 restart." BF-D-M-72

Comment: Page 2-19, Line 22: The statement is made that "TVA has committed to rebuild the sixth cooling tower." To avoid any potential confusion with regulatory commitments, please replace the referenced statement with the following sentence: "As reflected in the Record of Decision for the TVA Final Environmental Impact Statement (Federal Register Vol. 67, No. 117, pp. 41565-41569, June 18, 2002), TVA's decision was to adopt the agency-preferred alternative to refurbish and restart BFN Unit 1, to proceed with NRC license extensions for all three units at BFN, and to construct a single 20-cell linear mechanical draft cooling tower in the currently vacant position (tower 4) where a tower that was destroyed by an accidental fire in 1986 was never replaced. With EPU of Units 2 and 3 at 120 percent of the originally licensed power level and the rebuilding of this tower, the consumptive use of cooling water would therefore increase." BF-D-M-7

Response: *Section 2.2.2 has been modified to state that the restart of Unit 1 will require construction of a sixth tower. This is consistent with the licensee's 2004 Unit 1 Extended Power Uprate Environmental Report. The text in Appendix E was not changed because the BA had already been submitted to the FWS.*

Comment: Page 1-6, Line 6: The phrase "and its support organization" is not understood. To whom or what entity does this refer? BF-D-M-3

Response: *The comment is noted, and the text in Section 1.2.2 has been changed.*

Comment: Page 2-7, Line 18: The number 7800 is correct but TVA 2003a may not be the correct reference (source). BF-D-M-6

Response: *The comment is noted, and the text in Section 2.1.3 has been changed to include the appropriate reference.*

Comment: Page 2-44, Line 14: The *Cornus* spp. parenthetic should be changed to *Cornus florida*. BF-D-M-11

Response: *The text in Section 2.2.6 has been changed based on the information provided in this comment.*

Comment: Page 2-45, Line 5: The scientific name for black willow (*Salix nigra*) is not provided. BF-D-M-13

Response: *The scientific name for black willow was provided on page 2-44, line 25 of the DSEIS. The scientific name is provided only once in a section immediately after the first usage of the common name of the species. This comment resulted in no change in the text.*

Comment: Page 4-49, Line 16: To be more accurate, this sentence should be corrected as follows: "candidate species) that occur or historically have occurred in either Wheeler Reservoir." BF-D-M-45

Response: *The comment is noted, and the text in Section 4.6.1 has been changed.*

Comment: Page 4-49, Line 30: To use correct terminology, replace the phrase "Each sensitive area review project" with "Each proposed transmission line vegetation management project." BF-D-M-46

Response: *The comment is noted, and the text in Section 4.6.1 has been changed.*

Comment: Page 4-53, Line 9: As written, this sentence may be misleading. With the new condensers and other changes the total intake flow when Unit 1 is restarted will be higher than for previous three-unit operation. BF-D-M-49

Response: *The text in Section 4.7 has been changed to include the fact that the flow with the new condenser tubes is greater than the original three-unit flow, but the extended power uprate (EPU) will not result in an increased flow rate.*

Comment: Page 8-17, Line 31: TVA projects that the total number of workers would exceed 500 for approximately 2 1/2 years (see TVA's Environmental Report for BFN License Renewal, Page E-289, paragraph under Socioeconomics). BF-D-M-60

Response: *The text in Section 8.2.1.1 of the SEIS has been modified.*

Comment: Page 8-36, Sentence beginning on Line 2: This sentence appears to contradict itself; it may have too many negatives. BF-D-M-62

Response: *The text in Section 8.2.3.1 of the SEIS has been modified.*

Comment: Page 8-36, Sentence beginning on Line 32: This sentence is not clear; words may have been omitted, or it might contain grammatical errors. BF-D-M-63

Response: *The text in Section 8.2.1.1 of the SEIS has been modified.*

Comment: Page 8-53, Line 29: Suggest spelling out DSM (Demand-Side Management). BF-D-M-66

Response: *Demand-side management was defined on page 8-2; no change in the text was required.*

Comment: Page 8-32, Table 8-6, Impact Category for Air Quality: The stated quantities of air emissions are the values reported in Section E.7.2.2.1 of TVA's Environmental Report for BFN License Renewal, but they are based on seven NGCC plants. In Section 8.2.3 on Page 8-31 of NRC's SEIS, the statement is made that eight NGCC plants would be needed. BF-D-M-61

Response: *Section 8.2.3 has been revised. The analysis is based on seven replacement natural gas, combined-cycle power plants rather than eight.*

A.2.22 Comments Concerning Issues Outside the Scope of the Environmental Review for License Renewal: Aging Management, Blended Low Enriched Uranium Fuel, Cost of Power, Operational Safety, Restart of Browns Ferry Unit 1, and Safeguards and Security

Aging Management

Comment: If there is any possibility of premature aging of any of the containment vessels as discussed above, TVA should be required to determine by scientific measurement the structural soundness of each reactor containment vessel using non-invasive techniques or whatever method is available. If these techniques do not exist, TVA should be required (before license approval) to develop the techniques and undertake the testing and analysis to determine and be able to assure the local public and the NRC that there is no danger of containment vessel failure. BF-D-E-9 and BF-D-K-9

Response: *Various structures and components are inspected as part of the license renewal process. These include passive structures and components that perform an intended function without moving parts or without a change in configuration, change in properties, or change of state. These may include structures and components that are classified as inherently reliable under the Maintenance Rule (56 FR 31324, July 10, 1991 as amended), or structures and components for which aging degradation is not readily monitored. In addition, inspections of long-lived structures and components that are not subject to replacement based on a qualified life or specified time period are required for license renewal. For further information on the requirements for license renewal inspections, please refer to Inspection Procedure 71002, "License Renewal Inspection," which can be downloaded from the NRC website at http://www.nrc.gov.*

Comment: What has the NRC done to assure and how does the NRC know that the reactor containment vessels at the facility are structurally sound and capable of safe operation for 20 years beyond their "designed to" life? BF-D-E-7 and BF-D-K-7

Response: *NRC's ongoing reactor oversight program focuses on prevention of safety problems so that potential issues like aging and thermal shock do not lead to accidents and subsequent environmental impacts. The intent of the NRC's safety review is to determine if the licensee has adequately demonstrated that the effects of aging will not adversely affect any systems, structures, or components identified in 10 CFR 54.4. The safety review process includes site inspections to assess whether the applicant has implemented and complied with the regulations for license renewal. The inspection teams comprise technical, program, and operational experts from the NRC and its consultants. For a license renewal review, teams of specialized inspectors travel to the reactor site at least twice and sometimes three times to verify whether the effects of aging will be managed such that the plant can be operated during the period of extended operation without undue risk to the health and safety of the public. The review results reside in a publicly available safety evaluation report available online at http://www.nrc.gov. The comment provides no new information and, therefore, will not be* *evaluated further in the context of the environmental review. However, the comments will be forwarded to the project manager for the license renewal safety review for consideration.*

Comment: Before approval is granted by the NRC to extend reactor life by fifty percent, at least the following should be done as a minimum: TVA should report the total number of automatic shutdowns that have occurred at each Browns Ferry reactor during its operation. The NRC should investigate (and report to the public about) the reportable occurrences, automatic shutdowns, or other safety violations which have occurred at each reactor including the significance of these events relative to the safe operating lifetime of the reactors. BF-D-E-8 and BF-D-K-8

Comment: The only response I received from the NRC relative to my comments was that the issue I raised was a safety issue and would be part of the safety review and not part of the environmental review....Hopefully, this issue was dealt with during the safety review, and there is someone at today's meeting that can discuss this and explain the results of the safety review and how the above concerns have been resolved. BF-D-E-5 and BF-D-K-5

Comment: I believe that there have been a significant number of automatic shutdowns of the three Browns Ferry reactors. If that is the case, and if what I read about the effects of these events is true, this of major concern to anyone living in this area or downwind. There is the possibility that one or more of the Browns Ferry containment vessel structures have been weakened and prematurely aged. This could pose a serious threat for the people of the Tennessee Valley, especially considering that the TVA and NRC are in the process of extending the operation of all three reactors fifty percent beyond their "designed" to operational life. BF-D-E-10

Comment: During the ten years of initial operation, TVA was plagued by an amazingly large number of reportable occurrences...Over a period of less than four months in the fall of 1980, there were 66 reportable occurrences at the three units or more than one every two days at Browns Ferry facility. These events were fairly evenly distributed among all three reactors (Unit 1 had 23, Unit 2 had 21, and Unit 3 had 22).

If operation during the above time period was typical of Browns Ferry operation over the first ten years, then more than two thousand reportable occurrences would have occurred at Browns Ferry in the first ten years of operation. I couldn't determine at the time how many of the reportable occurrences had resulted in SCRAMS or automatic shutdowns of the nuclear reactor, but my understanding at the time was that automatic shutdowns often occurred.

During the 80s, I read a lot about nuclear power generation. I learned that when an abnormal event triggers an automatic shutdown, it is somewhat of an emergency process. This process is designed to shut down the reactor much more rapidly than when the reaction is shut down using normal operating procedures. The faster-than-normal cooling of the reactor containment structure thermally shocks the structure resulting in great stresses throughout the structure with the disturbing potential of weakening it. Reportedly, this could result in premature aging of the containment structure. BF-D-E-3 and BF-D-K-3

Comment: At that time I raised concern about the safety of the containment structures for the three units as a result of the containment vessels being thermally shocked through repeated automatic shutdowns of the reactor units. I had previously raised this issue with TVA when it requested public comment concerning extending the life of the three reactors in 2001. I received no response from TVA concerning my comments. BF-D-E-1 and BF-D-K-1

Response: *As part of the NRC staff's safety review, the integrity of the reactor pressure vessel and torus are subjected to a rigorous safety assessment. The effects of pressure and thermal shock resulting from a scram is not as significant for a boiling water reactor because of the large steam volume of the primary system. Furthermore, the number of scrams in recent operating history of BFN Units 2 and 3 is less than suggested by the comments. In the period 1999 through 2004 there were eight unplanned scrams on Unit 2 and four on Unit 3. NRC's ongoing safety program focuses on prevention of safety problems so that potential issues like aging and thermal shock do not lead to accidents. To the extent that the comments pertaining to safety of equipment and aging are within the scope of license renewal, these issues will be addressed during the parallel safety analysis review performed under 10 CFR Part 54. Operational safety issues are outside the scope of the environmental review and will not be evaluated further in this SEIS. The comments provide no new and significant information; therefore, no changes were made to the SEIS text. However, the comments will be forwarded to the project manager for the license renewal safety review for consideration.*

Comment: And during relicensing are there any top priority issues in the maintenance and infrastructure of any of the nuclear power plants? Specifically, Browns Ferry Nuclear Power Plant in Limestone County, Alabama; Sequoyah Nuclear Power Plant, Dekalb and Jackson County; and Joseph M. Farley Nuclear Power Plant of Houston and Henry County. And if so, are any of them manufactured issues waiting to transition over to a newer, better, more advanced technology. BF-D-D-2

Response: *Normal maintenance issues at BFN are evaluated during the regular, routine inspections of the plant and plant operations. Infrastructure and other changes that could reduce core damage frequency were evaluated as part of the severe accident mitigation alternatives (SAMA) review, and summarized in Chapter 5 of the SEIS. The SAMA review found that none of the candidate SAMAs were cost-beneficial. The SEIS only considered potential environmental impacts at the BFN site, and did not consider other reactor sites. The comment provided no new and significant information; therefore, no change was made to the SEIS text.*

Blended Low Enriched Uranium Fuel

Comment: I want to know if your comments that you would address the issue on the fuel is on the record this time. BF-D-A-19

Comment: In a letter dated August 27, 2003, addressed to the Director of the Office of Nuclear Material and Safeguards, which is at the NRC, Framatome began the letter and wrote, and I quote. "As discussed with Mr. Peter Lee of the Fuel Cycle Facilities Branch and various other NRC staff members during a meeting with FANP representatives at your headquarters on July 21, 2003, FANP is planning facility modifications at its Richland, Washington facility to support the processing of Blended Low Enriched Uranium (BLEU)..." And I'm not sure what this is. It says ..." UO2 powder for use in the fabrication of TVA's BW fuel bundles." The letter is signed by D. W. Parker, Manager, Environmental Health, Safety and Licensing. It is on Framatome letterhead. How can you ignore this information in this EIS? BF-D-A-5 and BF-D-L-4

Comment: I ask that you rethink your position on drafting up an EIS that permits TVA to burn nuclear weapons materials in this reactor. I ask that you look at your obligations as public employees and see the wrong in such a decision as permitting this plant to go forward without the analysis for the type of fuel that TVA will burn here. BF-D-A-16

Comment: In this place several months ago, Chip, you and the Region II boys and the Rockville staffers all went to great length to assure me that, if the NRC knew that the untried fuel process from the Erwin, Tennessee plant of Nuclear Fuel Services, using France's Framatome process, would be a part of the EIS, when completed. Now that was to be the fuel that was to be used here at this plant for those of you here who don't know. NRC would make that part of the EIS. You quickly stated that I didn't need to worry. Boys, I'm worried. BF-D-A-3 and BF-D-L-2

Comment: And I find it remarkable that you still don't want to save the rate payers the cost of another hearing and put the analysis in the EIS. BF-D-A-6 and BF-D-L-5

Comment: I can't determine if the NRC staff is the world's largest group of paid snake oil salesmen or just totally incompetent. Maybe you can't read or understand the English language. I don't know. Maybe you don't know how to spell Framatome. Maybe you don't know how to spell NFS. How about if I give you some more clues? BF-D-A-4 and BF-D-L-3

Comment: Also, I did notice that you forgot to get the language correct in the transcript copy I received by mail concerning the NFS and Framatome fuel issue. I have a copy here so you will know where to look. This copy came out of your document room in Rockville, prior to your last meeting with me here in this room, and was retrieved down here, in Tennessee, by computer, late one night when I had nothing to do. BF-D-A-8 and BF-D-L-7

Response: *TVA does have contracts to purchase Blended Low Enriched Uranium (BLEU) fuel for Units 2 and 3 and BLEU fuel has been delivered to the site. TVA currently does not plan to* *use BLEU fuel in Unit 1. BLEU fuel is manufactured by downblending weapons-grade, highly enriched uranium (approximately 59 percent U-235) to a level of approximately 3 to 5 percent U-235, which is a typical enrichment level for nuclear power plant fuel. The resulting BLEU fuel is in nearly all respects indistinguishable from fuel created by the normal fuel enrichment and manufacturing processes. The BLEU fuel that TVA will use in Units 2 and 3 meets all of the applicable specifications for these reactors; therefore, switching to BLEU fuel for the reactors does not require a license amendment, and requires no additional environmental review, or public hearings. The use of BLEU fuel likely decreases the environmental impact of plant operations because there would be less offsite impact due to uranium mining, and the downblending process eliminates a stockpile of highly enriched uranium that presents safeguards and security issues. The comments did not provide new and significant information; therefore, no change was made to the text.*

<u>Cost of Power</u>

Comment: As we pointed out in our scoping comments, TVA is very close to exceeding its congressionally mandated debt ceiling of $30 billion. Currently, TVA has about $25 billion in debt, in addition to $3 billion to $5 billion worth of other obligations that could be considered debt (e.g., leaseback contracts, pre-purchase of electricity, etc.). The restart of Browns Ferry Unit 1 is estimated to cost a total of $1.8 billion. According to NRC regulations related to Supplemental EIS for license renewals [10 CFR 51.95(c)(2)], the SEIS "is not required to include discussion of 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." The solvency of TVA certainly appears to be "essential" to making any meaningful comparison of alternative and should be included in the final SEIS. BF-D-O-6

Comment: I think the cost-benefit analysis (of nuclear power) has not shown itself to be worthwhile. BF-D-F-3

Comment: TVA has spent $2 billion to restart Browns Ferry Unit. Is it possible that TVA is going to recuperate $2 billion from one nuclear reactor in 20 years? It doesn't seem likely to me that's going to happen. They abandoned a $360 million project, a gas-fired power plant at $150 million into the project, and it was deemed lack of demand. That was in March of '02. So from '02 to now we've come to the point where we need to spend $3 billion to reactivate a nuclear reactor, and I don't understand how it is going to be paid for or how it is going to pay for itself. The math doesn't work in my head. Maybe I don't know how to add figures that big. It doesn't work for me. BF-D-J-1

Comment: This is something that we really need to look at, and the cost of it. I hear that they're talking about – well, no, not here that they're talking about, there's been a huge grant to do a study for Bellefonte. And what did we pump in to an endless pit there, $4 billion, was it?

Four billion dollars for absolutely nothing now. And now we're going off on some other tangent. BF-D-H-11

Comment: The economic impact also. I mean how much money is that going to cost? In this area right now TVA, their estimated cost for restarting Unit 1 is $1.8 billion, which exceeds the U.S. Department of Energy's highest cost estimate by $100 million. TVA has an existing debt of around $250 billion and they don't have much more room on that. This is being passed on to their customers. This is a major concern here. BF-D-H-2

Comment: How can you tell children, you know, we can burn all the lights we want to and it will be cheap. It is not going to be cheap. It is expensive. TVA has spent a fortune on their power. BF-D-H-9

Response: *The economic decision made by TVA to pursue relicensing of BFN, in addition to TVA's standing debt, is outside the scope of the environmental review. Specifically, 10 CFR 51.95(c)(2), states that a license renewal EIS does not need to discuss the cost of power. The decision to apply for relicensing is a business decision over which NRC has no regulatory control. The comments provide no new and significant information; therefore, no changes were made to the SEIS text.*

<u>Operational Safety</u>

Comment: TVA had such a horrible operating record in the initial 10 years of operation (1975 to 1985), that all three reactions were shut down in 1985 reportedly due to safety concerns and repeated safety violations. BF-D-E-2 and BF-D-K-2

Comment: And with all of these wonderful studies you've done, it still does not address the most crucial issue concerning the operation of this plant. We came seriously close in 1975 to a very major accident, which was reported on the east and west coast before people in this area knew what had happened. BF-D-G-2

Response: *The safety record for Units 2 and 3 since they were restarted has been much improved compared to the record prior to 1985. The maintenance and operation of BFN Units 2 and 3 are monitored daily by NRC's onsite inspectors. The onsite inspectors provide quarterly reports of all of their findings; these reports are available on the NRC website. The comments provide no new and significant information; therefore, no change was made to the SEIS text.*

Comment: The plant itself has got to have a cooling system that works. The paint chip – people say well, painting. Painting don't really matter. Painting does matter. Ask Davis Bessie Plant. Some of you guys probably already know that they had to redo a lot of their painting in their systems too. BF-D-C-7

Comment: The things that I witnessed inside the torus, they're scary. But you guys didn't get a chance to see that because the mess was mopped up, okay. I don't blame TVA for this. I blame the contractor. Okay. TVA is doing the best they can do to straighten the problems out. I realize that. I'm not here to beat them up. BF-D-C-1

Response: *The NRC inspectors have evaluated the surface coatings on the interior of the Unit 1 torus, and have determined that TVA's efforts to sandblast and re-application of coatings were successful. The NRC found that the licensee's program for restoration of the coatings in the Unit 1 torus complied with NRC requirements. Repairs to identified coating problems were completed by qualified individuals and accomplished in accordance with approved procedures. The NRC's findings are documented in Inspection Report (IR 000259-04-009) dated February 11, 2005 (Accession No. ML050420392). The comments provided no new and significant information; therefore, no change was made to the SEIS text.*

Comment: And least you forget, I remind you of the recent 32-ton crane trolley that was dropped between the reactor buildings. And what is worse, you cannot determine if the accident – excuse me, unplanned event – is a safety issue. And you want the public to trust you. BF-D-A-17

Comment: We would also like to raise concerns over a serious accident that occurred at Browns Ferry on October 24, 2004 - 32 tons of equipment were dropped onto the refueling floor by a faulty overhead crane. When Browns Ferry exceeds its spent fuel capacity, which certainly will occur if it continues to operate, the overhead crane will likely be used to move and load 100-ton dry storage casks used for storing nuclear waste from the spent fuel pool. The possible devastation that could occur if such a load were dropped is serious, and needs to be addressed well before the reactors are relicensed or Unit 1 is brought back online. BF-D-O-3

Response: *The comments refer to an October 24, 2004, event in which the original 29 MT (32-ton) bridge crane trolley was dropped approximately 1.22 m (4 ft) when a synthetic sling failed. The drop resulted in surface cracking and spalling of the concrete ceiling beneath the point of impact on the Unit 1 refueling floor. The root cause of the event was fully evaluated, and it was determined that the sling failure was the result of inadequate procedure and poor work performance. The NRC found the event to be of very low safety significance. The NRC resident inspectors issued a finding regarding this event and the licensee entered it into its corrective action program. An independent structural engineer was commissioned by the licensee to evaluate the structural integrity of the floor at the point of impact to determine if the floor still met its design criteria. There was no permanent structural damage to the refuel floor, and there was no functional degradation. The resident inspector's report of this incident is available through the NRC ADAMS website under accession number ML050310001. The comment provides no new and significant information; therefore, no change was made to the SEIS text.*

Comment: I found out that 15 percent of the energy that is derived from the 375 nuclear power stations in the United States that six are on a critical list, and one of them happens to be Browns Ferry Nuclear Power Plant—or was as of 1988. And that was my concern and still is my main issue...What is the Nuclear Regulatory Commission doing to reduce the factors that makes Browns Ferry Nuclear Power Plant one of these ones that is or was on the critical list as of 1988? BF-D-D-1

Response: *The NRC no longer maintains a critical, or watch, list of poorly performing plants. The watch list was an element of the NRC's Systematic Assessment of Licensee Performance program, which was superceded in 2000 by the revised Reactor Oversight Process (ROP). Since the implementation of the ROP, the operating BFN units have never left the Licensee Response Band, which is the best performance category in the ROP. Notwithstanding this information, operational safety issues are outside the scope of 10 CFR Part 51 and will not be evaluated further in this SEIS.*

Restart of Browns Ferry Unit 1

Comment: When you look at Mr. James Speegle, here, how do you look him in the eye and tell him that you, the NRC, cannot stop the abuse because you refuse to do what is required to stop the abuse of those such as Mr. Speegle that feel that public health and safety is important and refuse to take the abuse from TVA managers over safety problems? BF-D-A-13

Comment: That whole contracting company up there filed bankruptcy years ago. They're using this, at the cost of safety to everyone in this community, to regain what they lost years ago. That's not our fault. That's bad management. TVA may or may not want to look into this of you getting another contractor. Obviously, I was right about the things I complained about, or Williams Power would never have been brought in to redo what Stone and Webster worked on for almost a year. BF-D-C-6

Comment: The gentleman onsite that conducted all this stuff has made the comments in the last two weeks that he has been cleared of all charges. I haven't even gotten a report from NRC yet saying what the results were. He's saying NRC is telling him this. It makes me, and other people, think that NRC is helping cover things up. I don't look at it that way. I hate to. But this gentleman onsite is a safety issue himself. BF-D-C-5

Comment: I don't know how to stress to you the importance of how it is to get this situation under control, because the same people that done this in the torus are the same people still up there running things in that plant. Everything from the lead, everything from the non-lead that was treated like lead, and then created so much toxic chemicals that, ultimately, TVA has got to pay to have it buried or put somewhere. I mean why do you want to create waste when it didn't have to be created? They made money on it. They claim 150 and 60 spots of lead removal a day. We couldn't do 20. With the crew we had, I promise you, we couldn't do 20. BF-D-C-17

Comment: It's a shame to have to stand here and look like I'm degrading somebody because they fired me. That's not what I'm here for. I was paid $1200 a week; I went down to $210 and it took eight weeks to get that. I was financially hurt from this. That wasn't what I done it for. I could have kept my mouth shut and went on. I didn't. I did this for the community and for the fact that I know that was being done wrong up there. And like I said, if I was wrong about what I complained about, they never would have spent those many millions of dollars to have it redone. BF-D-C-12

Comment: So I would like to ask you all today if you all would please find out who instructed it to be redone as far as the inside of that torus. Who come up with the initiative to say, hey, maybe there is a problem. Let's stop back and find out what we got to do. All they had to do was listen to the people inside the plant that knew what to do to begin with, and that was to sandblast it from water line to water line and the problem never would have occurred. BF-D-C-13

Comment: The thing that bothers me the most is when a man from supervision will stand there and tell you: Don't worry about it. They'll pay you come Wednesday. Confusion is money. If they don't like the way we done it this time, it tears me up, we'll do it again, and they'll pay us for it. These are not people that are worried about safety. These are people that are worried about filling their pocketbooks to where they can go back home, stay there, and live comfortably, and let us have to deal with the problems they caused at this plant. BF-D-C-3

Comment: We skipped around over rust. And every time we would ask why are we missing this spot and doing this one? Our answers we got back were "They'll pay us to do it on another contract." Well, that's wrong. That is greed. And they threw safety out the window for greed. BF-D-C-14

Comment: Thank you TVA for making sure this thing is done right. I really appreciate that. I think you all had a big part in the overall redo of this torus. But I spoke up, exactly what your open-door policies tells me to do. And it says there's no reprisals towards anyone for speaking up. Well, I got reprised against me. They run me off. Cost me my livelihood. I can't hardly work anywhere anymore. I can't get a job paying anything near what I was making up there. And it's not because I'm not skilled, it's because I got tired of looking at what was going on. BF-D-C-15

Comment: Like I said, I don't blame TVA for this. I blame the contractor. But ultimately, somebody has got to clean house. And I think somebody needs to start cleaning house pretty soon before we have major problems that we can't correct. BF-D-C-11

Comment: Like I said, I could have kept my mouth shut and made my $1200 a week and took my family on vacations. I didn't do that. I stood up for what this paper right here tells me what I should and could do. And I got fired for it. And it is because people threw safety out the door and wanted to get their pockets full of money. And that's basically all it came down to. And I'm asking you guys to keep an eye on the safety. BF-D-C-18

Comment: I was in that torus and two milestones were missed. Now that might have been Stone and Webster's milestones; it might have been TVA's milestones. But they were missed. Because every time we go to the point of finishing up, they would come and say, hey, we're not going to make it. And when they would talk about milestones, everybody knows here they're talking about money, their bonuses. Cut the bonuses out. Make them do it right. If the job ain't right, don't pay them. BF-D-C-16

Comment: I know that you won't go in and do the inspections and everything. Please do a really good job, because on Unit 1 there have been a number of whistle blowers that have lost their jobs. One acquaintance of mine is an avid supporter of nuclear power. He did his job; saw things that should have been done in other ways, or were not being done properly; he lost his job. Things like this are going on. When we almost had the melt down with the first accident, I knew some of the people that worked at Browns Ferry, and one of them was a operator who was a severe alcoholic. He was killed in a car wreck on the way to work. I thought okay, it's better now. We don't really have to worry about this, you know. TVA has really cleaned up their act and they're doing a better job. Then, when I hear about all of these whistle blowers with Unit 1, that's scary. That's really scary. And I did know this guy, and he was an operator. BF-D-H-4

Response: *The NRC's environmental review is confined to environmental matters relevant to license renewal. The NRC inspectors have evaluated the surface coatings on the interior of the Unit 1 torus and have determined that TVA's efforts to sandblast and re-apply a protective coating was successful. The NRC found that the licensee's program for restoration of the coatings in the Unit 1 torus complied with NRC requirements. Repairs to the coating were completed by qualified individuals and accomplished in accordance with approved procedures. The staff's findings are documented in Inspection Report IR 05000259-04-009 dated February 11, 2005 (ML050420392). The comments provide no new and significant information; therefore, no changes were made to the SEIS text.*

Comment: Since this unit is not operating, I find it remarkable that you base these decisions on operations when they aren't operating. BF-D-A-1

Comment: I worked on Unit 3. Nothing in Unit 1 has been done the way Unit 3 was revamped and redone back in the early 90s. Nothing. Everything has changed differently. The torus was redone right. BF-D-C-9

Comment: Browns Ferry Unit 1 has been in the non-defined regulatory status of "administrative hold" for nearly 20 years, which is a longer time period than it actually operated. The operating license for Unit 1 should have been revoked after it was shut down in 1985 for failing "to consistently maintain a documented design basis and to control the plant's configuration in accordance with that basis." To ensure optimal safety at the plant, TVA should now be required to go through NRC's license application process for Unit 1 as required for any new plant. Only after an extended period of operation without any incident or accident should TVA be allowed to apply for a license extension. To give a license extension to a plant that has not operated in 20 years is utterly absurd. We are further concerned over safety allegations brought forward by former contractors that performed work for the Browns Ferry Unit 1 Restart process, citing that poor practices have occurred and work has been done outside of design specifications. Until the safety allegations can be thoroughly reviewed by the NRC, the restart should not go forward, and consequently, the relicensing of Unit 1, in particular, should not be allowed. BF-D-O-2

Response: *TVA is currently in the process of preparing Unit 1 for restart. This action is occurring under the current operating license. The restart of this unit does not require a separate licensing action and is not part of license renewal. Unit 1 must meet the current licensing requirements prior to restart. The NRC has a special reactor oversight program to assess licensees' activities and progress related to readying Unit 1 for restart. Restart of Unit 1 is outside the scope of the environmental review for license renewal. The comments provide no new and significant information; therefore, no changes were made to the SEIS text.*

<u>Safeguards and Security</u>

Comment: Jackie mentioned 911. We all thought these worst-case scenarios were ridiculous and are never going to happen; that people projected that this could happen 30 years ago or if not longer, and now we're in the age of the worst-case scenario. I think it is absurd not to be addressing these issues primarily and foremost, especially since the citizens' money is going to fund these projects without them having all of the information out there in front of them. I think it is really immoral. BF-D-G-5

Response: *NRC and other Federal agencies have heightened vigilance and implemented initiatives to evaluate and respond to possible threats posed by terrorists, including the use of aircraft against commercial nuclear power plants and independent spent fuel storage installations (ISFSIs). Malevolent acts remain speculative and beyond the scope of a NEPA review. The NRC routinely assesses threats and other information provided by other Federal agencies and sources. The NRC also ensures that licensees meet appropriate security levels. The NRC will continue to focus on prevention of terrorist acts for all nuclear facilities and will not focus on site-specific evaluations of speculative environmental impacts. While these are legitimate matters of concern, they should continue to be addressed through the ongoing regulatory process as a current and generic regulatory issue that affects all nuclear facilities and many activities conducted at nuclear facilities. The NRC has taken a number of actions to respond to the events of September 11, 2001, and plans to take additional measures. However, the issue of security and risk from malevolent acts at nuclear power plants is not unique to facilities that have requested a renewal to their license and, therefore, will not be addressed within the scope of this SEIS. The comment did not provide new and significant information and does not pertain to the scope of license renewals set forth in 10 CFR Parts 51 and 54; therefore, it will not be evaluated further.*

Comment: The three Browns Ferry nuclear reactors are all BWR-Mark I GE-4 design, which has numerous inherent security flaws: the spent-fuel pool is elevated above ground level, making it vulnerable from above, below, and from the side; the reactor itself is located above ground level; and the reactor lacks a traditional "containment dome" and instead has a thin steel shell. Of the 104 nuclear reactors in the United States, 34 have these particular vulnerabilities to acts of terrorism. The Nuclear Security Coalition, of which Public Citizen and SACE are members, have submitted a petition to the NRC that requests the NRC to provide stronger defenses of boiling-water reactors (BWRs) with Mark I and II containments and their spent fuel. We have attached the Coalition's NRC petition and petition annex to these comments. Given the serious vulnerabilities of these types of reactors to attack, this petition should be fully considered and acted upon by the Commission before decisions are made about relicensing any of the Mark I and II BWRs, including the three reactors at Browns Ferry. BF-D-O-1

Response: *The petition referenced in this comment was submitted to the NRC on August 10, 2004, under separate cover and is being evaluated by the NRC staff under 10 CFR 2.206 independently of the BFN license renewal. The 33 page petition attached to the comment was not reproduced in this SEIS because it had been submitted separately to the NRC for consideration, and the petition is outside the scope of the environmental review. The petition is available from ADAMS at the NRC website http://www/nrc.gov/reading-rm/adams.html under accession number ML050630419. As part of a comprehensive review of security for NRC-licensed facilities, the NRC conducted detailed site-specific engineering studies of a limited number of nuclear power plants to assess potential vulnerabilities of deliberate attacks involving large commercial aircraft. These studies found that the potential for core damage or radiological releases that could affect public health were low. Additional site-specific analyses are underway or being planned. The issues raised in this petition are outside the scope of license renewal and will be addressed as part of a response to a 2.206 petition. The comment provided no new and significant information; therefore, no change was made to the SEIS text.*

Transcript of the Afternoon Public Meeting on January 25, 2005, Athens, Alabama

Afternoon session (1:30 to 4:00 p.m.)

[Introduction by Chip Cameron]
[Presentation by Andy Kugler]
[Presentation by Michael Masnik]

MR. CAMERON: Thank you, Mike.

Questions about process at this point?

Yes, sir, and please identify yourself.

MR. HORN: Stewart Horn.

Did you issue the draft SEIS in November or was that the draft GEIS?

MR. MASNIK: It is a bit confusing. There are two documents. There is a Generic Environmental Impact Statement, which was issued in 1996, that looked at, in a generic sense, the process of re-licensing plants and evaluated impacts of license renewal on a generic basis.

What we do then -- and Mike will discuss this a little bit further in a few minutes -- but what we do then is, we also do a Site Specific Environmental Impact Statement, which we consider a supplement to this generic. So you have to sort of look at both of them, although the SEIS, or the Supplement to the Environment Impact Statement, does discuss the specific issues even raised in the GEIS.

MR. CAMERON: Does that clear it up for --

MR. MASNIK: I know it is a bit complicated, but why don't you listen to Mike's evaluation and, then, if there are further questions, we can answer it.

MR. CAMERON: All right.

Yes.

MS. KNOX: I have several other things I wanted to talk about.

My name is Dawn Knox. I have several other questions I wanted to ask, but I heard you say that at your scope there was no talk of hearings. Is that something that can still be brought up in the future, or did that have to be something that was decided at the scope?

MR. CAMERON: Can you clarify for Dawn what you meant when you talked about -- that's right, Andy mentioned it -- can you clarify what the hearing was that you were talking about?

MR. KUGLER: Well, it wasn't related to scoping. Scoping is an environmental process where we're looking to determine what issues we should be looking at when we develop the Environmental Impact Statement.

Separate from that, there was an opportunity to request a hearing and that started when we determined that the application was sufficient for our review. We issued a Federal Register notice stating that we had this application, it is sufficient for review, and it would have provided for a 60-day opportunity to request a hearing. Now, this was back last year. It would have been in the spring time. I don't know the exact dates. We could get those. But that opportunity has closed. It closed back at that time, and that was the opportunity to request a hearing.

MR. CAMERON: This hearing that Andy is talking about, it's not like a public meeting like this is, it's an adjudicatory hearing; is that correct, Andy?

MR. KUGLER: That's correct. It is a formal process in front of an administrative law group or a panel of administrative law judges.

What we are doing here -- sometimes people refer to this as a hearing. This is a public meeting. For us the term "hearing" has a different meaning. It is much more formal. It's a legal process.

MS. KNOX: Who would have had to request a hearing?

MR. KUGLER: Anybody can request the hearing. Anybody who has an interest in the review. They do have to -- well, I'm going to get beyond my range here. I may have the lawyer speak to this, but they have to establish standing, which means that they have an interest that they can show in the activity. They have to then submit contentions, issues that they have with the application that was received.

MR. CAMERON: Dawn, what Andy is saying is that anyone can request one of these to participate in the adjudicatory hearing, but they won't necessarily be permitted to participate unless they meet certain requirements.

In regard to your question about is there any way that someone could request a hearing, now I'm going to ask -- not to get in to it now, but I'm going to ask our attorney, Ann Hodgdon, who is over there, to talk to you about something called -- how you do a late filed request, okay?

Did you have another question on process before we go on?

MS. KNOX: That was my question.

MR. CAMERON: That was it?

MS. KNOX: Yes.

MR. CAMERON: Thank you, Dawn.

Other? Other questions? (No response)

We're going to go to Dr. Mike Sackschewsky and, as I mentioned, he's the team leader for the environmental review. He's going to go through the findings in the Draft Environmental Impact Statement and, then, we'll go back out to you for questions on that.

Mike.

[Presentation by Michael Sackschewsky]

MR. CAMERON: Thank you very much.

Before we go to questions, if I may just introduce one other person from the NRC staff, Mr. P. T. Kuo right here. And P. T. is the Chief of the License Renewal and Environmental Impacts Program. So he's in charge of not only the environmental review that we're talking about but also the safety site review.

Thank you for being here, P.T.

Questions about the draft EIS?

Yes, sir, and please introduce yourself to us.

MR. LAWSON: Hi, I'm Brian Lawson with the Huntsville Times.

As you described the conclusions, and as you reviewed other sites, in your experience is it typical to find what amounts to no significance across the board? Is that an unusual finding for you or does that run consistent with other experiences you've had?

MR. SACKSCHEWSKY: That is fairly consistent with, I think, most of the other reviews that have been done.

MR. CAMERON: Okay. Mike are you going to amplify -- okay. That's fine.

Yes, sir, and, then, we'll go back to him.

MR. SHEAR: Dennis Shear, I'm with the Times Daily Newspaper in Florence.

Have there been any applications for a new -- you all have said, hey, this is not going to work or have you all seen no significant impact?

MR. CAMERON: And this is in terms of license renewal applications.

MR. MASNIK: It is Mike Masnik.

It is a good question. We get that question quite often. We have done over 20 of these reviews so far and in each case the license renewal has been granted. There's a number in house under review at this time.

The reason for that is -- there's a couple of reasons for it. First, this is a fairly well-defined process at this point. The licensees know what to submit and what they have to submit and what we look at.

So, typically, since this costs a licensee a lot of money, their application, in almost every case, is fairly complete.

It is also an iterative process in a way in that, if there are shortcomings in the application -- and just about every application has some areas where we need some additional information. As I mentioned, we got 11,000 pages of material from the licensee. That information is provided. If it's insufficient, we might go back to the licensee a second time.

Additionally, if there are inspections and the inspections demonstrate that there's some weaknesses in the facility's aging program, the licensee would obviously make improvements to that program to the extent that we probably would be satisfied.

So the answer is no, we have not turned down a licensee, but I think there is a pretty good reason why that's the case so far.

MR. CAMERON: Thanks, Mike.

Let's go to Ann.

MS. HARRIS: I've got five questions.

MR. CAMERON: Okay. This is Ann Harris for the record. Do you want to ask them all at once and, then, we'll answer?

MS. HARRIS: It is up to you.

MR. CAMERON: Why don't you give us all five and, then, we'll proceed to answer them 'cause I think that will be more efficient. Okay?

MS. HARRIS: Talking about the cumulative effect here of what you found, and I want to know if that cumulative effect was determined on separate units or you combined all three of 'em to come to what Unit 1 will do? Was it totally separate throughout the decision on cumulative effects?

The other thing is, I see that you talk about cumulative effects but I'm not sure that what you are using as cumulative effects is the reactor, the design, the safety, the whole. Did you add of that? I'm seeing something different whenever you talk about emissions.

When you determine the cumulative effect of emissions, what is the basis and what was the model that you used? What is the level? And what are the percentage of waste increase from the use of fuel? I didn't see that there any where.

There has to be an increase if you are going to use a new unit, because it is going to produce waste.

From the current level here what is Unit 1's waste analysis done totally alone? And if so, why?

MR. MASNIK: Can you repeat that? I couldn't follow that one.

MS. HARRIS: Well, Unit 1 waste. During the analysis you didn't find any problems with it, but you also didn't talk about what that waste is going to come from. I want to know what percentage or level of increase of waste that you determined would increase above what Unit 2 and 3 are now producing.

MR. CAMERON: Is that the last?

MS. HARRIS: Right now.

MR. CAMERON: Mike, do you want to -- let's try to -- I know it's a lot to keep tract of. Let's try to answer Ann's questions as best we can, and, then, we'll check with her to see if we got it.

MR. MASNIK: I guess your first question was: did we look at -- when we evaluated cumulative affects, did we look at separating Unit 1 from Units 2 and 3?

The answer is no.

I think your specific question from the standpoint of cumulative affects related to generation of additional waste and emissions. Okay. As Mike described, both the issue related to the fuel cycle and the radiological releases from the plant were considered Category 1 issues, which means that we considered them generically back in the early 90s and determined that the impacts would be the same for all facilities. We also determined that the impacts would be small.

From the standpoint of the waste issue, the additional waste that would be generated from Unit 1 for an additional 20 years, the Commission believes this is an acceptable amount and that the waste would ultimately end up in a repository somewhere, you know, a permanent repository.

From the standpoint of emissions, again, the amount of radiological releases from the plant are extremely small. As a result, the additional 20 years we feel would not result in any releases that are outside our regulations. So again, it would be a generic determination and a Category 1 issue.

MR. CAMERON: Ann, is there anything else that we didn't --

MS. HARRIS: You didn't answer my question.

MR. KUGLER: Chip, let me add one more thing because I think this may be what she's asking about, and I'm not sure Mike hit it.

When we were looking at emissions from the plant, liquid and gaseous emissions, we applied a multiplication factor of one-point-eight to consider the addition of Unit 1, the third unit, and to consider the uprated power level as well because we did all of this analysis assuming that the plants were operating 120 percent power, because Tennessee Valley Authority has applied for an uprate.

Now that uprate hasn't been completed, but in order to make this analysis conservative, we worked with the assumption that the uprate happened so that we would be basically doing the worse case, the higher power level. So that's considered within the way we looked at the emissions from the plant as well.

MR. CAMERON: Is your main concern addressed here?

MS. HARRIS: No. I got a lot of nuke speak which didn't mean anything.

What I'm looking for is, if you didn't look at the percentage of waste increase, you had -- there has to be a waste increase. You're starting up basically a new unit. If you don't have an increase in waste, whose eating it.

The other thing is, if there is a waste increase, I want to know how much it is.

MR. CAMERON: That's two separate questions here. One is a factual question in terms of how much additional waste will be produced over the license renewal extension? I mean we should be able to have a number for that either now or before we adjourn. That's a factual question that we should have an answer for, hopefully.

The other point is -- I think the implication of Ann's question is, if the plant that's going to be running longer, i.e, the licenses renewed, then more waste is being produced and that would lead us to a negative conclusion.

I think what you're saying is that, even though there would be more waste produced, it's still within our analysis that it's a small impact. That's the answer; is that correct?

MR. KUGLER: Yes, that's correct.

What we tried to do here was, you've got two units running and we know how much waste they're producing every year. We have data on that. You add a third unit in to operation, it will produce about the same amount of waste and effluents. Now, if you increase the power level of those plants, that will increase the amount of effluents.

What we did was, in our analysis we tried to take both of those things in to account, the addition of Unit 1 running and the increase in the power levels of the plants. We tried to take both of those things in to account in our analysis.

MR. CAMERON: And are concluded in --

MR. KUGLER: And our conclusions are based on those higher effluent levels.

MR. CAMERON: If at some point we can find out the exact number, we --

MS. HARRIS: Did I understand you to say that you considered it's a negligible impact over a 20-year period for this one unit?

MR. KUGLER: What we concluded was that the impacts on the environment would be small with the additional unit running, yes.

MS. HARRIS: The answer would be yes.

MR. KUGLER: I didn't use the word negligible because I'm not sure we're saying negligible. We said small. Maybe it is just semantics.

MR. CAMERON: But that is the conclusion, it's small.

MR. KUGLER: We define small as an impact that is not significant to the environment, yes.

MR. CAMERON: Let me ask Barry Zalcman if he has something to add here.

MR. ZALCMAN: Thanks, Chip.

I think one of the issues that may be confusing is Unit 1 (Browns Ferry) is an operating nuclear power plant. It has a license to operate. It has been operated for some time, but the staff has already evaluated the impacts of operating that nuclear power plant for its initial term. This action is to look at the additional 20 years of operation.

So we have looked at the impact of three plants operating. The restart of Unit 1 is not part of this licensing action. As a matter of fact, it is not a licensing action. They have an operating license. So the cumulative impacts look at the individual as well as the combined effects at Browns Ferry.

MR. CAMERON: Thank you.

Did we have someone over here? Yes, sir. Please introduce yourself to us.

MR. WILLIS: It is Bill Willis with the News Courier newspaper here in Athens. Have any other TVA plants gone through this review process for license renewal? Does the agency have any track record.

MR. CAMERON: Michael.

MR. MASNIK: No. This is the first units from TVA to come in for license renewal.

MR. CAMERON: Thank you.

We will go to -- please introduce yourself.

MS. LEG: My name is Julie Leg.

I just have a general question about licensing in general. Why is the licensing period for so long? Why 20 years? Why 40 years?

MR. CAMERON: We are going to go to Barry Zalcman of the NRC staff again.

MR. ZALCMAN: Thank you very much. A very good question. Its like why is your driver's license good for five years.

The fact of the matter is, when Congress first established the Atomic Energy Act and allowed the Atomic Energy Commission, and subsequently the Nuclear Regulatory Commission, to issue licenses, there was some questions as to how long.

From an engineering perspective there is no real limitation on the length of licenses, but from economic considerations and anti-trust considerations, Congress believed that 40 years was a reasonable period of time.

So it stems back from that.

And for license renewal the staff, while granted the authority under the Atomic Energy Act to renew licenses, had no mechanism for renewing licenses. So when we embarked on that process in the late 80s and through the early 90s, that was the mechanism involving the public in establishing a rule. Through that rulemaking process we had public engagement, state public utility commissioners engaging in that process and found that the 20 year period was a reasonably long panning horizon, so that energy supplies could be provided with assurity for public and public use.

So these are time frames, in part, established by Congress for the Agency to deal with, and now by rule, engaging public in that rulemaking process.

MS. LEG: Is it just every 20 years? Are the plants just audited every 20 years and, then, get re-licensed or are they audited otherwise?

MR. CAMERON: I'm assuming that Julie is using the term "audited" to mean inspected or some type of NRC review.

So Barry, are you going to answer that for us?

MR. ZALCMAN: I can respond only because I'm the closest to the microphone.

The reality is, the staff is performing oversight at this facility every day.

As Andy indicated earlier, we have NRC resident inspectors that are part of the NRC core that are located at the facility that live in the community, part of inspection team activities that go on day in and day out. That's their job.

There are special team inspections, there are augmented team inspections, a variety of other inspections that are led by regions. So we have a regional representative.

So there are other inspections that go on and on, on a continuing basis. And, then, if we need some special inside or technical expertise, even folks out of headquarters come in. But it's not a snapshot in time; it is a continuum. Inspection activities go on every day.

MR. CAMERON: Dawn?

MS. KNOX: I know earlier Mr. Kugler, I believe, had said that the safety evaluation report had not yet been conducted, but at the same time does that mean that you all have evaluated the maximum amount of millirems for exposure? Is that still 25 millirems?

MR. CAMERON: I think we are going to have to change batteries in this at some point, but do you get the gist of Dawn's question?

MR. MASNIK: Can we go back to slide 5 just real quick?

Just so there's no misunderstanding, there's both an environmental and a safety review. We're talking about the environmental review, but your comment is an environmental comment in the sense that we concern ourselves with the release of radionuclides from the facility and the off-site dose consequences of that.

There are very prescriptive requirements for how much radiation that can be released from the plant. There are also many layers of protection to prevent the release of radioactivity. Radioactivity is allowed to be released from the plant only from monitored release points.

And we calculate -- or the licensee calculates -- and the NRC makes sure these calculations are correct -- how much radioactive isotopes are released to the environment.

They are required annually to submit a report to us that essentially summarizes the previous year's worth of data, and they actually do dose calculations and determine what the maximum number might be to a member of the public that, for example, lives along the shoreline and eats fish out of the river and spends 500 hours a year at the shoreline.

So it is a very conservative estimate. It's a very small amount. I can' certainly give you those numbers afterwards. I have them. I even have a copy of the report. You know, it's not much.

I just wanted to show you here again the environmental review on the lower and the safety review on the top.

MR. CAMERON: Did you have another question?

MS. LEG: Yes, sir, several more as a matter of fact.

Where is the permanent toxic waste repository in the United States located that is to have been operational by the year 1998, as mandated by the National Waste Policy Act of 1982?

MR. SACKSCHEWSKY: It's the High-Level Waste Repository I believe is what you're referring to, and this is where the spent fuel will ultimately end up in the United States.

I think you know, and most people in this room know, that has been proposed for Yucca Mountain. There have been studies that have been done for many years. Its a facility that will be licensed by the Department of Energy and it will, if licensed, end up taking all the fuel. That licensing process has slowed down and bogged down and is not done yet.

MR. CAMERON: Just one clarification on what Mike said is that the repository will be licensed by the NRC.

MR. SACKSCHEWSKY: Yes.

MR. CAMERON: The Department of Energy has to get a license from us, meet our regulations before it could construct and operate the repository.

They originally were going to submit a license application in December of last year but have delayed that for several months into the future, so we do not have a license application.

MS. LEG: You said Yucca Mountain where?

MR. SACKSCHEWSKY: It's Yucca Mountain in Nevada.

MS. LEG: Are there any intentions of integrating Browns Ferry Nuclear Power Plant of Limestone County from a boiling water reactor to a pressurized water reactor as those at Sequoia Nuclear Power Plant of DeKalb and Jackson Counties and Joseph M. Farley Plant of Houston and Henry Counties, or are heavy water reactors with the use of deuteron may be an option or high-temperature gas reactors?

MR. SACKSCHEWSKY: I missed the first part of that.

MR. CAMERON: I believe the gist of this is, is there any plan to convert any of the reactors at Browns Ferry to some different reactor process than what they are now from boiling water to pressurized?

MR. SACKSCHEWSKY: No, ma'am. I mean its practically physically impossible to do that.

MR. CAMERON: Do you have another question, and, then, we are going to try to push on.

MS. LEG: Does the local government or officials have to approve an evacuation route before a breeder or factory reactor can be approved for a licensing operation by the Nuclear Regulatory Commission?

And does our local government have or hold a ban or restriction on development to keep plutonium out of the Tennessee Valley because of its 24-year half-life and toxicity?

MR. CAMERON: I think the best thing you can do in response to that question is perhaps just talk briefly about what the emergency planning regulations and the role of local government without worrying particularly about the breeder or whatever.

In other words, what is applicable to the Browns Ferry reactors now in terms of local government.

MR. MASNIK: There are no plans currently for a breeder reactor, and it is the policy of the United States not to pursue breeder reactor technology.

From the standpoint of emergency planning the NRC requires that there be an emergency plan, and the NRC works closely with FEMA (Federal Emergency Management Authority) to produce an emergency -- well, the licensee produces an emergency plan. We oversee the plan as well as FEMA and that requires local participation. I believe there are one or two people here today from the local Emergency Planning Program in Limestone County or the area around the plant.

MR. CAMERON: And Dawn, I know you have some other questions. Let's go to the public comment part of the meeting, and, then, we'll make sure that we get back to you either during the formal part of the meeting or right afterwards to answer any questions that you have.

For local government officials who are here or who know about emergency planning, perhaps after the meeting they can also explain it to Dawn.

Let's go to Mr. Horn?

MR. HORN: My understanding of this process is that it will be completed and a decision will be made probably within a year or close to it; is that correct?

MR. CAMERON: Can we get on the record about when will the decision on license renewal for this plant be made?

MR. MASNIK: I have a schedule. It will take me a minute or two to look at it. I don't know off the top of my head when the date is.

MR. CAMERON: He has another question while you are looking that date up. Go ahead, sir.

MR. HORN: I'm assuming this process will be completed within at least seven, maybe more, years prior to the time the first plant will start operating or maybe six years, but the last one like ten years. Is there a process such that circumstances that may change in the operation of the facility that would affect the environmental impact will be considered after this process has been completed, between the time it is completed and when the actual operation of the renewed license will occur?

MR. CAMERON: In other words, how do we factor in any new information that we might get that would affect the operation of the plant in terms of environmental impact?

MR. MASNIK: Whenever the licensee makes a change to the facility they're required to do a certain number of reviews. One of the reviews is to determine whether or not the change will result in an environmental impact that's outside what was previously considered. Once this document is issued final, it becomes the document by which the licensee will compare -- along with the original EIS, compare any future impacts.

So let's say the licensee in four or five years decides to totally redesign the cooling system. If it would result in impacts greater than what was considered by the NRC in our document here or the original environmental impact statement, then the licensee would be required to come in and we would be required to do another environmental review.

So this establishes an envelope, essentially, over the facility under which the licensee can operate.

MR. HORN: The approval process basically is completed at the time that this decision is made; is that correct?

MR. MASNIK: That's correct.

MR. CAMERON: Go ahead. Thank you.

MR. MASNIK: I think someone has the date. April of 2006 is what our current schedule proposes that a decision would be made.

MR. CAMERON: Yes, sir.

MR. TIMBERLAKE: Ralph Timberlake.

I was concerned. You talk about the chemical effect on our environmental but isn't it nuclear waste that is going to have to be transported to Yucca Mountain, and have you done this study along the route and possible route of how it will affect the environment during the transmission? Also in bringing in the nuclear fuel in the refueling of the nuclear reactor.

MR. MASNIK: It's a little known fact -- I mean nuclear fuel is transported on the roads of the United States almost every day, somewhere in the country.

The industry has had a long experience with transferring spent nuclear fuel, and there are NRC requirements that are imposed on shippers. It's a pretty routine process. The vehicles are placarded. There's limits as to what the radiation field can be in around the transport vehicle, as well as protection to the driver.

As far as new fuel, new fuel is relatively benign, although it again is transported on a daily basis, and there are requirements for it as well.

MR. CAMERON: I think the nature of the question goes to how did either the Generic Environmental Impact Statement or the supplement consider transportation of spent fuel. I think Mike referred to that earlier.

Isn't that what you wanted to know is how that type of impact was considered in the Environmental Impact Statement? Did Barry answer that?

MR. ZALCMAN: Barry Zalcman again. Very good question. Let me point out that in the presentation we made we refer to the Generic Environmental Impact Statement being completed in a 1996 time frame.

In that time frame this was an open issue. As a matter of fact it was Category 2 issue at the time. The Commission felt that the staff could do a little more work in focusing on what the cumulative impacts would be of transporting all this spent fuel. So any one licensee that sought a license renewal application would have to look at the cumulative impacts across all plants in the country. So, the staff undertook that effort.

In 1999 the staff completed an Addendum 1 to the Generic Environmental Impact Statement. So, when you look at this issue, and you had raised earlier about the repository in general, in Chapter 6 of this supplement we refer to the objective that the Commission had. The conclusion that it had made, which was not just the 1996 Generic Environmental Impact Statement, but also in the Addendum 1 to the Generic Environmental Impact Statement. So the staff did that evaluation. The staff did publish its results. It is available, and if you have that interest we'll make sure we get you a copy.

MR. CAMERON: Thank you, Barry.

We're going to go to that part of the meeting where we listen to all of you and -- oh, we have one more presentation. Excuse me for forgetting about Bob Palla. Very important subject, Severe Accident Mitigation Alternatives. It is in the Draft Environmental Impact Statement.

[Presentation by Bob Palla]

MR. CAMERON: Thank you, Bob. We have a couple of questions for you.

MR. SPEEGLE: Yes. My name is James Speegle and was a painter at Brown Ferry Nuclear Plant.

You were talking about the costs of doing these jobs to get this plant in a safe manner, is that -- am I understanding you correctly in that? You were talking about the overall impact of the cost plus the safety involved.

MR. PALLA: What we look at is, in essence, the existing level of risk that this plant poses, and we decompose the risk profile to try to understand if there are cost beneficial improvements that could be made to further reduce the risk.

So we're looking at the amount of risk reduction that is possible, and different areas that contribute to risk, and we look at the costs of achieving reduction.

MR. CAMERON: But the basic assumption is, though, the plant is at a safe level and what we're looking at is increases.

MR. PALLA: Absolutely. We're not questioning the level of risk. The level of risk is acceptable by the measures that the Commission uses. We are looking at cost-beneficial ways of further reducing it.

MR. SPEEGLE: What I'm getting at is, basically, we went into the torus and we worked on this thing for almost the better part of a year doing it the wrong way, and, then, we had another contractor come in and mop up the mess and do it the right way. Did they factor in doing that torus two times, financially?

The safety impact of it alone is just unreal because you were not -- not NRC directly nor TVA. I'm referring this to the contractors. They were going to cut corners, and safety corners were more important. They wanted to make the dollar and cut the safety out. They weren't doing the job correctly. And now that its went back and been done correctly, who made the decision to go back in there and have it redone?

MR. PALLA: You're really bringing up an operational issue that -- I guess what I'd say is we are starting from a baseline where the plant is assumed to be operating in accordance with its design basis.

And the types of activities you are describing may be more related to maintaining the plant's operating basis.

It's not the type -- we were looking, really, at the potential for accidents to occur at the plant and ways to reduce that.

MR. SPEEGLE: If this had been done correctly the first time instead of messing with it for over a year, I wouldn't be asking these safety questions.

But now in my mind, and a lot of other people's mind, this went on so long what other issues were not done correctly in this plant?

MR. PALLA: Perhaps that calls in the question whether the plant is being operated in accordance with its design basis.

As Andy Kugler described earlier, there's a parallel review of the safety analysis. This is really -- if it belong there, it would be on the safety side. But this is really an operational issue. This isn't really a license renewal issue. I think it's something we would not be dealing with today.

MR. CAMERON: In other words, it is an operational issue. These types of operational issues are something that the NRC watches for and is very concerned about. It is not the subject of the severe accident mitigation alternatives.

And in just general terms, if there is something that needs to be corrected at a plant to make conform to NRC's safety regulation, the licensee is responsible for fixing that, and there's no cost-benefit valuation of whether they are going to do it or not.

And I know we are going to hear from you, Mr. Speegle, in a few minutes more on this, so we'll be back to you.

Yes, sir.

MR. BOSWIN: Sort of the same question I asked earlier. As you guys have gone through your relicensing at other facilities, and you've gone through the SAMA process, in the 20 or so that have been relicensed already are you finding that the SAMA review has found situations where there are actual cost benefits, or are you tending to run the same direction here as well that's --

MR. PALLA: We found them in probably about half. I don't have an exact number, but I think its roughly about half of the plants you'll find something. They tend to be relatively low cost modification, procedural changes for the most part.

The residual level of risk at these operating plants is sufficiently low that when you go through the regulatory analysis guidance, in effect it dictates the amount of money that one could justify spending. That number is fairly low. And we tend to find procedural enhancements.

We did for Browns Ferry found a few that came close in this screening process that we did. But when they were looked at closer, either the costs were recognized to be higher than they were originally estimated or the benefits were lower, so they fell away. So in the end we didn't find any that were cost-beneficial at Browns Ferry.

MR. CAMERON: Do you have a quick followup?

MR BOSWIN: Very quickly.

The list that you generated that you run through each time at each facility, if you finding that it would work perfectly in your model, and it would be cheaper maybe in your model than, in fact, it might be. Even then, generally speaking, it is applicable. Does that raise questions about the model at all that maybe there ends on a Volkswagen.

I guess I'm wondering where it was generated from if you're finding very little applicability across the board.

MR. PALLA: If you'll look at our report -- there's a long list at the beginning. There's 135 potential SAMAs. This comes from a combination of SAMAs that have been identified in previous studies as well as plant-specific improvements that derive directly from the plant-specific PRA. So it's a combination of those.

And, then, they are basically screened through a number of different criteria.

Some of those improvements could relate to pressurized water reactors and are not applicable to a boiling water reactor, so those are easily dismissed. And, then, some of the other ones could be from another BWR that it may have had more value at one plant than another because certain accidents may be more likely at some plants than others.

The risk profile is the makeup of all the various accidents that contribute to core damage, and that profile is somewhat different from plant to plant. So that will impact whether a SAMA's beneficial at one plant and why it might not be at another.

MR. CAMERON: I think what Bob is saying is that there's not necessarily a model; that there is going to be a plant-specific SAMA done at each plant, and each plant is unique. Is that right?

MR. PALLA: That's right. I mean we don't expect that because an improvement was cost-beneficial at one plant. But we don't expect it would necessarily be at the next unit. But we have been asking licensees to address that.

When we've found them in previous reviews, we've asked them to explore them further to be sure that nothing falls through the crack.

MR. CAMERON: Give us your name.

MR. BOSWIN: It's Brian Boswin; I'm with the Huntsville Times.

MR. CAMERON: Thank you, Brian.

Ann Harris and, then, I think we have to move on to the final summary by Mike, and, then, get you all up there to listen to your more formal comments.

Ann.

MS. HARRIS: I've got four short questions that will take four short answers.

MR. CAMERON: We'll do them one at a time, then.

MS. HARRIS: Have you looked at any issues surrounding the shroud on Unit 1? Or have TVA?

MR. PALLA: Quick answer is, as part of SAMA evaluation we did not. This is another one of those operational issues.

A-1 MS. HARRIS: Since this unit is not operating, I find it remarkable that you base these decisions on operations when they aren't operating.

MR. CAMERON: Is that a question?

MS. HARRIS: That's a comment.

Did TVA test for embrittlement on the reactor in the reactor building that's been sitting for over 18 years?

MR. PALLA: Maybe one of the guys on the safety side could answer that because --

MR. CAMERON: In other words, that's not part of the SAMA.

MR. PALLA: That's right.

MR. CAMERON: P.T.? This is P.T. Kuo.

MR. KUO: As Chip says, my name is P.T. Kuo. On the safety side we review those type of things. We look at their reactor vessel, beltline level. We look at how the TVA people manage it, or inspect it.

This is being handled on the part of review. Like Dr. Masnik is talking about there's two power reviews. One power review is the safety side. And we have experts reviewing all those questions that you just raised.

MR. CAMERON: Thank you Dr. Kuo for that.

And Ram, did you have something you wanted to add to Dr. Kuo's.

MR. SUBBARATNAM: My name is Ram Subbaratnam, the Safety PM.

Safety is not a progress as fast like the environmental side. In the process of making the evaluation, we got the data, information from the licensee. We will be making a determination on that question in the future.

MR. CAMERON: So we are looking at it, then.

MR. SUBBARATNAM: Yes.

MR. CAMERON: Did you have a couple of others here?

MS. HARRIS: One other.

MR. CAMERON: One other.

MS. HARRIS: I'm sorry, two.

If you burn the cooling towers down again, how will you cool down; and have you looked at that problem as if it should happen again because we do know that it does happen?

MR. CAMERON: Part of the SAMA analysis?

MR. PALLA: No.

MS. HARRIS: Why not?

MR. PALLA: Well, it --

MS. HARRIS: It is that --

MR. CAMERON: Wait a minute, Ann. Let's make sure we get all of this on the record.

It is not part of the SAMA analysis. The question is, why not? Bob, do you want to clarify?

It's not as if an issue isn't looked at but it may not be looked at as part of the SAMA analysis.

MR. PALLA: What we tend to do in the SAMA analysis is focus on things that are recognized to be important contributors to risk. And this type of event is not identified in the risk assessment.

MS. HARRIS: (Inaudible)

MR. PALLA: Well, it has to be a credible event. These things are assigned probabilities, and I don't know what the probability of the event is that you're speaking of.

I could say that it is not -- it's showing itself as a dominant contributor to risk.

MR. CAMERON: Regardless of whether people like the answer or not, the answer is, it's not a dominant contributor to risk. I just want to make sure that people know that.

MR. MASNIK: Mike Masnik.

But you have to understand that the cooling towers are not necessary for the cool down of the facility. The ultimate heat sink for the facility is the river.

So if another cooling tower burned down, as one has in the past, it is not a vital system from the standpoint of the facility.

MR. CAMERON: One more question and, then, we'll go to you.

MS. HARRIS: How much input -- and what was the level of input -- where you looked at how much human error contributed to SAMA?

MR. PALLA: Well, human errors are important in the risk assessment. The way that this process is done, the probabilistic safety assessment would identify the important human actions. And, then, we use what is called "importance analyses," which is kind of a mathematical sensitivity study that shows how much risk could be increased or decreased if certain basic events in the model were either always perfect or always failed.

So what we tend to do with this model, the Probabilistic model is identify areas for improvements, and areas also for performance, if degraded, would cause a problem.

What we would tend to find is areas that an error that was important in the risk profile could be reduced through a procedural enhancement.

So when we find procedural changes as potential SAMAs, it general is because there was a human error that was important to risk that could be further reduced.

So our process tends to identify those human errors that are important, and, then, we look to ways that those human actions could be reduced.

That's what this analysis does, it looks for further reductions.

MR. CAMERON: All right. Thank you.

Yes, ma'am.

MS. HILL: I'm Brenda Hill and I am so confused. I do not understand. You have a model that is developed that you use to do a mathematical equation on; is that correct?

MR. PALLA: Yeah.

Our model is a representative of --

MS. HILL: Wait a minute. Give me a minute. Don't confuse me any more, okay.

You have a mathematical equation that takes in to account human error as well as physiological organic changes, and the buildings are falling down type stuff, and you put this in a mathematical equation.

MR. PALLA: We don't have buildings falling down. What we have is combination of events that have to occur simultaneously.

MS. HILL: Yeah, but you do have things happening to the buildings. I mean any time you have -- this building eventually is going to fall down, right?

MR. PALLA: No, we don't think the building is going to fall down. We can have someone from the safety side explain why not.

MS. HILL: Eventually, at some point in time, this building we're in right now will fall down. Yes or no.

MR. PALLA: Well, some day.

MS. HILL: Yes or no. At some point in time this building --

MR. PALLA: Sure.

MS. HILL: Okay.

MR. PALLA: We're talking a 20-year license renewal, and we're assuring that it won't happen in 20 years.

MS. HILL: You are taking mathematical equations and using them to establish whether or not this place is safe and, as part of a mathematical equation, you are taking in to account human beings who are prone to error, and you're telling me that your nuclear plants are going to be safer.

MR. CAMERON: One assumption, Brenda, that you need to remember about this whole SAMA analysis is that this is done to identify additional things to make it safer. It's not addressing, as Bob said before, whether the plant is safe. The assumption that it is safe and they put this analysis on top of it.

MS. HILL: Okay. Can you explain a little more to me about where did your model come from? What is it? I've heard of Chernobyl, I've heard of Three Mile Island, and all these others. Are those type of things taken in to account when you're doing this?

MR. PALLA: Yes, they are.

What the model is, is a recognition of physically what is in place to protect the core. So the basic function is core cooling, let's say, for the reactor. There are numerous pumps that can be used: high-pressure pumps, low-pressure pumps. Perhaps any of which would succeed.

In order to melt the core, you have to fail high pressure, you have to fail a depressurization function because you have low-pressure pumps as well. So if your high-pressure pumps fail, you can depressurize and use the low-pressure pumps.

You know, you could have an operator error, failure to depressurize, in which case, even if you had low-pressure pumps, they're of no use to you if you're at high-pressure.

But this model will look at the pumps that you have, the number of pumps. There is statistical information that describes the probability that the pump, even though it's there and thought to be operable, might not work. And if you have three pumps, then you have to have the probability that Pump A, Pump B, and Pump C don't work.

And, then, if you are looking at the low-pressure pumps, you have to have a failure to depressurize as part of that; and, then, you'd have to have failure of the low-pressure pumps.

So what the model does is look at all of the ways the core could be kept cool. And what it tells you is, these are the different combinations of things that would have to happen for the core to be damaged.

At Three Mile Island, for example, the operators had some mechanical problems, and, then, there could be some human errors in there, too.

This is part of the model is, the important human actions are modeled in the probability that those are not successful.

MR. CAMERON: If there's any further explanation that we could give Brenda after the meeting to maybe explain what exactly you mean by a model and how this works may be helpful.

MS. HILL: Well, you can explain it to me.

MR. CAMERON: Michael, do you want to sum up and, then, we're going to go out to people in the audience.

[Presentation by Michael Masnik]

MR. CAMERON: Thank you, Mike.

Now, we are going to hear from you. One thing we find useful in some cases is to have a representative of the license applicant make a few remarks about what their rationale and vision is in terms of license renewal. So we have Mr. Chuck Wilson, who is the Project Manager for the Environmental Review on license renewal from TVA.

Why don't you go up there, and will try and figure out what is causing this interference.

MR. WILSON: Thanks, Chip.

I'm Chuck Wilson. I'm the License Renewal Environmental Project Manager for TVA. I've got just a couple of very brief comments.

Next slide.

First, I want to say that a number of TVA reviewers are looking at this Draft Environmental Impact Statement, and TVA will be providing comments before the comment period closes, March 2nd.

B-1 I can also say that TVA agrees with NRC's overall conclusion that the environmental impacts of Browns Ferry License Renewal are minimal.

Next slide.

B-2 Also, I wanted to say, very briefly, being a Federal agency, in the spring of 2002 TVA prepared its own environmental impact statement addressing Browns Ferry License Renewal, and Browns Ferry Unit 1 restart. There were no significant environmental impacts, and license renewal was found to allow power production without green house gases, which is consistent with TVA's clean air initiatives. It also maximizes use of existing assets and avoids the impacts of new site construction.

So, our overall conclusion at that time that it was an environmentally sound thing to do.

Thanks. That's all the comments I have.

MR. CAMERON: Thank you very much, Mr. Wilson.

I was going to go to Ann Harris next. Ann, do you want to stretch out a little bit?

MS. HARRIS: Yes.

MR. CAMERON: Let's next go to Mr. Speegle and, then, we'll go to Julie Leg. and, then, Dawn Knox after that. Eventually, we'll get to Ann Harris and the rest of you.

Mr. Speegle.

MR. SPEEGLE: First of all, I'd like to say thank you all for letting us have this opportunity to get our concerns on paper.

My name is James Speegle. I was a painter at Browns Ferry Nuclear Plant and a Foreman inside the torus for the better part of over a year.

C-1 The things that I witnesses inside the torus, they're scary. But you guys didn't get a chance to see that because the mess was mopped up, okay.

I don't blame TVA for this. I blame the contractor. Okay. TVA is doing the best they can do to
C-2 straighten the problems out. I realize that. I'm not here to beat them up. And nobody needs to sit here and think I'm against nuclear power. I'm not. We got to have it. We got to have energy.

C-3 The thing that bothers me the most is when a man from supervision will stand there and tell you: Don't worry about it. They'll pay you come Wednesday. Confusion is money. If they don't like the way we done it this time, it tears me up, we'll do it again, and they'll pay us for it.

These are not people that are worried about safety. These are people that are worried about filling their pocketbooks to where they can go back home, stay there, and live comfortably, and let us have to deal with the problems they caused at this plant.

Is there ever going to be a problem? Who knows. They didn't think there would be one at Chernobyl either.

C-4 Eighty-two percent of the kids born in Chernobyl over where Chernobyl is at in Russia, is born with birth defects. Eighty-two percent. And some of it could have been prevented. Maybe some of this can be prevented up here. This is definitely a safety issue that needs to be addressed.

I do know that NRC is looking into some of this stuff.

C-5 The gentleman onsite that conducted all this stuff has made the comments in the last two weeks that he has been cleared of all charges. I haven't even gotten a report from NRC yet saying what the results were. He's saying NRC is telling him this.

It makes me, and other people, think that NRC is helping cover things up. I don't look at it that way. I hate to. But this gentleman on site is a safety issue himself. Okay.

C-6 That whole contracting company up there filed bankruptcy years ago. They're using this, at the cost of safety to everyone in this community, to regain what they lost years ago. That's not our fault. That's bad management.

TVA may or may not want to look into this of you getting another contractor.

Obviously, I was right about the things I complained out, or Williams Power would never have been brought in to redo what Stone and Webster worked on for almost a year.

C-7 The plant itself has got to have a cooling system that works.

The paint chip -- people say well, painting. Painting don't really matter. Painting does matter. Ask Davis Bessie Plant. Some of you guys probably already know that they had to redo a lot of their painting in their systems too.

C-8, C-9 Browns Ferry Unit 2 and 3 run efficient. They run clean; they run good. I worked on Unit 3. Nothing in Unit 1 has been done the way Unit 3 was revamped and redone back in the early 90s. Nothing. Everything has changed differently. The torus was redone right.

C-10 This torus started out -- and I do believe it was financial gain, and they throwed safety out the window to get there.

We had a man to get internally contaminated in there by these people, by instructing him to do the things the wrong way.

I stopped two other gentlemen from doing the job. They stuck him in. He done it the way they wanted; he got internally contaminated. He has yet to get a report from NRC as to why these people didn't get disciplined for sending him in there like that. Why?

I mean did the report not be sent to NRC, or is it just not been finished yet to get back with him. It was over eight or nine -- well, close to a year now that he was internally contaminated under instructions by people that are still in that plant doing things in this manner.

C-11 Like I said, I don't blame TVA for this. I blame the contractor. But ultimately, somebody has got to clean house. And I think somebody needs to start cleaning house pretty soon before we have major problems that we can't correct.

C-12 It's a shame to have to stand here and look like I'm degrading somebody because they fired me. That's not what I'm here for.

I was paid $1200 a week; I went down to $210 and it took eight weeks to get that. I was financially hurt from this. That wasn't what I done it for. I could have kept my mouth shut and went on. I didn't. I did this for the community and for the fact that I know that was being done wrong up there. And like I said, if I was wrong about what I complained about, they never would have spent those many millions of dollars to have it redone.

C-13 So I would like to ask you all today if you all would please find out who instructed it to be redone as far as the inside of that torus. Who come up with the initiative to say, hey, maybe there is a problem. Let's stop back and find out what we got to do.

All they had to do was listen to the people inside the plant that knew what to do to begin with, and that was to sandblast it from water line to water line and the problem never would have occurred.

C-14 We skipped around over rust. And every time we would ask why are we missing this spot and doing this one? Our answers we got back were "They'll pay us to do it on another contract."

Well, that's wrong. That is greed. And they threw safety out the window for greed.

If anybody in here feels I'm wrong about that, please, give me a comment right now. I need to know. Am I thinking the wrong thing when I'm worried about this plant shutting down and not being able to cool down because the torus is being done wrong?

Now I know it is done right.

C-15 Thank you TVA for making sure this thing is done right. I really appreciate that. I think you all had a big part in the overall redo of this torus.

But I spoke up, exactly what your open-door policies tells me to do. And it says there's no reprisals towards anyone for speaking up. Well, I got reprised against me. They run me off. Cost me my livelihood.

I can't hardly work anywhere anymore. I can't get a job paying anything near what I was making up there. And it's not because I'm not skilled, it's because I got tired of looking at what was going on.

I'm asking you to eliminate the problem. Eliminate the problem and get this thing back on track.

You said you made milestones and everything was in line, maybe so. It might have been met.
C-16 But I was in that torus and two milestones were missed.

Now that might have been Stone and Webster's milestones; it might have been TVA's milestones. But they were missed. Because every time we go to the point of finishing up, they would come and say, hey, we're not going to make it. And when they would talk about milestones, everybody knows here they're talking about money, their bonuses.

Cut the bonuses out. Make them do it right. If the job ain't right, don't pay them.

I think Stone and Webster ought to have to reimburse TVA for the redo that Williams Power put out, and the money that was spent towards them. Stone and Webster ought to be accountable for that money.

I mean, would that not be a fair assumption? If somebody pays me to do something for them, and I don't do it right, and somebody has to redo it, I should be the one forking the bill over.

I just think that TVA took a rough beating on this thing too, but I took it too.

C-17 I don't know how to stress to you the importance of how it is to get this situation under control, because the same people that done this in the torus are the same people still up there running things in that plant. Everything from the lead, everything from the non-lead that was treated like lead, and then created so much toxic chemicals that, ultimately, TVA has got to pay to have it buried or put some where.

I mean why do you want to create waste when it didn't have to be created. They made money on it.

They claim 150 and 60 spots of lead removal a day. We couldn't do 20. With the crew we had, I promise you, we couldn't do 20.

It is pitiful to sit here and know all this went on and you can't get any answers from anybody.

I asked some questions earlier and they said, well, upper management is looking at it and everything. And I appreciate that, but I need some answers.

I have trouble sitting around at night thinking what's going on at that plant. And this is not
C-18 because I was fired. Like I said, I could have kept my mouth shut and made my $1200 a week and took my family on vacations. I didn't do that. I didn't do that. I stood up for what this paper right here tells me what I should and could do. And I got fired for it. And it is because people threw safety out the door and wanted to get their pockets full of money. And that's basically all it came down to.

And I'm asking you guys to keep an eye on the safety. I can't stress it enough. It needs to be looked at.

There's a book *Corrosion Prevention by Protective Coatings* by Charles G. Monger. This book tells you everything you need to know. Everything in this book was done inside that torus. It even gives you the attitude of the people that run the job in that torus.

I got several copies of it. I would like to speak to TVA, NRC before I leave here today and give some of these copies to you all and let you all sit and read them and see what I'm referring to. It's textbook stuff. All they had to do was go by the book.

They threw the book out and grabbed the money, and safety was an issue that really got throwed out.

Thank you very much.

MR. CAMERON: Thank you, Mr. Speegle, for taking the time to come down to talk to us, too.

Ann Harris, are you ready now?

MS. HARRIS: Yes.

MR. CAMERON: This is Ann Harris. Ann is with the Sierra Club.

MS. HARRIS: My name is Ann Harris, and I represent the State of Franklin Group of the Tennessee Chapter of the Sierra Club.

A-2 I am here today because I find that the NRC staff does not have a low that they will stop at to bend over for the nuclear industry.

A-3 In this place several months ago, Chip, you and the Region II boys and the Rockville staffers all went to great length to assure me that, if the NRC knew that the untried fuel process from the Erwin, Tennessee plant of Nuclear Fuel Services, using France's Framatome process, would be a part of the EIS, when completed.

Now that was to be the fuel that was to be used here at this plant for those of you here who don't know.

NRC would make that part of the EIS.

You quickly stated that I didn't need to worry. Boys, I'm worried.

A-4 I can't determine if the NRC staff is the world's largest group of paid snake oil salesmen or just totally incompetent. Maybe you can't read or understand the English language. I don't know. Maybe you don't know how to spell Framatome. Maybe you don't know how to spell NFS. How about if I give you some more clues?

A-5 In a letter dated August 27, 2003, addressed to the Director of the Office of Nuclear Material and Safeguards, which is at the NRC, Framatome began the letter and wrote, and I quote.

"As discussed with Mr. Peter Lee of the Fuel Cycle Facilities Branch and various other NRC staff members during a meeting with FANP representatives at your headquarters on July 21, 2003, FANP is planning facility modifications at its Richland, Washington facility to support the processing of Blended Low Enriched Uranium (BLEU)..." And I'm not sure what this is. It says ..." UO2 powder for use in the fabrication of TVA's BW fuel bundles."

The letter is signed by D. W. Parker, Manager, Environmental Health, Safety and Licensing. It is on Framatome letterhead. How can you ignore this information in this EIS?

So you'll know, TVA has only one nuclear boiling water reactor site, Browns Ferry.

A-6 That is the same site referred to in the letter referenced above. And I find it remarkable that you still don't want to save the rate payers the cost of another hearing and put the analysis in

A-7 the EIS. I understand that TVA has plenty of money. And yeah, I understand you boys are not concerned about money since your salaries will be paid regardless of whatever remarkably bad decision you produce.

A-8 Also, I did notice that you forgot to get the language correct in the transcript copy I received by mail concerning the NFS and Framatome fuel issue. I have a copy here so you will know where to look. This copy came out of your document room in Rockville, prior to your last meeting with me here in this room, and was retrieved down here, in Tennessee, by computer, late one night when I had nothing to do.

A-9 And I pay particular attention to the so-called "official record" of the last meeting we had down here. Where you erased the part about how you would address the fuel issue that I questioned you on if you had the knowledge. Boys, it is time that you found new dictionaries and begin to read.

A-10 I have recently taught adults at the junior college level and I cannot imagine having one of your written decisions given to me to grade. Let me tell you, you have failed my classes, since I have put forth a decision for class work on how not to do research and what failures you are on ethics, language and your responsibilities as government employees.

Somehow I will find a way to ask my U.S. Congressman to retrieve your salaries because of

A-11 malfeasance in office. For the uneducated, it means intentional wrong doing. How you deny your incompetence and continual actions that promote you as a laughing stock of the entire US? Are you so incompetent that you can't find jobs elsewhere rather than become snake oil salesmen? I'm amazed.

A-12 I give you further examples of your continued malfeasance. TVA obtained its first license for building nuke plants for this very plant in the last century, during the sixties. For those of you who are not old enough to know. That was over forty years ago.

In the seventies, you were advised and carried a load of embarrassment into congressional hearings during the eighties about the abuse of employees by TVA management in direct violation of federal law.

Now here we are today with the same boiler plate statement that TVA does not condone abuse over public health and safety.

A-13 When you look at Mr. James Speegle, here, how do you look him in the eye and tell him that you, the NRC, cannot stop the abuse because you refuse to do what is required to stop the abuse of those such as Mr. Speegle that feel that Public Health and Safety is important and refuse to take the abuse from TVA managers over safety problems?

A-14 In 1993, when I found the infamous Memorandum of Understanding between TVA and NRC stating that the NRC would turn over to TVA management names of those raising safety issues to the NRC, I was embarrassed for you guys. And here we all are 12 years later and the practice in that agreement is still being carried out. Don't correct me.

I know you canceled the MOU, but you forgot to stop the practice. Do you boys here today know that TVA's record at the Department of Labor is the largest in the nation? And did you know that you have never been able to stop that abuse because of your refusal to do your job?

A-15 All the time and words in the world will never heal the continued incompetent of the NRC staff and commission. Your continued refusal to perform your jobs is a clear indicator that the NRC will continue to put public health and safety below industry financial report. The time will soon come when your actions will come to hit you in the seat of the pants as you leave a nuclear site.

I ask that you rethink your position on drafting up an EIS that permits TVA to burn nuclear weapons materials in this reactor.

I ask that you look at your obligations as public employees and see the wrong in such a

A-16 decision as permitting this plant to go forward without the analysis for the type of fuel that TVA will burn here.

A-17 And least you forget, I remind you of the recent 32-ton crane trolley that was dropped between the reactor buildings. And what is worse, you cannot determine if the accident -- excuse me, unplanned event -- is a safety issue. And you want the public to trust you.

A-18 In my 21 years of dealing with you boys I still cannot trust you with public health and safety. How sad you are.

By signed copy of this letter, I formally request that this statement be a part of the official record of these proceedings.

MR. CAMERON: Obviously, we need to go back and -- pardon me?

MS. HARRIS: I expect some answers.

MR. CAMERON: We need to go back and look at what we said about analyzing this particular type of fuel. And if we can shed any light on that before the meeting is over, we'll do that. That is a comment to look at that, and we receive it as such.

Dawn or Julie, either one of you prefer to go first?

(Inaudible)

Do one of you want to come up right now? Dawn Knox.

MS. KNOX: Hi, my name is Dawn Knox. I am a citizen of Madison County, Alabama. I'm 24 years old.

I heard about this Nuclear Regulatory Commission Meeting in the Huntsville Times. I felt like it is my duty, as a citizen, to come up here and contribute what I have to contribute.

I've done a little bit of studying and I do have several questions that I would like to be answered.

D-1 But my main concern is, I found out that 15 percent of the energy that is derived from the 375 nuclear power stations in the United States that six are on a critical list, and one of them happens to be Browns Ferry Nuclear Power Plant. Or was as of 1988. And that was my concern and still is my main issue.

I do have several questions about that also. What is the Nuclear Regulatory Commission doing to reduce the factors that makes Browns Ferry Nuclear Power Plant one of these ones that is or was on the critical list as of 1988?

D-2 And during relicensing are there any top priority issues in the maintenance and infrastructure of any of the nuclear power plants? Specifically, Browns Ferry Nuclear Power Plant in Limestone County, Alabama; Sequoyah Nuclear Power Plant, Dekalb and Jackson County; and Joseph M. Farley Nuclear Power Plant of Houston and Henry County. And if so, are any of them manufactured issues waiting to a transition over to a newer, better, more advanced technology.

D-3 Are we moving over to a more efficient form of energy?

I have several questions. I would like to get with a few of you afterwards, if that is okay.

Thank you.

MR. CAMERON: We will be happy get with you on the issues that you raised as well as any other questions that you have right after the meeting, and take as long as we need to do that.

Julie?

MS. LEG: I'll submit my questions and comments in writing.

MR. CAMERON: Okay. I'm sorry if I misunderstood. And if you have questions you want to talk to the staff about, please feel free to do so.

We heard from Mr. Horn earlier, and I believe he wants to make a comment now.

MR. HORN: This is Stewart Horn. I provided comments at the Environmental Scoping Meeting
E-1 for Browns Ferry held in Athens last April. At that time I raised concern about the safety of the containment structures for the three units as a result of the containment vessels being thermally shocked through repeated automatic shutdowns of the reactor units. I had previously raised this issue with TVA when it requested public comment concerning extending the life of the three reactors in 2001. I received no response from TVA concerning my comments.

E-2 As many people don't remember, and TVA never advertises, TVA had such a horrible operating record in the initial 10 years of operation (1975 to 1985), that all three reactions were shut down in 1985 reportedly due to safety concerns and repeated safety violations.

It took six years to reopen Unit 2 and ten years to reopen Unit 3. Unit 1, in which the near disastrous fire occurred, never reopened and has been mothballed for almost 20 years. During the ten years of initial operation, TVA was plagued by an amazingly large number of
E-3 reportable occurrences. I went to the Athens Library during this time and reviewed some of the statistics in the Browns Ferry operating records which, at that time, were maintained in the library.

Over a period of less than four months in the fall of 1980, there were 66 reportable occurrences at the three units or more than one every two days at Browns Ferry facility. These events were fairly evenly distributed among all three reactors (Unit had 23, Unit 2 had 21, and Unit 3 had 22).

If operation during the above time period was typical of Browns Ferry operation over the first ten years, then more than two thousand reportable occurrences would have occurred at Browns Ferry in the first ten years of operation. I couldn't determine at the time how many of the reportable occurrences had resulted in SCRAMS or automatic shutdowns of the nuclear reactor, but my understanding at the time was that automatic shutdowns often occurred.

During the 80s, I read a lot about nuclear power generation. I learned that when an abnormal event triggers an automatic shutdown, it is somewhat of an emergency process. This process is designed to shut down the reactor much more rapidly than when the reaction is shut down using normal operating procedures. The faster than normal cooling of the reactor containment structure thermally shocks the structure resulting in great stresses throughout the structure with the disturbing potential of weakening it. Reportedly, this could result in premature aging of the containment structure.

E-4 After the meeting last April, I went to the Athens Library to try to determine how many automatic shutdowns had occurred at Browns Ferry. The historical NRC Browns Ferry files are no longer there. I called NRC. They told me that the information would be available through the online NRC public documentation system. I struggled to try to find the data online, but eventually gave up after suffering severe frustration. I then called NRC and requested that someone there find the data for me, but I never received any information.

E-5 The only response I received from the NRC relative to my comments was that the issue I raised was a safety issue and would be part of the safety review and not part of the environmental
E-6 review. I was told that the safety review meetings would be conducted in Washington, and I was not able to attend these. Hopefully, this issue was dealt with during the safety review, and there is someone at today's meeting that can discuss this and explain the results of the safety review and how the above concerns have been resolved.

E-7 What has the NRC done to assure and how does the NRC know that the reactor containment vessels at the facility are structurally sound and capable of safe operation for 20 years beyond there "designed to" life?
Before approval is granted by the NRC to extend reactor life by fifty percent, at least the
E-8 following should be done as a minimum:

TVA should report the total number of automatic shutdowns that have occurred at each Browns Ferry reactor during its operation.

The NRC should investigate (and report to the public about) the reportable occurrences, automatic shutdowns, or other safety violations which have occurred at each reactor including the significance of these events relative to the safe operating lifetime of the reactors.

E-9 If there is any possibility of premature aging of any of the containment vessels as discussed above, TVA should be required to determine by scientific measurement the structural soundness of each reactor containment vessel using non-invasive techniques or whatever method is available. If these techniques do not exist, TVA should be required (before license approval) to develop the techniques and undertake the testing and analysis to determine and be able to assure the local public and the NRC that there is no danger of containment vessel failure.

E-10 I believe that there have been a significant number of automatic shutdowns of the three Browns Ferry reactors. If that is the case, and if what I read about the effects of these events is true, this of major concern to anyone living in this area or downwind. There is the possibility that one or more of the Browns Ferry containment vessel structures have been weakened and prematurely aged. This could pose a serious threat for the people of the Tennessee Valley, especially considering that the TVA and NRC are in the process of extending the operation of all three reactors fifty percent beyond their "designed to" operational life.

E-11 I have another question for the NRC regarding relicensing approval of the mothballed Unit 1 reactor. Have you already renewed the operating license of this reactor, or have you informed TVA that approval of license renewal is guaranteed? The TVA has spent $885,000,000 on this project, and it is beyond belief that they would have done such a thing if there may be the remotest possibility that approval might not be forthcoming. If approval has not already been granted or is not guaranteed, has the NRC encouraged the TVA to initiate work on this project under these circumstances?

Thank you for your time and attention. I appreciate the process that includes and encourages the public to comment.

MR. CAMERON: Thanks, Mr. Horn, and our safety people are going to talk to you about this. Thank you.

Mr. Timberlake.

MR. TIMBERLAKE: Good evening, ladies and gentlemen, members of this distinguished and illustrious country, to those that we have entrusted our lives to.

F-1 It is with great sadness that I stand before you hearing such appalling reports that our citizens have laid against you, right or wrong. However, TVA, I know is an agency that has a very thick skin. No matter how much you tell them the truth, they seem to find ways to spin it differently.

Having said that, I am Ralph Timberlake from -- I reside in Huntsville, Alabama, and I live downwind from this one reactor, which is Browns Ferry, and I got the other one on the other end of me, Bellefonte. I understand it is fixing to crawl back on line.

F-2, F-3 I'm a proponent being against nuclear power. I think the cost-benefit analysis has not shown itself to be worthwhile.

As someone alluded to earlier about the Chernobyl factor and the Three Mile Island, we have not successfully cleaned up those areas. Those areas have been lost to our grandchildren and generations past them. It is something for us to consider.

F-5 Nuclear power, though we should not be afraid, is not something that we can control. We do not fully understand it. We're talking about 20,000 years before it is fully decayed and, then, we don't know if it is going to be safe. It is all speculation. Unless someone here lives longer than some of the Pharaohs that we are finding mummies of these days.

F-6 I would like to say that given the fact that information is very difficult to obtain through the bureaucracy that this license renewal should be withheld. I do not think that the track record of TVA warrants us a renewal, based on not unequivocal answers.

The people who presented their case today kept saying, well, this doesn't apply this; this
F-7 doesn't apply to that. It's not a matter of what it applies, because if I get some of that nuclear radiation in me, I cannot get it out. It will affect me and my children and all the way down the line.

As you well know, TVA got in trouble with polluting the water, and I think someone make something about how are you going to cool this reactors down. By the river.

F-8 But if I remember a little bit of the information I read at one time, if you raise the water temperature in the water, in the rivers and other stream, it can have an impact, a severe and negative impact upon the wildlife that deals with this water, and the fishery and all the other animals and mammals that is within that water. How far down stream that's going to affect, no one took the time to deal with.

Hopefully, the pristine area that we reside in here will be maintained. Though we are in an
F-9 agrarian area, per se, except for probably Redstone, we would like to retain that. We would like to believe that we are going to have these pristine trees, we're going to have viable fisheries and other means of transportation to which these two reactor -- this reactor which you are talking about today could have a severe impact and, then, we are going to be back discussing probably again Bellefonte, if that's going to have an impact.

F-10 If we can somehow restore the public trust in our officials, if we cannot trust our officials, which seems from the comment earlier, we cannot, something needs to be done.

I would entreat you to take the time, those that are in authority and those that are receiving our trust and our funds from our taxes, would take time to try to restore public competence and trust in you.

If we don't trust you, it is going to be a problem. And, then, surely reprisals should be a horror to all of us sitting here. If the people, which we are a people-driven government, let us understand that -- you cannot be everywhere at one time. If the eyes and ears of those that are willing to put their families and lives on the line are not rewarded, is not appreciated, we do ourselves and our posterity a great and horrendous disservice.

So I beg you, beseech you that you some how take time to look at this matters and do not be afraid for the sake of money 'cause no amount of money is worth their life of one single person.

And I would like to leave you with one saying, *Pax vobiscum*. That means peace go with you.
F-11 We need peace in this valley, and that nuclear plant out there is not only a target for everything else, it is the source of contention right now.

I again thank you for taking the time, and I really appreciate the service you try to do. Just work with us and we'll try to work with you all.

Thank you.

MR. CAMERON: Thank you, Mr. Timberlake.

Hopefully, our analysis in the Final Environmental Impact Statement is going to be creditable. You will be able to see what decisions we are making, and why. The NRC staff is available to answer questions, to talk to people if they have concerns. If there's things that are not understood, if there's something that has been overlooked, we're very open in that regard.

That's the last speaker that we had.

Ann, did you have something else you wish to say?

MS. HARRIS: Yes. I want to know if your comments that you would address the issue on the
A-19 fuel is on the record this time.

MR. CAMERON: Yes, it is.

Because we don't have a cordless and because Ann has a little bit of a back problem that prevents her from getting up to that mic, just let me reiterate for the record what she said, which I believe you said: That it was my comment that we would need to look at the transcript from the last meeting and see what we actually did say about that issue. That is on the record.

Now the NRC staff might want to say something in that regard now. I don't know. I think Mike Masnik does. Michael.

MR. MASNIK: Ann, I did go back after the meeting and I did look in to your issue. At first I thought you were talking about MOX, but after a while I realized it was the BLEU fuel. To be honest with you, it took me a week or so to figure out all the ramifications because that review is being handled by our Materials folks, which is a different organization within the Agency.

Anyway, the results of my looking in to it are summarized in the Scoping Summary Report, which I believe was sent to you, which looked at issues, and this issue is outside the scope. Nevertheless, we will address it in the Final Environmental Impact Statement. I'll be sure that we will address the issue.

MR. CAMERON: Thank you, Mike.

As Mike said, just to summarize because there was important statements made about what the NRC staff did in that regard, is that we did not overlook the issue. We did look at it. We didn't think it was in the scope of license renewal. It doesn't mean it is not an important issue. It means that it is not within the scope of license renewal that's explicitly talked about in the scoping study. We have heard the concern again, and we will look at it again in the context of the Final Environmental Impact Statement.

So I think it is important for people to hear that we did listen to that. We didn't gloss it over. We will look at it again.

Thank you all for being here.

We have another meeting tonight at seven o'clock, open house at six. We welcome all of you to come back and talk to us again, in addition to other people. Tonight, we are going to sit down with any of you who want to discuss issues further.

I know that Julie and Dawn have some questions. Julie raised an issue early on about participating in the hearing. We have our representative from Office of General Counsel here.

I'm going to turn it over to Andy Kugler, who is the Chief of the Environmental Review Section.

We do have something that we call a feedback form, perhaps rightly called the feedback form today, but it is to give us an evaluation of things we could do in terms of these meetings, in terms of notice, whatever, but we welcome your comments. They help us. They are in the back of the room. You don't have to fill them out now. If you want to, that's fine. You can leave them with us, but they already are franked. In other words, you could just put them in the mailbox and we'll get them.

Thank you.

Andy, do you want to --

MR. KUGLER: That was amazing. I did want to mention the Meeting Feedback Forms. We do appreciate getting feedback from you, looking for ways to do things better, to make the meetings more useful for you.

Other than that, I just wanted to thank you for coming to our meeting, for participating with us, and we will stay around after the meeting to talk to you and hopefully be able to answer some of your questions.

Thank you.

(Whereupon, at 4:00 p.m. the session was ended.)

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Stewart Horn
498 Keel Hollow Rd.
New Hope, AL 35760
January 25, 2005

The Nuclear Regulatory Commission
Washington, D.C.

The following comments are submitted concerning the Draft Supplemental Environmental Impact Statement for License Renewal at Browns Ferry Nuclear Power Plants, Supplement 21.

I provided comments at the Environmental Scoping meeting for Browns Ferry held in Athens last April. At that time I raised concern about the safety of the containment structures for the three units as a result of the containment vessels being thermally shocked through repeated automatic shutdowns of the reactor units. I had previously raised this issue with TVA when it requested public comment concerning extending the life of the three reactors in 2001. I received no response from TVA concerning my comments. K-1

As many people don't remember and TVA never advertises, TVA had such a horrible operating record in the initial 10 years of operation (1975 to 1985), that all three reactors were shut down in 1985 reportedly due to safety concerns and repeated safety violations. It took 6 years to reopen Unit 2 and 10 years to reopen Unit 3. Unit 1, in which the near disastrous fire occurred, never reopened and has been mothballed for almost 20 years. During the 10 years of initial operation, TVA was plagued by an amazingly large number of Reportable Occurrences. I went to the Athens Library during this time and reviewed some of the statistics in the Browns Ferry operating records which, at that time, were maintained in the library. Over a period of less than four months in the fall of 1980, there were 66 Reportable Occurrences at the three units or more than one every two days at the Browns Ferry facility. These events were fairly evenly distributed among all three reactors (Unit 1 had 23, Unit 2 had 21, and Unit 3 had 22). If operation during the above time period was typical of Browns Ferry operation over the first 10 years, then more than 2,000 Reportable Occurrences would have occurred at Browns Ferry in the first 10 years of operation. I couldn't determine at the time how many of the Reportable Occurrences had resulted in SCRAMS or automatic shutdowns of the nuclear reactor, but my understanding at the time was that automatic shutdowns often occurred. K-2

During the 1980s, I read a lot about nuclear power generation. I learned that when an abnormal event triggers an automatic shutdown, it is somewhat of an emergency process. This process is designed to shut down the reactor much more rapidly than when the reactor is shut down using normal operating procedures. The faster than normal cooling of the reactor containment structure thermally shocks the structure resulting in great stresses throughout the structure with the disturbing potential of weakening it. Reportedly, this could result in "premature aging" of the containment structure. K-3

After the meeting last April, I went to the Athens Library to try to determine how many automatic shutdowns had occurred at Browns Ferry. The historical NRC Browns Ferry files are no longer there. NRC told me that the information would be available through the on-line NRC public documentation system. I struggled to try to find the data on-line, but eventually gave up after suffering severe frustration. I then called NRC and requested that someone there find the data for me, but I never received any information. K-4

The only response I received from the NRC relative to my comments was that the issue I raised was a safety issue and would be part of the safety review and not part of the environmental review. I was told that the safety review meetings would be conducted in Washington, and I was not able to attend these. K-5
Hopefully, this issue was dealt with during the safety review, and there is someone at today's meeting that can discuss this and explain the results of the safety review and how the above concerns have been resolved. K-6

What has the NRC done to assure and how does the NRC know that the reactor containment vessels at the facility are structurally sound and capable of safe operation for 20 years beyond there "designed to" life? K-7

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K-8 Before approval is granted by the NRC to extend reactor life by 50% at least the following should be done as a minimum:

1. TVA should report the total number of automatic shutdowns that have occurred at each Browns Ferry reactor during its operation.

2. The NRC should investigate (and report to the public about) the Reportable Occurrences, automatic shutdowns, or other safety violations which have occurred at each reactor including the significance of these events relative to the safe operating lifetime of the reactors.

K-9

3. If there is any possibility of premature aging of any of the containment vessels as discussed above, TVA should be required to determine by scientific measurement the structural soundness of each reactor containment vessel using non-invasive techniques or whatever method is available. If these techniques do not exist, TVA should be required (before license approval) to develop the techniques and undertake the testing and analysis to determine and be able to assure the local public and the NRC that there is no danger of containment vessel failure.

K-10 I believe that there have been a significant number of automatic shutdowns of the three Browns Ferry reactors. If that is the case, and if what I read about the effects of these events is true, this is of major concern to anyone living in this area or downwind. There is the possibility that one or more of the Browns Ferry containment vessel structures have been weakened and prematurely aged. This could pose a serious threat for the people of the Tennessee Valley, especially considering that the TVA and the NRC are in the process of extending the operation of all three reactors 50% beyond their "designed to" operational life.

K-11 I have another question for the NRC regarding relicensing approval of the mothballed Unit 1 reactor. Have you already renewed the operating license of this reactor, or have you informed TVA that approval of license renewal is guaranteed? The TVA has already spent $885,000,000 on this project, and it is beyond belief that they would have done such a thing if there may be the remotest possibility that approval might not be forthcoming. If approval has not already been granted or is not guaranteed, has the NRC encouraged the TVA to initiate work on this project under these circumstances?

Thank you for your time and attention. I appreciate the process that includes and encourages the public to comment.

Sincerely,

Stewart V. Horn

Stewart V. Horn

01/28/2005 10:31 9315892778 S ANDERSON PAGE 02

January 25, 2005

Browns Ferry Nuclear Plant
Athens, Al, Meeting on EIS

My name is Ann Harris. I represent the State of Franklin Group of the Tennessee Chapter of the Sierra Club

I am here today because I find that the NRC staff does not have a low that they will stop at to bend over for the nuclear industry. In this place several months ago, Chip, you and the region II boys, Rockville staffers all went to great lengths to assure me that if the NRC knew that the untried fuel process from the Erwin, TN plant of Nuclear Fuel Services (NFS) using France's Framatome process, the NRC would make that a part of the EIS. You quickly stated that I need not worry. Well boys, I am worried. L-1 L-2

I cannot determine if the NRC staff is the world's largest group of paid snake oil salesmen of just totally incompetent. Maybe you cannot read or understand the English language. Maybe you don't know how to spell Framatome, maybe NFS? How about if I give you more clues? L-3 L-4

In a letter dated August 27, 2003, addressed to the Director, Office of Nuclear Material Safety and Safeguards, (at the NRC), Framatome began the letter and wrote (quote):

> **"As discussed with Mr. Peter Lee of the Fuel Cycle Facilities Branch and various other NRC staff members during a meeting with FANP representatives at your headquarters on July 21, 2003, FANP is planning facility modifications at its Richland, Washington facility to support the processing of Blended Low Enriched Uranium (BLEU) UO_2 powder for use in the frabrication of TVA's BWR fuel bundles." (End quote).**

The letter is signed by D.W. Parker, Manager, Environmental Health, Safety and Licensing. It is on Framatome letterhead. How can you ignore this information in this EIS?

So there is no mistake and you will know, TVA has only one nuclear boiling water reactor site. Browns Ferry! L-5

That is the same site referred to in the letter referenced above. And I find it remarkable that you still don't want to save the rate payers the cost of another hearing and put the analysis in the EIS. I know that TVA has plenty of money, and you boys are not concerned about money since your salaries will be paid regardless of whatever remarkably bad decision you produce. L-6

Also I did notice that you forgot to get the language correct in the transcript copy I received by mail concerning the NFS and Framatome fuel issue. I have a copy hre so you will know where to look. This copy came out of your document room in Rockville and was retrieved down here, in TN, by computer, late one night when I had nothing to do. L-7 L-8

And I did pay particular attention to the so called "official record" of the last meeting we had down here. Where you erased the part about how you would address the fuel issue that I questions you on to determine if you had the knowledge. Boys, it is time that you found new dictionaries and begin to read. I have recently taught adults at the junior college level and I cannot imagine having one of your written decisions given to me to grade. Le me tell you, you have failed my classes, since I have put forth a decision for class work on how not to do research and what failures you are on ethics, language and your responsibilities as government employees. L-9

Ann Harris
1/25/05
NRC
Athens, AL

Transcript of the Evening Public Meeting on January 25, 2005, Athens, Alabama

Evening Session (7:00 to 10:00 p.m.)

[Introduction by Chip Cameron]
[Presentation by Andy Kugler]
[Presentation by Mike Masnik]

MR. CAMERON: You just heard from Andy and Mike about our process. Are there any questions at all about process that we can answer before we go on to the Draft Environmental Impact Statement?

Yes, and please introduce yourself to us.

MS. TIPPER: Jackie Tipper.

The scoping meeting, where was the scoping meeting, and who were the people involved with that?

MR. MASNIK: It was a meeting very similar to this one, in this room. It occurred on April 1st of this year, and we had, I would say, what(?) about 20 members of the public in the afternoon and probably about an equal number in the evening. It was a noticed meeting held in this room.

MS. TIPPER: In this one?

MR. MASNIK: Yes, in this room, on the first of April of this past year.

MR. CAMERON: Mike, maybe to alleviate some of Jackie's concerns, maybe you could just talk a little bit about scoping versus the comment on the Draft Environmental Impact Statement where I think this is probably -- although scoping is important, this is a major event.

MS. TIPPER: Let me ask another question.

MR. CAMERON: Go ahead.

MS. TIPPER: This meeting, Dennis Sherad did an article in the Times Daily. I read the Decatur Daily front and back, except I do not read the classified ads. I saw nothing in the Decatur Daily about this meeting at all.

MR. MASNIK: Well, my understanding --

MS. TIPPER: How are people supposed to, you know, know about this?

MR. MASNIK: Well, we attempt to notify the public in a number of different ways. To answer your question specifically, I believe it was in the classified ads of the Decatur Daily. We had ads in four newspaper: Florence, Huntsville, Athens and Decatur. And my understanding was last -- not this past Sunday but Sunday a week ago there was an article and in that article it happened to mentioned this meeting. That may have been where you had seen it. I believe it was in the Decatur Daily that article was published.

MS. TIPPER: The information I got was from the Times Daily. I didn't find any information from Decatur Daily at all.

MR. MASNIK: Oh, I'm sorry. Okay.

MS. TIPPER: And I called them and asked them why there had been no information, and they had no idea what I was talking about.

MR. MASNIK: Well, we do put out a press release. So there is a press release that's issued. We publish the ads in the papers. Of course, we don't pick all the papers, but we try to get representative papers from each of the communities surrounding the plant. We publish it in the Federal Register. We maintain a website, the NRC website and all the meetings are noticed there. We notified the local governments, and we ask them to announce it at their town council meetings.

I mean we do everything we can, but unfortunately, it is difficult to reach most members of the public. Unless you are interested in following it, it's probably difficult to get the word.

MS. TIPPER: River Neighbors. That is not -- you all aren't publishing that any more. TVA is not.

MR. CAMERON: Just to clarify one thing -- and maybe you don't need to have this clarified for you -- but we all from the Nuclear Regulatory Commission. I don't know what TVA publishes or, if they do publish it, whether there was any mention of this particular meeting in it.

I guess just to reiterate, we're here to try to give you as much information about the draft EIS as possible and, then, there is this subsequent comment period that you have an opportunity to comment.

Even though we do put the notice out at a lot of places, I think we do realize we could probably always do better than we do. So, thank you for that reminder. We won't forget you on the record.

MR. MASNIK: I think we had 15 posters that we put out as well.

MR. CAMERON: Okay, so there were posters around town. Thank you.

MS. TIPPER: Which town?

MR. CAMERON: I'm not sure. Rogersville, Athens, Calhoun College. Well, we're glad you're here.

Other questions on process?

(No response.)

We are going to go to Dr. Sackschewsky to talk about the Draft Environmental Impact Statement.

[Presentation by Michael Sackschewsky]

MR. CAMERON: Thank you very much.

You just heard about the types of information the NRC evaluated, what conclusions were drawn, and alternatives. Is there any questions on this? Anything that Mike can explain in a little bit more detail?

Yes. Nancy, could you just introduce yourself to us, please.

MS. MUSE: I'm Nancy Muse from Florence, Alabama. It is my understanding as an Army brat -- my dad was a career Army -- the Army and the military consider, when they go in to any type of operation, the worse-case scenario. I am wondering if the NRC, in your impact assessments, thought about or considered -- I mean, what you're saying to me sounds great unless it is the worst-case scenario.

In the event of the worst-case scenario, is the impact of the nuclear reactor technology comparable to that of alternative energy technology?

MR. CAMERON: Two issues. One, I think worse case analysis generally but then there's specifically an issue that Nancy brought up about comparing continued operation of the plant versus alternative technology.

MS. MUSE: Well, I mean, if you talk about the impact alternative energy like a windmill would have on birds that hit it, you know, fly into it -- maybe migratory birds -- the worse-case scenario with a nuclear plant, can you compare that on a scale, the same type of scale that you would to the worse scenario using alternative energy sources whether it be solar, the wind, or whatever it may be.

MR. MASNIK: This is Mike Masnik.

The NEPA is the legislation that requires us to do an environmental impact statement. Under NEPA, the case law and the regulation basically has concluded that we don't do a worst-case scenario. In other words, we're not required to look at what would be the environmental impact should the worst possible accident occur at the plant.

Now the plant does -- you know, we evaluate the impact of the plant during normal operation and off normal operation, but not the kinds of accidents I think you are thinking of where we would have, for example, a core melt down and a massive release of radiation. So we do not do that. Compare that to the worst-case scenario of the alternatives.

MR. CAMERON: But at least for comparing the alternatives we look at the environment impacts, obviously, from license renewal, and we look at the environmental impacts from the alternatives also.

MR. MASNIK: Essentially, if you have a copy of the document that's Chapter 8 where we look at different alternatives and we look at the impact of those alternatives on the environment.

MR. CAMERON: Before we go back to Nancy, yes, sir.

MR. POSEY: My name is Grant Posey. I'm from Town Creek.

This document that you're referring to, how is that disseminated? How did that get into the public hands? Was that just from the meetings or was it made available at a point where you could go pick it up and review it prior to the meeting? How was that handled?

MR. CAMERON: Michael.

MR. MASNIK: We do a normal distribution of this. Obviously, you are not on the list for normal distribution. But what we did was, during the scoping meeting we had asked for people to sign up. We would have given you a copy when it was available.

Additionally, our web site explains how you could a copy of it as well. So we do make it available. Unfortunately, you didn't get one before the meeting, although we do have a comment period that stretches to March 2nd. So, if after tonight you look at the document and you have some comments, you have a fair amount of time to get back to us with them.

We also put it in the Athens Limestone Library here in town, so it was available there also.

MR. POSEY: Couple of other questions. You are talking about the effluents, the normal release of radiation that occurs with the operation of a nuclear plant. Then, the gentleman spoke about solids. Can you explain to me what solids mean?

And you talked about that they are packaged and shipped or disposed of. Can you explain that to me? And explain environmental justice.

MR. SACKSCHEWSKY: Solid wastes can be a variety of things but, typically, they would be things like rags, tools, anything that's solid that is somewhat contaminated that would need to be disposed of. There are procedures that they would follow for that. It normally would be barreled up some way and shipped off to some licensed landfill that accepts that kind of waste.

Environmental justice came out of an executive order, oh, back in the mid-1990s. Basically, it refers to a requirement for all federal agencies in the NEPA process to evaluate whether a particular project is inordinately affecting a minority or low-income population.

MR. CAMERON: Do you need more information on that or is that enough for now?

MR. POSEY: Is the low grade radioactivity of the solids -- I'm assuming that's very low grade. Its like cleanup rags and tools --

MR. CAMERON: Yes.

MR. POSEY: -- and it's shipped to where? Where are these facilities that --

MR. SACKSCHEWSKY: Solid wastes, we're very concerned about it. A nuclear plant cannot dispose of solid waste unless -- contaminated solid waste unless it is to a licensed burial facility. And these are facilities -- Barnwell is one. There's one out on the west coast. These are facilities that are designed to accept low-level waste and dispose of it in shallow surface landfill situations, which are monitored.

MR. CAMERON: Okay. Let me go over to Nancy and, then, I'll be right back, Jack.

MS. MUSE: The speaker referred to the scientific community having a broad consensus set the amount of radiation released into the environment. Browns Ferry was -- well, I don't know if you said negligible, but it was -- in essence, what I was reading between the lines, nothing to worry about? I want to know what scientific community and who funded the study, and who are the scientists who came to this conclusion.

MR. CAMERON: I think there wasn't exactly -- the statement about the unanimity wasn't referring specifically to Browns Ferry. And Mike, you might want to clarify what you were trying to say there. But, more importantly, can you tell Jackie and the rest of the people what science the NRC -- how does the NRC set its regulations on radiation? I think that gets to who the scientific community is.

MR. KUGLER: I'm not sure I got a full answer because it is not my field.

This is Andy Kugler again.

I know one of the organizations whose information we rely on is the International Committee on Radiation Protection (ICRP). I know there are others. If I had somebody here who has that background, they probably could rattle off the names pretty easily. But they've done independent studies and they've reached conclusions as to what levels of exposure are safe.

What we're saying is that we've set our limits within those limits and that these plants operate well below those.

We actually have information in the Environmental Impact Statement on the actual, I'm sorry, not the actual but the maximum exposure that anybody could have possibly received from these releases.

What we do is, we do a very conservative calculation. If the person stood by the fence all year and ate things that came from the river right next to the plant, you know, things of that sort, basically, what is the most that a person could possibly get based on these releases. Those numbers are very small. They are much less than our limits. And they are in the Environmental Impact Statement. Are they in Section 2.2.7? I'm not certain of the section. It's in chapter two, I believe, where we give that information.

I think Barry may have a pamphlet or two from the brochures that we brought that may give a little more information.

MR. CAMERON: We also have a recent pamphlet that's written in the context of the project that I think goes into, perhaps, a little detail about how the standards are set by the ICRP, and there's also a NCRP (National Committee on Radiological Protection).

MR. MASNIK: I also have some detailed numbers from the plant, and if you want to speak with me after the meeting, I can share those with you on what the releases were for last year and how that compares to the standards.

MR. CAMERON: Okay. Let's go to Jackie.

MS. TIPPER: I called three different times concerning this meeting to NRC, and I asked -- well, two times I only talked to an answering machine. At one of those times I gave a telephone, two telephone numbers and asked if there was any information on the internet where we could look and find this draft. My call was never returned.

This last time that I called they didn't seem to know anything about this meeting at all. I talked to two different people there at that point in time.

My question is, this study, the time frame, how long does this time frame hold for? Is this for how many years?

MR. MASNIK: This evaluates continued operation of the plant for an additional 20 years at the time the current license expires.

MS. TIPPER: So it doesn't cover anything past the additional time that it is licensed for.

MR. MASNIK: The three units are currently licensed for a period of time up to 2013, 2014, and 2016. What this evaluates is those dates forward for 20 additional years.

MS. TIPPER: So after the plant is no longer in use nothing else is covered.

MR. MASNIK: Well, there are a number of scenarios but probably one reasonable one would be if the plant receives a license renewal -- and let's pick Unit 2 -- at 2014 it would not shut down. Right now under the current license it would have to shut down. It would operate for another 20 years. So that would be 2034. At that time the plant would cease operation and would now enter decommissioning. And there's some requirements for a licensee. For example, five years before the expiration date of the license they have to send in a preliminary decommissioning cost estimate.

Then, what would happen is, after the plant permanently ceased operation in 2034, they would enter decommissioning. We'd have another series of public meetings where the licensee and NRC would discuss the decommissioning process. Typically, that takes probably between eight and ten years addition.

MS. TIPPER: Has that ever happened?

MR. MASNIK: Oh, yes. We've had a number of facilities -- I apologize for the microphone but we can't seem to fix it.

We have a number of facilities that are undergoing decommissioning now. We have the Shoreham Plant, Pathfinder, Fort St. Vrain are three plants that have completely completed the decommissioning process and the license is terminated, and the facility could be used for unrestricted use, which means that you could use it for an industrial facility or, for that matter, for a school.

They would remove the radioactivity to a level where it could be used for unrestricted use, what we call unrestricted use.

MS. TIPPER: You move the radioactive material away from there?

MR. MASNIK: You understand that during the normal operation of the plant you have two things happening: you have contamination, which is radioactive material in places where you don't want it; and, then, you have another process called "activation" where material becomes radioactive if it's near the core.

Both of those things result in solid objects becoming radioactive. And if you remove that or clean the surface -- I mean, you can actually clean the radioactivity off the surface of an object to the point where you can no longer detect it, and it's considered clean at that point.

You would have contaminated liquids. Those can be cleaned up using ion-exchange resins. There's a variety of processes for treating liquid waste. And you end up with water that's no longer contaminated or has very low levels of contamination that you could dispose of at that point.

There is a whole field and a whole industry designed to clean these facilities up -- (static)

MS. TIPPER: Is this figured into the cost of operating the facilities?

MR. MASNIK: Actually, licensees are required by our regulations to have a decommissioning trust fund, which requires them to put a certain amount of money aside each year. The amount of money that is required at the time they permanently cease operation is required by our regulations. It is on the order of three or four hundred million dollars that would have to be put in a trust.

So that money, even if, for example, the utility goes bankrupt or has severe financial difficulties, there's sufficient funds available to clean up the facility.

MS. TIPPER: Well, it's my understanding that TVA's Trust Fund has been deemed insufficient.

MR. MASNIK: Well, I don't know how much there is in the trust fund now, but is there someone here from the licensee who maybe could speak to that issue?

MS. TIPPER: And rates are going up and people are losing their jobs.

MR. CAMERON: There is a decommissioning trust fund for -- it's by reactor or reactor site.

MR. MASNIK: By reactor.

MR. CAMERON: By reactor. If anybody has the information in terms of what is in the trust fund for Browns Ferry, we could provide that. But if we don't have that right here, we'll --

MR. MASNIK: I do know that every two years, by regulation, they are required to submit a report to the NRC which is reviewed by us.

MR. CAMERON: I think we have some information here.

MR. BEASLEY: My name is Craig Beasley; I'm with TVA.

We do have the decommissioning trust fund. The investment is growing now. It's moving up to the levels where it should be. I don't have those numbers, but I can get them for you tomorrow.

MR. CAMERON: Thank you, Craig. Thank you very much.

Jackie, after the meeting, perhaps you can give us the number that you called at the NRC because maybe we're not getting them the right information to be able to tell people. So that would be very helpful to us.

Larry? Anybody have another question before we go on?

Nancy.

MS. MUSE: The only problem I see with this book is there are footnotes and no references, specific scientists or companies that fund the studies that were used to create this book. I didn't see any kind of references here either.

MR. CAMERON: A lot of this is non-profit organizations, government organizations who do this type of work and look at studies that have been done on, you know, Hiroshima or places like that.
Can we get -- not right now, but can we get Nancy a fuller set of background on this that will give her an idea?

MR. MASNIK: I think if she gives Etoy her name and address we will get you some more information. I mean, those pamphlets were designed for people just to have sort of a general understanding of what it is. If you desire more information, we certainly can get it to you.

MR. CAMERON: Okay.

G-1 MS. MUSE: I have a comment about the groundwater. If NEPA does not require the worst-case scenario to be examined or outlined, it seems like it would be a very nice courtesy of NRC and TVA to provide us with information as to what would happen. Say, like, back in 1975 when a candle started a fire. What would have happened or what could have happened if we did have a melt down to the ground water. It would be a courtesy. It is not legally required but --

MR. CAMERON: We'll take that as a comment.

MR. ZALCMAN: My name is Barry Zalcman. Let me quickly address some of the issues that you are raising, the worst-case analysis.

It is probably a wonderful segue 'cause the next person that is going to make a presentation is going to talk about both design-basis and severe accidents and some of those impacts you may be interested in. If you still have questions after Mr. Palla makes his presentation, then perhaps we can have a full discussion on it.

MR. CAMERON: Let's go to Bob Palla now. If there are other questions, we'll come back. Okay. Let's have Bob, as I mentioned, Senior Reactor Engineer, expert on severe accident analysis, probabilistic risk assessment, and he's going to talk about what we know as SAMAs.

[Presentation by Bob Palla]

MR. CAMERON: Thank you, Bob.

I believe we have a question back here.

MS. MUSE: Well, I understand -- I think the surface level of your process, but I'm wondering just on a layman's level what would happen. Despite all the SAMA and the other terminology you referred to, what would have happened in 1975 or what can still happen if there was a mechanical failure and we did have a melt down? I would like to know, you know, here in this room, what would happen to the groundwater.

MR. PALLA: What would happen to?

MS. MUSE: Yes, if we had a melt down.

MR. PALLA: To groundwater. Well --

MR. CAMERON: In other words, Bob, this may be out of your area because what Nancy is assuming that all of these preventive measures fail and that there's actually is an accident and what would be the effect on the ground water. I don't know if any of us want to speculate on that, except to say that it obviously is not going to be a good event.

MR. PALLA: Let me just begin by saying that all of these postulated events are not equal. Some are more severe than others. You can have a core damage event that core damage is arrested in vessel. The core may never leave the vessel, the radiation may still be contained within the containment. It could be a TMI type accident. So not all accidents result in full-blown core melts, failure of the vessel. Even if the vessel failed, the core damage could still be arrested within the containment.

There are severe guidelines that have been implemented at plants, including Browns Ferry, that direct operators to add water to the containment, to the dry well. So in the event the reactor vessel would fail, and the core would melt through it, there would be water in the dry well, and that this water could quench the debris as it leaves the vessel. So it would be arrested there. Again, it would be contained.

There are certain measures -- in the event that all of those measures fail the core melt isn't a China Syndrome, like in the movies. The molten core debris eventually is quenched. It takes many, many hours to breach a concrete base.

Over the course of -- probably on the order of a day or more, typical time associated with base melt through, certain measures could be taken to confine the fission products.

MR. CAMERON: Thank you, Bob.

Mike, you are going --

MR. MASNIK: We also had some experience unfortunately on this at Three Mile Island where we did have a core melt, and we did have a relocation of 33 tons of the core to the bottom head of the vessel. The system worked. I mean it essentially contained the molten core and there was no release of material through the bottom head.

Subsequent to that, there was some contamination and some of that contamination found its way through the concrete base mat in one of the auxiliary buildings. It did get into the groundwater but it didn't move very much. It turns out that very often the radioisotopes are attached to clay particles, so we didn't see much movement of most of the radioisotopes that were released from the facility.

You can speculate a lot, but we have a little experience in that area as well.

MR. CAMERON: Thank you, Bob; thank you, Mike.
Jackie.

MS. TIPPER: The Browns Ferry reactors are a BWR mark IGE-4 design, which has numerous inherent safety flaws including elevated spent fuel pools that are vulnerable from above, and above-ground reactor and a thin still shell in place of the traditional containment dome.

Now, I don't know about you all, but the worst case scenario after 911 to me was somebody flying a great big jet into the reactor. And it is my understanding that this plant could not withstand that type of accident.

Also, that the building that the control mechanisms are in does not have a real strong enforcement on it, as well as the above-ground storage.

This is a major concern. I've thought about it many times. I live right across the river. I'm on the other side of the river. I'm a school teacher. You know, I teach children. This is something that we think about.

MR. CAMERON: That's why it is particularly important for you to be here and for us to provide you some information about security generally.

Specifically, if Andy or any of the others can talk about any studies that have been done in terms of, you know, aircraft, this type of design, whatever, I'll turn it over to you.

MR. KUGLER: I don't have any specific details on this particular design, but even before 911, NRC took security of these plants very seriously. And since 911, obviously, we've taken a lot of steps to even go further.

There have been a number of orders and advisories to the plants to beef up security. A number of changes have been made to improve security at the plants, and the staff is continuing to evaluate what other changes may be appropriate. Obviously, there's a lot of that.

Even if I have the information, I couldn't really say much about it because of the nature of the information. But because it is not something I need to know I don't even have it.

In terms of the way we look at accidents in an Environmental Impact Statement, we don't specifically look at leveling events, you know, attacks on the plant. What we do look at is what things would have to fail, for whatever reason, whether it be because of an equipment failure or because of some intention act, what things would have to fail to lead to these sorts of accidents.

In the sense that we look at the worst case sort of accidents, we do that. We don't look at specific causes such as some external force or starting the event.

I don't know if that helps, but I think that's probably all I have that I could add at this point.

MR. CAMERON: And I think, Barry, we do have a little bit of a summary of some things that we've been doing that provide you with some more detail on that.

Grant.

MR. DASNEY: My first question actually is, how many people are here that are not with the NRC or TVA?

(Hands raised)

So we have five people. Six.

Is a transcript of this going to be made available or disseminated through -- I don't live in this county. I live across the river in another county. I live 15 miles down the river, so whatever happens here, you know, it goes down stream. So my involvement is just as much as anybody that lives in this county where these notices were posted and so forth. They never got to where I live. So I'm interested in that.

You were talking about cost of risk reduction and whether the cost to the supplier (TVA) to reduce a risk is worth what? Is it worth having a leak for the money it is going to cost them to fix it? You talked about evaluating the cost of that reduction. The cost-benefit analysis.

Do you ever think about -- when you build buildings, when you build a surgical center, you expect at some point to recoup that cost the ten billion dollars that it cost you to build that surgical center, eventually at some point it is going to be paid and you are actually going to start making money.

Do you guys ever take into consideration the cost of -- what a facility costs to build, and is it ever going to pay for itself 20 years down the road? Will TVA ever recoup the cost of those billions of dollars to reactive this unit in my life time? If not, why are we doing this? Why are they doing it?

MR. CAMERON: Can we address this?

MR. PALLA: I'll probably start with that one and work backwards as best I can. I hope I can remember the question.

Let me start with that one. From the NRC's perspective it is not really relevant to us whether they recoup their cost. That's a decision they make. I assume they're only going to make a decision like that if they feel they can recoup the cost. But for us, that's not a concern for us. Our concern is safety. So that's a simple answer to that part of that question.

In terms of why we're looking at cost benefit when we're looking at these improvements, the best way to explain that is, our regulations require them to operate within a certain box. As long as they stay within that box, they should be -- they're operating safely. Okay.

What we're doing here is saying, okay, you're inside the box; you're operating safely. That's all good. Are there any other things that you could do that might even make it better? Not necessarily required but they could still make it better.

Then, if we find some things that look like, yeah, these are things that could improve performance in certain accident sequences, then we say, all right, is it worth the possible benefit that you can get out of it.

The thing is that plants have looked at severe accident analysis since the 80s, and issues they've identified -- vulnerabilities that they've identified in their plants have already been dealt with. So at this stage, this far along, we're not likely to find very much but we still look.

Usually, most of the things we are finding now are things that are relatively low cost. Perhaps some additional training or procedure changes. But that's why we look at cost benefits because we're already in the place where the plants are being operated safely, and we're just looking at places where maybe there can be some improvements.

MR. CAMERON: Can we send Grant and others a copy of the transcript?

MR. PALLA: If you signed up on the card and asked to be put on the mailing list, everybody on our mailing list is going to get a copy of the meeting summary, and will also get a copy of the final environmental impact statement when it is issued. Automatically, we just send that out.

In terms of how other people can reach it, we do put these documents -- the environmental impact statements themselves are directly on the web page. Other documents that either we issue or we receive from licensees are available through our document management system, which is also accessible through our web page. Anybody from anywhere can get at these documents.

MR. DASNEY: If they're aware that they're there.

MR. PALLA: If they're aware that they're there. I understand that. That's where the mailing list comes in. When people sign up or come into these meetings and give us the information, we will send them that information. Beyond that, you know, how would you reach everybody in however many counties. There is no way to do it. The people have to -- well, you know, you can't. I can't mail it to everybody in the surrounding counties, but we do make it available on the web so that anybody can get at it if they have an interest.

MR. CAMERON: And you are going to get some more paper.

Let's take another question and, then, go to the summary, and listen to you a little bit more formally.

Nancy.

MS. MUSE: I appreciate the knowledge and wisdom of many folks in this room that know a whole lot more about this technology than I do. And with all due respect, I'm a school teacher also, and I have two questions or statements. And I'm not accusing anyone of actually willingly participating in the comedy of the absurd or the comedy of errors, but it seems like we are dancing around the main issue.

G-2 All the studies on issue, I really appreciate. Thank you for doing your job. I know you are doing the best you can. But one reason why there is only five of us here is because people in this area don't ask questions. They hear what's in the news or in the newspaper and they don't dig deeper. And with all of these wonderful studies you've done, it still does not address the most crucial issue concerning the operation of this plant.

We came seriously close in 1975 to a very major accident, which was reported on the east and west coast before people in this are knew what had happened.

G-3 We have politicians who are unopposed to nuclear energy and nuclear power who suppress the stark, cold reality (static)...

G-4 Also, the issue of radioactive waste from this plant, I would like to have a history of where this waste has gone, what kind of waste has gone where, where is it going now, how much of it is still stored on the site. A lot of people don't understand that we have a nuclear waste ground right here in our back yard. And somebody are naive and oblivious to the realities of this technology.

Like I said, it seems like the talk tonight is very useful. And I do know that you're doing the best you can, but we're dancing around the issue. We're playing ring-around-the-rosy.

G-5 Jackie mentioned 911. We all thought these worst-case scenarios were ridiculous and are never going to happen; that people projected that this could happen 30 years ago or if not longer,

G-6 and now we're in the age of the worst-case scenario. I think it is absurd not to be addressing these issues primarily and foremost, especially since the citizens' money is going to fund these projects without them having all of the information out there in front of them. I think it is really immoral. And I'm not blaming any one person in this room because you're doing your job. The technology is here. We did not invent it; we're dealing with it.

But I think it is time to phase it out and I would like for everyone in this room to please consider looking at options to restarting these plants.

Thank you.

MR. CAMERON: Thank you. I think that was more in the form of a comment. Thank you, Nancy. I think that my colleagues would say that we're trying to address the issue to make sure the plants are safe. Our responsibility -- in fact, the only thing we are authorized to do is to consider whether the plants are safe and meeting our safety regulations. And if they do that, then they can offer it unless something changes on the congressional level.

Mike, do you want to talk about conclusions?

[Presentation by Michael Masnilk]

MR. CAMERON: Thank you, Mike.

Before we go to comments, Jackie, do you have a question for us?

MS. TIPPER: I would like those questions Nancy presented concerning the waste to be answered and to know specifically is plutonium produced from nuclear plants, isotopes' half-lives, you know. I would like for the waste to be addressed.

MR. CAMERON: You just had a question that you raised now about plutonium. Is there any way -- I think, Nancy, you asked about how much spent fuel, basically, is produced by one of these plants. Can we generally address that as well as what the elements are? I mean I want to try to do this. These are important points, but I would like to try to do it simply, if we could, right now.

Mike, I don't know if we can or if you are the right person, but I think you sense what the type of information is that Jackie and Nancy would like to hear, which talks about volume, quantity, and potential toxicity, I guess.

MR. MASNIK: I'll answer the simplest question first, and that is, during nuclear reaction in the reactor core, plutonium is produced and it is one of the fission products. That plutonium, of course, is part of the spent fuel and it is considered self-protecting in that it is so radioactive that it would be very difficult for someone to get very close to it.

The question on waste, I can't give you a precise number of the volume or the weight of waste that is produced. But I've read accounts where the amount of high-level waste that is generated by a plant during one year of operation could fit underneath one of these tables. It is not -- I mean, it is the form of long rods now, but if you disassemble those rods and put that amount of material in a container, it would be about the size of one of -- it would be able to fit underneath one of these tables.

That waste is currently stored on site. There is no place at this time to ship that waste. The waste is stored in spent fuel pool, in a wet environment (in a pool, under water) and the licensee also has plans to store the fuel in dry storage, in an independent spent fuel storage facility, or ISFSF site until a permanent high-level waste repository is available, and then the fuel will be shipped there and disposed of permanently.

MR. CAMERON: Two followups on that and then we're going to go to the next part of the meeting.

Nancy.

G-7 MS. MUSE: Well, it goes against common sense to plunge forward with this technology when we've had years to find this permanent repository or depository for the spent fuel.

Science is wonderful, but it doesn't compare with common sense then it's not very useful.

If you have a toilet that's clogged up, you don't keep using the toilet.

G-8 I have concerns too. I think more people would be here tonight if these kinds of issues were in the newspaper, if the politicians didn't stifle this information, which I know does happen. If you start talking about transporting this highly radioactive material across the country to Utah or out west to the Rocky Mountains, there are going to be people in those states that are going to not be happy. That's already been proven to be true. And they're going to see people very worried about the security of that transported waste.

And to me it is just absurd to have these kinds of questions looming over our heads and to spend all of this money to further this technology.

MR. CAMERON: Thank you, Nancy; we have that comment on the transcript.

Jackie.

H-1 MS. TIPPER: One of the things mentioned in the study has to do with the economic impact. Well, the half-life of plutonium is -- what is it(?) 240,000 years? That's going to have to be guarded for that long. How can we rationalize this to our children, to the future? We don't even have a place to put it right now.

Like Nancy said, this really doesn't make any sense.

H-2 The economic impact also. I mean how much money is that going to cost? In this area right now TVA, their estimated cost for restarting Unit 1 is 1.8 billion dollars, which exceeds the U.S. Department of Energy's highest cost estimate by $100 million. TVA has an existing debt of around $250 billion and they don't have much more room on that. This is being passed on to their customers. This is a major concern here.

H-3 People are losing their jobs and there are people considering -- no people, whole areas that are considering not even using TVA power now. This is something to think about, too. This is going to be on the back of the future. We need to consider these things, definitely.

MR. CAMERON: Thank you, Jackie.

MR. MASNIK: I understand the comment, and we'll consider it.

H-4 MS. TIPPER: One more, okay? I know that you won't go in and do the inspections and everything. Please do a really good job, because on Unit 1 there have been a number of whistle blowers that have lost their jobs.

One acquaintance of mine is an avid supporter of nuclear power. He did his job; saw things that should have been done in other ways, or were not being done properly; he lost his job. Things like this are going on.

When we almost had the melt down with the first accident, I knew some of the people that worked at Browns Ferry, and one of them was a operator who was a severe alcoholic. He was killed in a car wreck on the way to work.

I thought okay, it's better now. We don't really have to worry about this, you know. TVA has really cleaned up their act and they're doing a better job. Then, when I hear about all of these whistle blowers with Unit 1, that's scary. That's really scary. And I did know this guy, and he was an operator.
You all have got to do the very, very best that you can to make sure that everything -- if it happens, it's done really right.

H-5 How many other plants in the United States have been relicensed? Aren't most people getting away from nuclear power? Renewable energy sources. If we had just put the money that we poured in to nuclear power toward renewable energy sources and conservation. We don't do squat with conservation. We could save billions and billions of dollars just with conservation.

MR. CAMERON: One thing we can get is the number of license renewals. And at the risk of you getting one more piece of paper -- because he's thinking over there -- we do take very seriously allegations from people who raise safety concerns.

With that, Barry, could you bring that pamphlet over for Grant and Jackie?

Thank you for that admonition and we take that seriously.

MR. MASNIK: I just want to say the number is about 20, 21 have had their license renewal, and 21 units and not necessarily sites. We have five or six inhouse now. There have been quite a few. And we do take our job very seriously. I want you to know that.

MR. CAMERON: We're going to move on to the formal comment part of the meeting. We can come back if there's another question, but I really would like to get you on and get it on the record.

Usually, when we do these, we find it useful to have people here just generally, before they talk what the rationale and the vision, so to speak, of the company is in terms of license renewal.

We have Mr. Chuck Wilson as our first speaker who is the License Renewal Environmental Management Project Manager for TVA. Would you like to address us for a few minutes?

MR. WILSON: Thanks, Chip. I'll be very brief.

Once again, I'm Chuck Wilson. I'm the License Renewal Environmental Project Manager for TVA. I've got a couple of comments to make.

TVA is reviewing also NRC's draft environmental impact statement and will be providing comments on or before the comment period closes March 2nd.

I-1 TVA agrees with NRC's basic overall conclusion that the environmental impacts of Browns Ferry License Renewal are minimal. We can say that because being a federal agency we also have to comply with NEPA.

I-2 In the spring of 2002 we completed our own environmental impact statement which addressed Browns Ferry License Renewal and Browns Ferry Unit 1 restart. There were no significant environmental impacts, and we did find that, in general, license renewal allows power production without greenhouse gases, which is consistent with TVA's clean air initiatives that you hear so much about.

License renewal also maximizes use of existing assets and it avoids the impacts of new site construction.

So, in general, we fully supported renewing the licenses of Browns Ferry as a good thing to do.

Thanks. That's all I've got to say.

MR. CAMERON: Thank you very much.

We're going to go to Jackie. Would you like to come up and comment for us? You can stay there and use this, if you prefer, or you can come up there.

MS. TIPPER: I'll use this.

H-6 H-7 The major problem with nuclear power has to do with storage of the waste. I don't think anybody has really figured in how much this is going to cost. I don't think they can. That's what makes nuclear power totally unfeasible, and the possibility of accidents, even though they might be very remote, would be so catastrophic that we're going with this.

H-8 There are alternatives. There are answers to clean air other than nuclear power. We have incentives for solar power and conservation. There's nothing out there now.

Jimmy Carter had great programs going for getting people into renewable energy sources. We're not doing any of that now. We can come up with solutions that are safe that the generations ahead of us are not going to have to take care of and guard and be afraid of. This is what is just wrong. It is morally wrong what we're doing.

H-9 How can you tell children, you know, we can burn all the lights we want to and it will be cheap. It is not going to be cheap. It is expensive. TVA has spent a fortune on their power. (static) ...Yellow Creek with babies and backpacks...(static) ...they're grown up and their activists also.

H-10 It was wrong then and it is wrong now. You all can do your job the very best you can, but that waste is still going to be there. And we don't have faith in the human race, if this is the only way

H-11 to go. We are too short sighted. Everybody maybe thinks that the world is going to end tomorrow, but we don't know. We're supposed to be stewards. We don't know this.

And I sure wish there were more people that paid attention and cared. So few people read the paper. Still look at the elections -- I won't go there.

Amendment 2 failing. That's one of my main peeves right there.

This is something that we really need to look at, and the cost of it. I hear that they're talking about -- well, no, not here that they're talking about, there's been a huge grant to do a study for Bellefonte. And what did we pump in to an endless pit there, $4 billion dollars, was it? Four billion dollars for absolutely nothing now. And now we're going off on some other tangent.

Let's just try to do better.

MR. CAMERON: Thank you, Jackie.

Nancy, can we go to you and then we'll go to Grant. Do you want to come up or do you want to use this?

MS. MUSE: I'm Nancy Muse, Florence, Alabama.

This may not be the most appropriate time for me to voice this concern or make a comment about responsibility, corporate responsibility or government responsibility, ethical responsibility.

One of the guys that was involved in an accident at Browns Ferry not too long after we had this meeting -- I guess it was last year, last spring, last April -- happened to be one of my old students when I taught him in high school. And as fate would have it, our paths crossed shortly after that accident.

G-9 He described to me what happened to him. He inhaled radioactive particles or particulates and I cannot envision exactly how it happened, but I believe it was radioactive water or steam escaped into the air and he happened to be there at the wrong time, and he inhaled it.

G-10 Now what really was totally immoral and absurd that this nuclear industry from the uranium mining all the way to the making of plutonium avoids any responsibility when workers in the mines, Native Americans, on down the line, pipefitters, get cancer. They always claim that it had nothing to do with the exposure of those workers, and somehow have gotten by with this.

There was a lawyer from Tennessee that represented indigenous Native Americans back in, I guess, the 70s who had their skin falling off, who had worked in the uranium mines. The industry denied any wrongdoing or any responsibility to help these people.

One of my lingering question marks is, this ex-student is a great guy. He used to wear snakeskin boots and have one of those little Billy Ray Cyrus haircuts back in the 80s, loves life. One of these days if he gets lung cancer or leukemia or some other form of cancer what is TVA going to say to him: well, we had nothing to do with it?

If I'm in the nursing home and I can still find out what's going on, if I can make it that long, I'm going to follow him around and I'm just going to see what happens to him. I'm going to document it. I'm going to make my own personal file on this ex-student of mine that I love dearly and see what happens to him. And if this industry is going to take the responsibility of what may befall him. He's just one out of a thousand workers who have not been in the reports because it isn't very good for the industry to admit that these things have happened, and no responsibility has been taken by the industry.

For now that's it.

MR. CAMERON: Thank you, Nancy.

Grant, do you want to talk to us?

MR. DASNEY: Well, one major comment is on the economic side, as I mentioned earlier. If you build a clinic, then at some point you expect that clinic to be paid for before it starts making money.

J-1 TVA has spent $2 billion to restart Browns Ferry Unit. Is it possible that TVA is going to recuperate $2 billion from one nuclear reactor in 20 years? It doesn't seem likely to me that's going to happen.

They abandoned a $360 million project, a gas-fired power plant a $150 million into the project, and it was deemed lack of demand. That was in March of '02. So from '02 to now we've come to the point where we need to spend $3 billion to reactivate a nuclear reactor, and I don't understand how it is going to be paid for or how it is going to pay for itself. The math doesn't work in my head. Maybe I don't know how to add figures that bid. It doesn't work for me.

MR. CAMERON: Thank you very much.

I think that's the last formal speaker that we had. I know that Nancy was holding a question from before. Do you still have a question?

MS. MUSE: I had a question. What's another ten minutes? Just kidding. It might take one minute.

This is just for the record. I'm Nancy Muse from Florence, Alabama. I'm against TVA's future
G-11 commitment, or present commitment also, to the nuclear program, regardless of the specific information within the environmental assessment and/or environmental impact statement.

G-12 The problems associated with short- and long-term of handling of storage of nuclear waste far outweigh the short-sighted continuation of this astronomically expensive and dangerous technology, when we should be committing money to renewable and sustainable alternative energy sources, such as photovoltaics and wind power. Which, when pared with conservation, is a much more logical solution to our energy needs.

MR. CAMERON: Thank you, Nancy.

And I would just like to thank all of you for your comments and bringing your concerns forward to us. I think you can see from some of the things that the NRC staff said about what we're doing here, the concerns are always important to us. Some of the concerns we can try to address because they're within our areas of responsibility, but I think all of the concerns are important to us as Americans in terms of larger policy choices.

Thank you for your comments tonight.

I'm just going to ask Andy Kugler to close the meeting for us. Andy.

If you can, please stay after the meeting because the staff and our experts are here. If there is anything else you want to talk about, if there's any other documents you want to take home, we can get those for you, too.

Andy.

MR. KUGLER: I just wanted to thank you again for coming out this evening.

One thing I did want to mention. In the packet of materials that Etoy gave you when you came in, one of the items was a Meeting Feedback Form. We look for ways to try to do things better, and if you have some suggestions on what we could do, we would certainly appreciate that feedback. You can either fill it out now and drop it off at the back, or its prepostage paid and you can fill it out later and mail it in. Either way, it will get to us and we can take a look at what comments you may have.

Beyond that, as Chip mentioned, we will be staying after the meeting. We would be happy to talk to you about any questions you may have.

Other than that, thank you for coming again, and drive safely going home.

Thank you.

(Whereupon at 8:44 p.m. the meeting was closed.)

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TVA

Tennessee Valley Authority, 1101 Market Street, Chattanooga, Tennessee 37402-2801

February 25, 2005

10 CFR 54
10 CFR 51

Chief, Rules and Directives Branch
Division of Administrative Services
Office of Administration, Mailstop T-6D59
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555-0001

Gentlemen:

In the Matter of	)	Docket Nos.	50-259
Tennessee Valley Authority	)		50-260
			50-296

TENNESSEE VALLEY AUTHORITY (TVA) COMMENTS ON DRAFT NUREG-1437 SUPPLEMENT 21 TO THE GENERIC ENVIRONMENTAL IMPACT STATEMENT FOR LICENSE RENEWAL OF THE BROWNS FERRY NUCLEAR PLANT (BFN), UNITS 1, 2, AND 3

Enclosed are TVA's comments on the subject document. TVA appreciates the opportunity to comment. This letter contains no new commitments.

If you have any questions about this information, please contact Chuck Wilson, Project Manager for BFN License Renewal Environmental Review, at (423) 751-6153 or cjwilson@tva.gov.

Sincerely,

John C. Fornicola

John C. Fornicola
Manager
Nuclear Assurance and Licensing

Enclosure

ENCLOSURE

TVA COMMENTS ON NRC'S SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT FOR BROWNS FERRY NUCLEAR PLANT (BFN) UNITS 1, 2, AND 3

Executive Summary

Page xx, Line 15: The statement is made that power generation alternatives are evaluated assuming that the replacement power generation plant is located at either the BFN site or some other unspecified alternative location. In contrast, Chapter 8 follows material supplied in TVA's Environmental Report which analyzes four different types of alternative power plants, all of which are analyzed at specified locations and none of which (for stated reasons) are at the BFN site. M-1

Section 1.2.2 License Renewal Evaluation Process

Page 1-5, paragraph beginning Line 39: This paragraph makes no mention of how TVA, being a federal agency, fulfilled its own NEPA obligations by preparing a Supplemental Environmental Impact Statement for Browns Ferry License Renewal. As explained in a letter dated June 4, 2004, to NRC from TVA's Mark Burzynski, Manager of Nuclear Licensing, each of the 92 license renewal environmental issues listed in NRC's GEIS and summarized in 10 CFR 51, Subpart A, Appendix B, Table B-1, were reviewed by TVA's various subject matter experts that were involved in preparing TVA's SEIS and the subsequent Environmental Report submitted by TVA as part of its application for BFN license renewal. M-2

Page 1-6, Line 6: The phrase "and its support organization" is not understood. To whom or what entity does this refer? M-3

Section 2.1.2 Reactor Systems

Page 2-4, Line 26: The sentence beginning on this line would be clarified if it was changed to read, "Each unit was originally licensed for an output..." M-4

Section 2.1.3 Cooling and Auxiliary Water Systems

Page 2-7, Line 7: Please check the number 8.75; this should possibly be 8.66. M-5

Page 2-7, Line 18: The number 7800 is correct but TVA2003a may not be the correct reference (source). M-6

Section 2.2.2 Water Use

Page 2-19, Line 22: The statement is made that "TVA has committed to rebuild the sixth cooling tower." To avoid any potential confusion with regulatory commitments, please replace the referenced statement with the following sentence: M-7

"As reflected in the Record of Decision for the TVA Final Environmental Impact Statement (Federal Register Vol. 67, No. 117, pp. 41565 – 41569, June 18, 2002), TVA's decision was to adopt the agency-preferred alternative to refurbish and restart BFN Unit 1, to proceed with NRC license extensions for all three units at BFN, and to construct a single 20-cell linear mechanical draft cooling tower in the currently vacant position (tower 4) where a tower that was destroyed by an accidental fire in 1986 was never replaced. With EPU of Units 2 and 3 at 120 percent of the originally licensed power level and the rebuilding of this tower, the consumptive use of cooling water would therefore increase."

M-8

Page 2-20, Line 6: Without any statement about the frequency of low flow at the plant, the assertion that the intake water flow encompasses a significant fraction of the daily average river flow can be somewhat misleading. Based on historical data, daily average river flows as low as the intake water flow occur less than 0.3 percent of the time, and daily average flows as low as three times the intake water flow occur only about 10 percent of the time. More specific values are stated in Section 4.1.1, Page 4-13, lines 28 – 30 (7Q10 of 8700 cfs in NPDES permit rationale). M-9

Page 2-20, Lines 9 through 12: The stated minimum daily average flows (if sufficient water is available) were implemented via TVA's Reservoir System Operation and Planning Review of 1990, and these target values were in place at the time of NRC's March 2004 site visit to gather environmental information. The target minimum river flows for BFN are now slightly different as a result of the ROD for the Reservoir Operations Study (May 19, 2004). The target minimum daily average flows now are 10,000 cfs July through September (same as before); 11,000 cfs December through March (higher than before); and 7,000 cfs otherwise (higher than before).

Section 2.2.5, Aquatic Resources M-10

Page 2-41, Lines 19 through 22: The Alabama cave shrimp discussion should be moved to the federal endangered species section.

Section 2.2.6 Terrestrial Resources M-11

Page 2-44, Line 14: The *Cornus* spp. parenthetic should be changed to *Cornus florida*. M-12

Page 2-44, Paragraph beginning Line 37: To be more accurate, the second sentence should be revised to state, "There are numerous invasive plants in the area

(TVA2003a), of which TVA has identified 19 as high priority, including Chinese privet, Japanese honeysuckle, Japanese knotweed, and Nepal grass." Also, the scientific name is included parenthetically for some plants in this sentence but not for others, which is inconsistent. M-13

Page 2-45, Line 5: The scientific name for black willow (*Salix nigra*) is not provided. M-14

Page 2-46, Table 2-3, Line 10: The table caption would be more accurate as "Federally Listed Terrestrial Species Reported from Counties Associated with the Browns Ferry Nuclear Plant Site and its Transmission Line Corridors." M-15

Page 2-47, Table 2-4, Line 5: The table caption would be more accurate as "Alabama State-Listed Terrestrial Species Reported from the Vicinity of the Browns Ferry Nuclear Plant and Associated Transmission Line Corridors." M-16

Page 2-49, Table 2-4, Line 29: The specific epithet for dwarf filmy fem is *petersii.* M-17

Page 2-50, Table 2-4, Line 3: The specific epithet for prairie trillium is *recurvatum.* M-18

Page 2-50, Table 2-5, Line 10: The table caption would be accurate as "Mississippi State-Listed Terrestrial Species Reported from the Vicinity of the Browns Ferry Nuclear Plant and Associated Transmission Line Corridors." M-19

Page 2-53, Table 2-5, Line 1: The specific epithet for white walnut is *cinerea.* M-20

Page 2-54, Lines 20 and 29: The statements in these two paragraphs about species being listed in various counties are potentially misleading, because they are threatened or endangered throughout their ranges, not just in these counties. M-21

Page 2-54, Lines 24 and 25: The statement that "there is no known nesting habitat within 5 km (3 mi) of the site" is misleading because there is nesting habitat along the shoreline. A more accurate description would be that "although there is nesting habitat along the shoreline in the area around BFN, there are no known nests." M-22

Page 2-55, Lines 1, 2, 13, 14, 23, 37, 38: Similar to the above comment on Page 2-54, Lines 20 and 29, the species discussed are threatened or endangered throughout their ranges, not just in these counties. M-23

Page 2-55, Lines 7 and 8: Delete the portion of the sentence after "drainage canals" which discusses "forested habitats." Gray bats don't normally use forested habitats unless along a stream. M-24

Page 2-55, Line 32: It is not accurate to refer to the Morgan County station for Hart's-tongue fern as being in the southern portion of its range. This fern is highly disjunct, and while it has been found as far south as Mexico, it occurs nowhere in between the few AL/TN stations and Michigan.

Section 2.2.7 Radiological Impacts M-25

Page 2-57, paragraph at top of page: For aquatic monitoring TVA does not currently sample invertebrates, and terrestrial monitoring includes food crops, soil, and milk if applicable.

Section 2.2.8.2 Public Services M-26

Page 2-61, beginning Line 33: The sentence beginning on this line should be clarified to state that the "approximately 1200 persons" is for the BFN non-outage operating staff, and does not include the Unit 1 recovery workers. For example, the sentence could be changed to read, "BFN, which is the primary traffic generator in the vicinity of the site, currently averages a daily site non-outage population of approximately 3600 persons; of this total, 1300 is for the total Unit 2/3 operating workforce, and 2300 is for Unit 1 recovery." The sentence beginning in Line 35 could also be changed to read, "The operating unit population currently peaks at approximately 2200 during outages, which occur every 24 months (per unit) for approximately 2 months."

M-27

Page 2-62, Line 20: Since DOE (eventually) takes responsibility for spent fuel at the nuclear plant site boundary, TVA will not be involved in spent fuel shipments past that point. As a suggestion, the words "TVA plans to" could be changed to "DOE may."

Section 2.2.8.4 Visual Aesthetics and Noise M-28

Page 2-65, Paragraph beginning Line 27: The acreage for Mallard-Fox Creek State Wildlife Management Area (WMA) is 1483 (all land acres). The acreage for Swan Creek State WMA is 8870 (3045 acres land; 5825 acres water). Both WMAs are managed by the Alabama Department of Conservation and Natural Resources, Division of Wildlife & Freshwater Fisheries, and both WMAs are used for waterfowl and small game hunting. (information corrected from BFN License Renewal Environmental Report) M-29

Page 2-66, Line 29: The referenced statement from TVA's SEIS for BFN License Renewal (TVA 2002a) states that "There are no Federal, State of Alabama, or local municipal noise standards, regulations or ordinances that apply to the action alternatives evaluated in this SEIS." Suggest re-wording the sentence beginning Line 29 to "Currently, there are no Federal, State, or local municipal noise standards or regulations that apply to BFN license renewal alternatives" or the equivalent. M-30

Page 2-66, paragraph beginning Line 29: The sound level values used in this paragraph do not include the planned sixth cooling tower. A suggested improvement is to use the

6-tower calculated results from Section 4.3.19 of TVA's FSEIS for BFN License Renewal as bounding values.

Section 2.2.8.5 Demography

Page 2-67, Line 5: Delete the reference to 10-mile ring increments; TVA estimated the population only for 20 and 50-mile rings. M-31

Page 2-67, sentence beginning Line 13: In contrast to this statement, the ER on Page E-34 states that the AL growth rate is projected to exceed that of Lauderdale and Morgan Counties from 2000 to 2015. M-32

Page 2-67, Line 37: The 24.5 percent value for Limestone County population growth between 1990 and 2001 is not recognized. It might have been based on an earlier population estimate. The correct change is 23.6 percent based on the most recently released (2004) U.S. Census Bureau county population estimates. M-33

Page 2-68, Line 1: The 2 percent growth per year value referenced from the BFN License Renewal Environmental Report (TVA 2003a) cannot be confirmed. The correct annual growth rate is 1.5 percent, not 2. M-34

Section 4.1.1 Water Use Conflicts

Page 4-14, Lines 6 and 7: This section is focused on make-up water, but the volume of water "consumed" by BFN (82 cfs, as stated on Page 4-13, Line 34) is much too small to ever threaten other uses of the large volume of water in Wheeler Reservoir (as stated on Page 4-13, Lines 39 – 41). Consequently, TVA would never de-rate the plant to mitigate water-use conflicts. The concluding sentence of this Section should be changed to state, "The staff determined that water-use conflicts would be SMALL and further mitigation measures are not warranted." M-35

Section 4.1.5 Microbiological Organisms

Page 4-25, Lines 5 – 8: What is stated is correct, but it begs for an explanation of why the diffuser discharge temperature could be 0.3°F warmer for two unit operation than for three unit operation (both at EPU), even though three units obviously generate 50 percent more heat than two units. Although this is true, the maximum temperatures in the analyses correspond to open mode conditions creating a temperature of 90°F at the downstream end of the mixing zone (i.e., the NPDES limit). Since the plant releases less heat with two units than it does with three units, it can operate at higher ambient river temperatures (and thus a higher diffuser discharge temperature) with two units and still stay within the downstream mixing zone limit of 90°F. M-36

Section 4.2 Transmission Lines

Page 4-26, Sentence beginning Line 15: Change "will be required if the proposed action" to "will be required whether or not the proposed action." M-37

Page 4-26, Paragraph beginning Line 36: The restriction class definitions vary depending on the type of maintenance and resource area being considered and do not necessarily agree with the simplified statements made here (see table of Class Definitions, pages E-562 and E-563 of Attachment E-6, Transmission Line Corridor Environmental Analysis, of the BFN License Renewal Environmental Report). M-38

Page 4-27, Line 2: The statement that "There is no broadcast application of herbicides." is incorrect. TVA does use and expects to continue using broadcast and/or aerial herbicides in sections of transmission line corridors where appropriate. M-39

Section 4.4.2 Public Services: Public Utilities

Page 4-37, Sentence beginning Line 10: This sentence appears to contradict itself regarding the existence or absence of refurbishment activities. Also, the permanent plant staffing will increase for Unit 1 operations. M-40

Page 4-37, Sentence beginning Line 14: The assumed numbers are not understood. Permanent plant staffing will increase by approximately 150 for Unit 1 operations. M-41

Section 4.4.4 Public Services: Transportation

Page 4-39, Line 21: The license renewal staff is in Chattanooga and is temporary; currently only one license renewal person is at the site. M-42

Page 4-39, Line 25: The number 1810 assumes 210 more vehicles on each road. If the traffic divides equally as stated, there would be 70 more vehicles on each road. M-43

Section 4.4.5 Historic and Archaeological Resources

Page 4-40, Sentence beginning in Line 10: License Renewal by itself changes nothing with regard to historic properties. M-44

Section 4.6.1 Aquatic Species

Page 4-49, Line 16: To be more accurate, this sentence should be corrected as follows: "...candidate species) that occur or historically have occurred in either Wheeler Reservoir..." M-45

Page 4-49, Line 30: To use correct terminology, replace the phrase "Each sensitive area review project" with "Each proposed transmission line vegetation management project..." M-46

Section 4.6.2 Terrestrial Species

Page 4-50, Paragraph beginning Line 17: The following information updates that previously provided by TVA for Natural Areas crossed by transmission corridors or within 0.5 mile of the corridors. For clarity, it is recommended that the text specify the five transmission line corridors that were reviewed and note the ones with no Natural Areas. Note in particular that for Lines 23 and 24, the Duck River State Wildlife Management Area, the Duck River Unit 1 Proposed Designated Critical Habitat, and Elk River and Richland Creek are not appropriate to the scope of this document because these sites are not on the line segments shown on page 2-16 (i.e., only the first 23 miles of the 87-mile-long Browns Ferry to Maury line are included as applicable, and the sites are all on the last segments of the line). This exclusion also applies to the Duck River State Scenic River. M-47

Browns Ferry-Maury 500-kV (L6060), Alabama

- Philadelphia Glade (within 0.5 mile)
- Swan Creek State Wildlife Management Area (within 0.5 mile)

Browns Ferry – Trinity 500-kV (L6078), Alabama

- This TL corridor does not cross any Natural Areas.
- Mallard-Fox Creek State Wildlife Management Area (within 0.5 mile)

Browns Ferry – Trinity 161-kV (L5054), Alabama

- This TL corridor does not cross any Natural Areas.
- Mallard-Fox Creek State Wildlife Management Area (within 0.5 mile)

Browns Ferry – Athens 161-kV (L5055), Alabama

- This TL corridor does not cross any Natural Areas.

Browns Ferry – Union 500-kV (L6091), Mississippi

- Natchez Trace National Parkway
- Canal Section Wildlife Management Area
- TN-TOM Lock D Pool Reservoir Reservation
- East Fork Tombigbee Macro Site
- John Bell Williams State Wildlife Management Area
- TN-TOM Lock E Pool Reservoir Reservation
- TN-TOM Waterway
- Foxtrap Creek Ravine Potential National Natural Landmark
- Bear Creek Unit 2 Proposed Designated Critical Habitat
- Lake Lamar Bruce State Fishing Lake (within 0.5 mile)

Page 4-50, Sentence beginning Line 30: Clarification is needed. TVA does not work with its Right-of-Way (ROW) maintenance contractors to develop restrictions for the ROW contractors to follow; instead, TVA develops and establishes guidelines for the ROW contractors to follow. M-48

Section 4.7 Evaluation of Potential New and Significant Information

Page 4-53, Line 9: As written, this sentence may be misleading. With the new condensers and other changes the total intake flow when Unit 1 is restarted will be higher than for previous three-unit operation. M-49

Page 4-53, Lines 22 – 24: The cited reference (Hopping 2004) discussed discharge temperatures but not specifically thermal stratification. However, it can be concluded from the information given that thermal stratification will also increase. Actually, reservoir stratification locally will be disrupted by mixing from the diffusers. As the flow moves downstream, stratification will be reestablished as the heat accumulates at the surface. Due to the larger amount of heat, the stratification will be larger than that before EPU. Any excess heat will escape to the atmosphere, and the stratification will slowly approach natural conditions as the flow continues further downstream. Far-field modeling reported in the Environmental Report for the BFN License Renewal Application indicates that surface temperatures in the forebay of Wheeler Dam will be, on the average, about 0.3°F warmer for three units at EPU (compared with three units at the originally licensed thermal power). On average, the flow reaches Wheeler Dam before natural conditions are fully reestablished. M-50

Section 4.8 1 Cumulative Impacts Resulting from Operation of the Plant Cooling System

Page 4-66, Line 12: The word "municipal" on this line appears to be an error; the intended word may be "industrial." M-51

Page 4-67, Bottom Paragraph beginning Line 30: This paragraph discusses the TVA Reservoir Operations Study (ROS). On Line 37 it is stated that "...for all alternatives the existing minimum flow past the plant could be maintained." The cited reference is a TVA fact sheet entitled "Wheeler Reservoir Operations under the ROS Preferred Alternative." Although it is true that existing minimum flow past the plant could be maintained, this was not explicitly stated in the cited reference; rather, it states that "...flow requirements also would be used to protect water quality and aquatic resources." Elsewhere in the ROS FEIS (Chapter 3), data are provided showing that target minimum flows will be maintained. As noted in the comments for Section 2.2.2 Water Use, the target minimum flows for BFN were slightly changed by the ROS, and in some months are now slightly higher compared to the pre-ROS values. M-52

Page 4-68, Lines 32 – 33: As noted in the comments for Section 2.2.2 Water Use, the statement about what is a "significant fraction" lacks a definition, and should be accompanied by a statement regarding the frequency of occurrence. M-53

Section 4.8.5 Cumulative Impacts on Groundwater Use and Quality

Page 4-71, Line 32: All BFN potable water comes from Athens Water Services, which has the Elk River (not the Tennessee River) as its principal source. M-54

Section 8-1 No-Action Alternative

Page 8-2, Paragraph beginning Line 7: Suggest re-ordering these options, from the most likely to the least likely, which would be (3), (2), (1), or (4). Spelled out, this would be as follows: "Under the no-action alternative, replacement of BFN electricity generation capacity would be met by (1) TVA generating alternatives other than BFN, (2) power purchased from other electricity providers, (3) demand-side management (DSM), or (4) some combination of these options. M-55

Section 8.1.7 Socioeconomics

Page 8-5, Line 22: The total TVA payment to Limestone County was $4,544,825 in FY 2002 and $4,566,727 in FY 2003. Not all of this, however, is attributable to BFN. The BFN portion of this payment was $2,008,723 in FY 2002 and $2,015,210 in FY 2003. Total county revenues are variable, causing the share to vary considerably from year to year. However, in FY 2002, the BFN portion of TVA's payment was 6.5 percent of the total county revenues of $30,758,933; in FY 2003, they were 10.03 percent of county revenues of $20,082,621. The 5.88 percent value quoted at the bottom of page E-209 of the Environmental Report is not correct. M-56

Page 8-5, Paragraph beginning Line 36: Per the above comment, the property tax revenue equivalent from BFN is approximately 10 percent or less of total Limestone County revenues. M-57

Section 8.1.10 Environmental Justice

Page 8-6, bottom paragraph: These potential negative and disproportionate impacts could apply to secondary job losses such as retail, services, etc., but not to direct BFN job losses. M-58

Section 8.2.1.1 Closed-Cycle Cooling System

Page 8-17, Line 31: TVA projects that the total number of workers would exceed 500 for approximately 2 ½ years (see TVA's Environmental Report for BFN License Renewal, Page E-289, paragraph under Socioeconomics). M-60

Section 8.2.3 Natural Gas Combined-Cycle Generation

Page 8-32, Table 8-6, Impact Category for Air Quality: The stated quantities of air emissions are the values reported in Section E.7.2.2.1 of TVA's Environmental Report for BFN License Renewal, but they are based on seven NGCC plants. In Section 8.2.3 on Page 8-31 of NRC's SEIS, the statement is made that eight NGCC plants would be needed. M-61

Page 8-36, Sentence beginning on Line 2: This sentence appears to contradict itself; it may have too many negatives. M-62

Page 8-36, Sentence beginning on Line 32: This sentence is not clear; words may have been omitted, or it might contain grammatical errors. M-63

Section 8.2.4.1 Closed-Cycle Cooling System

Page 8-40, Table 8-8, Impact Category of Land Use: The "Impact" is listed as MEDIUM to LARGE and the "Comment" statement is made that "Additional land-use impacts would occur for uranium mining." Currently, BFN has fuel contracts to use blended-down surplus highly-enriched uranium; these do not involve any uranium mining, and it is likely that an ABWR at Bellefonte could use the same fuel, especially if BFN was discontinued. M-64

Section 8.2.6.10 Delayed Retirement

The paragraph on Delayed Retirement is not consistent with the following statements made by TVA in a May 27, 2004 letter to NRC transmitting "Addition Information for License Renewal Environmental Review" from Mark Burzynski, Manager of Nuclear Licensing: "TVA has no schedule for retiring current generating units. TVA is adding environmental controls and maintaining the existing units as necessary to keep them running. TVA has no retired fossil units that would be considered for restarting." Please delete all references to TVA fossil plants being slated for retirement. M-65

Section 8.2.6.11 Utility-Sponsored Conservation

Page 8-53, Line 29: Suggest spelling out DSM (Demand-Side Management). M-66

Section 8.2.7 Combination of Alternatives

Page 8-54, Table 8-10, Impact Category on Air Quality: The air emissions values listed are approximately 80 percent of the values listed in Table 8-6, which were the values stated by TVA for seven 510 MW units. M-67

Appendix E, BFN Units 1, 2, and 3 Compliance Status and Consultation Correspondence

Page E-25, Line 36: As noted earlier, the use of the word "committed" could invite confusion with regulatory commitments. A more accurate characterization would be as follows: M-72

"As reflected in the Record of Decision for the TVA Final Environmental Impact Statement for BFN License Renewal (Federal Register Vol. 67, No. 117, pp. 41565 – 41569, June 18, 2002), TVA's decision was to adopt the agency-preferred alternative to refurbish and restart BFN Unit 1, to proceed with NRC license extensions for all three units at BFN, and to construct a single 20-cell linear mechanical draft cooling tower in the currently vacant position (tower 4) where a tower that was destroyed by an accidental fire in 1986 was never replaced. Regardless of the schedule for power uprates on any unit, the 6th tower is scheduled for completion prior to the first summer following Unit 1 restart."

M-68

Page E-29, Paragraph beginning Line 23: The restriction class definitions vary depending on the type of maintenance and resource area being considered and do not necessarily agree with the simplified statements made here (see table of Class Definitions, pages E-562 and E-563 of Attachment E-6, Transmission Line Corridor Environmental Analysis, of the BFN License Renewal Environmental Report).

M-69

Page E-29, Line 30: The statement that "There is no broadcast application of herbicides." is not correct. TVA does use and expects to continue using broadcast and/or aerial herbicides in sections of transmission line corridors where appropriate.

Appendix F, GEIS Environmental Issues Not Applicable to BFN Units 1, 2, 3 M-71

Page F-2, Table F-1, first item: The statement that BFN uses <100 gpm of groundwater is potentially misleading because BFN does not use any groundwater.

RDB received 3/3/05

United States Department of the Interior

OFFICE OF THE SECRETARY
OFFICE OF ENVIRONMENTAL POLICY AND COMPLIANCE
Richard B. Russell Federal Building
75 Spring Street, S.W.
Atlanta, Georgia 30303

ER 04/918

12/10/04
69 FR 71855

February 25, 2005

3

Division of Regulatory Improvement Programs
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

RE: Draft Generic Environmental Impact Statement (GEIS), Supplement 21, for License Renewal of Tennessee Valley Authority's (TVA), Browns Ferry Nuclear Plant. Units 1, 2, and 3, Alabama (NUREG – 1437, Supplement 21)

Dear Sir/Madame:

The Department of the Interior (Department) has completed review of the U.S. Nuclear Regulatory Commission's (NRC) Draft GEIS for License Renewal of the Tennessee Valley Authority) (TVA) Browns Ferry Nuclear Plant, Units 1, 2, and 3. We submit the following comments for your consideration.

Project Description

In December 2003, the TVA submitted an application to the NRC to renew the operating licenses for Browns Ferry Nuclear Plant, Units 1, 2, and 3 for an additional 20-year period. TVA's license renewal at Browns Ferry Nuclear plant (BFN) also proposes to increase the power production at each of the three units to 120% of their originally licensed power production capacity. It should be noted that Unit 1 at BFN has not operated since 1985, and the applicant is currently engaged in activities necessary to return this unit to service. In TVA's application to NRC to renew current operating licenses, TVA stated that almost all of the activities associated with this effort are confined to existing on-site structures, and little new construction is necessary. Therefore, any impacts associated with the construction of new facilities on-site would be bounded by those impacts discussed in the 1972 EIS prepared by TVA. Subsequently, NRC reviewed TVA's request and produced the Draft GEIS.

The NRC's Draft GEIS defined the purpose and need of re-licensing BFN in the following way: "...the proposed action (renewal of the operating licenses) 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." Secondly, the goal of NRC's environmental review was to meet requirements in 10 CFR 51.95(c)(4) and the Draft GEIS, to determine whether or not the adverse environmental impacts of license renewal are so great that

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Call=M. Masnik (MTM2)

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preserving the option of license renewal would be unreasonable for energy planning decision makers. Collectively, the statement of purpose and need and evaluation criterion mentioned above have guided NRC in determining whether or not an existing nuclear power plant could continue to operate beyond the period of the current operating license.

Environmental Concerns

Effects of plant operation on health of fish and other aquatic organisms in the Tennessee River

Based on TVA's Vital Signs Monitoring Reservoir Fish Assemblage Index, the fisheries resources in Wheeler Reservoir in the vicinity of BFN have maintained a "fair" or "good" rating since the early 1990's. Coupled with the monitoring of fish assemblages, TVA has also monitored overall ecological health via use of their Vital Signs Monitoring Program. The Vital Signs Monitoring Program divides TVA reservoirs into three zones: the inflow area (riverine-like segment), transition zone (mid-reservoir segment), and the fore bay (lake-like segment). This program has systematically monitored key physical, chemical, and biological indicators (i.e. dissolved oxygen, chlorophyll, sediments, benthic macro invertebrates, and fish) to evaluate ecological conditions of TVA reservoirs. When needed, TVA targets detailed assessments to identify significant problems and address those conditions as appropriate. TVA has sample/monitoring sites located upstream and downstream of BFN. The transition zone sampling site for Wheeler Reservoir is located at Tennessee River Mile (TRM) 295.9, approximately 1 mile upstream of BFN. The fore bay zone sampling site is located at TRM 277, near the confluence of the Elk River with Wheeler Reservoir. Based on the period of record for these two monitoring sites, they appear to maintain a "fair" to "good" rating from year to year for ecological health.

In 2000, TVA initiated macro invertebrate monitoring in support of BFN's thermal variance monitoring program. Since a number of federally-listed mussels are known to occur in Wheeler Reservoir and the Tennessee River, we were especially interested in reviewing TVA data on benthic macro invertebrate sampling and water quality chemistry at various monitoring sites in Wheeler Reservoir. The monitoring resulted in ratings of "excellent" for community density at TRM 295.9 monitoring site (approximately 1 mile upstream of BFN) in 2000 and "good" condition in 2001 and 2002. At TRM 291.7 (approximately 2 miles downstream of BFN diffusers) the rating was "excellent" for community density in 2001 and "good" in 2002. N-1

These ratings can be deceptive, however, giving the impression that the mussels and other invertebrates found at these locations are the desirable, native fauna. As mentioned in the Draft GEIS, Asiatic clams, an introduced exotic species, can dominate benthic environments, competing for food, nutrients, and space with native benthic organisms and may feed directly on native, unionid sperm, glochidia, and newly metamorphosed juvenile mussels. Since its first detection in the Tennessee River system in the early 1960's, the Asiatic clam has increased in number and spread throughout the entire Tennessee River system. These data should be reanalyzed to determine if TVA's assessment is an accurate measure of conditions for the native aquatic biota, or native federally or state listed species in or adjacent to these sampling sites. N-2

These and similar monitoring/sampling efforts by TVA are critical to ensuring that BFN's National Pollutant Discharge Elimination System (NPDES) permit limits, state water quality standards, and other environmental permit requirements are followed. Taken separately, the data

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suggest that there are relatively low or insignificant impacts occurring further downstream of the BFN site; however, a more detailed assessment is clearly necessary to evaluate conditions immediately downstream of the BFN site.

In addition to an examination of general conditions at individual sample sites, the detailed assessment should include an analysis of any episodically poor water quality conditions and specific conditions in bottom waters. For instance, if dissolved oxygen levels drop for extended periods of time at, or near the stream bottom in the reservoir within, adjacent to, or within the mixing zone downstream of the effluent/diffuser site; benthic-dwelling species, such as mussels, could be severely impacted or killed. If a toxic substance was released through the diffusers into the reservoir, benthic species near, downstream, or within the mixing zone of BFN would likely be adversely affected. These are the conditions, although sometimes short-lived, which may, nonetheless, exert profound effects on aquatic organism health and viability, particularly of non-mobile species such as mussels and other invertebrate fauna. N-3

The proposed license renewal at BFN seeks to increase the power production at each of the three units to 120% of their originally licensed power production capacity. Unit 1 has been off-line and not in service since 1985. By bringing Unit 1 back on-line, TVA's short term goal (within the next 5 years), there will be a need to increase the amount of water withdrawn from Wheeler Reservoir. The proposed operation of all three units at the new operating license levels will also require BFN to increase the amount of cooling water withdrawn from Wheeler Reservoir. These increases in water withdrawn from the reservoir will have a two-fold effect: first, an increase in entrainment of aquatic organisms into the intake structures from the reservoir and, secondly, significant increases in the volume of thermal heated water released back to the reservoir.

Entrainment and subsequent mortality of aquatic organisms in intake cooling water, and biocides

We are concerned about uptake of aquatic organisms into the boiler reactor water by entrainment, including larvae and early life stages of federally-protected mussels (if present), as well as other mussels, fish), phytoplankton, and zooplankton. Opportunities to divert fish from entrainment (e.g. strobe lights) and use of angled trash racks with sluiceways, and appropriate screens may mitigate for increased entrainment of larger fish and invertebrates, if incorporated into design plans. There may also be methods to minimize entrainment depending on depth of water withdrawal and location of water withdrawal structures. N-4

Boiler reactor water is subjected to intense pressure, heat, and biocide treatment. The raw water intake for BFN is treated biannually with a molluscicide to control bio-fouling by zebra mussels and Asiatic clams. Raw water samples are taken biweekly during the months of April to September and analyzed for zebra mussel larvae as an early detection system aimed at reducing the potential of bio-fouling of BFN's raw water intake structure. Without adequate screening and fish rack sluiceways, aquatic organisms taken up by entrainment into the intake pipe and subjected to such environment will be killed by these treatments. N-5

Water withdrawal, temperature, chlorine, copper, and hydrazine effects in the Tennessee River

We are not sure what biocides are utilized at BFN; however, chlorine is often used in biocides. Chlorine is extremely toxic to a wide variety of freshwater organisms (Hunn and Schnick 1990). Safe concentrations (i.e. those that do not produce any lethal or sub lethal effects) are likely N-6 much lower, especially considering the relatively sessile nature and long life span of mussels relative to these short-term test exposures. Under longer-term exposures (>96 hours), lethality to fish and aquatic invertebrates has been documented at chlorine concentrations between 3.4 and 26 ug/L (EPA 1985). Because chlorine" extreme toxicity, the EPA established a Federal ambient water quality criterion maximum concentration of 0.019 mg/L and a continuous concentration (CCC) of 0.011 mg/L for chlorine, respectively, to protect aquatic life (EPA 2002). Studies have shown that mussels are very similar in sensitivity to other sensitive aquatic organisms and that 0.019 mg/L is likely protective (Ingersoll 2003). To meet these limits, a dechlorination unit or use of alternatives such as UV or ozonation could be utilized. Alternatively, high flow rate velocity flushes, ultrasound, or robotic mechanical cleaning devices could occur on influent and effluent pipes.

The toxicity of chlorine to aquatic life is a function of total residual chlorine (TRC), which includes both free chlorine and chloramines (Flora et al. 1984). Monitoring of free chlorine does not serve as an adequate indicator of the potential toxicity of facility effluents nor does it provide adequate data to avoid toxic effects to listed mussels. Therefore, TRC should be measured rather than free chlorine. N-7

Hydrazine has been used to scavenge oxygen during blow downs of cooling towers in an effort to help reduce oxidization from occurring in the towers. Discharges of this potential toxicant into the Tennessee River may cause more than detrimental effects to federally listed mussels, if present, as well as many other aquatic organisms. The rate of degradation of hydrazine in water is highly dependent on factors such as pH, temperature, oxygen content, alkalinity, hardness, and the presence of organic material and metal ions. The toxicity of hydrazine increased for guppies in soft water (at pH <7.0) compared with the toxicity in hard water at pH ~ 8.0 (Slonim 1977), indicating increased persistence of hydrazine in soft, non-alkaline water such as that of Wheeler Reservoir (TVA 1971). Increased water temperature also enhances the toxicity of the compound for bluegills (Hunt el al., 1981) (http://www.inchem.org/dcoumentsˈehc/ehc/ehc68.htm#SectionNumber:5.1). Because the Tennessee River at BFN's point of discharge is expected to have low alkalinity and elevated in-stream water temperatures due to BFN's thermal discharge, these conditions raise our concerns for the toxicity of hydrazine in the discharge, and its potential adverse effects on aquatic biota. N-8

To operate units 2 and 3 at their current operating license level, BFN withdraws 1,635 cfs per unit. With the addition of Unit 1, the projected total withdrawal from Wheeler Reservoir through all three units would be approximately 4,907 cfs. TVA is seeking extended power up-rates (EPUs), which would increase the total combined power level produced at BFN. TVA claims an increase in power production would not require further increases in intake flows. When Units 1, 2, and 3 are generating at the proposed 120% capacity level, TVA believes BFN can continue to meet current ADEM regulatory limits of the NPDES permit by employing various mitigating strategies like de-rating and the use of the cooling tower helper mode of operation. TVA has committed to the construction of a sixth cooling tower to enable BFN to meet current NPDES permit limits.

Due to various system limitations, BFN cannot pull the entire condenser circulating water through the cooling towers when it operates in the helper mode. TVA estimates that during helper mode operation approximately 3,725 cfs is directed through the six cooling towers. Therefore, the remaining 1,000 cfs of thermal heated water bypasses the towers and will need to

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be directly routed to the river. TVA operates the cooling towers only when necessary to meet NPDES permit requirements, typically a few weeks during the hottest part of the summer (usually during July and August). Since July and August are the critical months for approaching maximum river water temperature limits specified in BFN's NPDES permit, BFN would be required to utilize the cooling towers or be forced to de-rate the plant.

The TVA modeled the daily average flow for Wheeler Reservoir at BFN. The TVA used an unsteady flow model of Wheeler Reservoir, utilizing data from Guntersville Dam and Wheeler Dam to assess a time series of the daily average flow for the period of 1976 to 2002. The average river flow past BFN was estimated as 46,606 cfs, ranging from a high of 378,742 cfs to a low of 2,638 cfs. Therefore, the water intake flow for Units 1, 2, and 3 of 4,907 cfs encompasses a significant fraction of the daily average and low river flow past BFN. The 7Q10 flow at BFN (as defined in the NPDES permit) is 8,700 cfs. Target minimum flows for Wheeler Reservoir were established by TVA's river operations environmental impact statement completed in 1990. The minimum daily average flows at BFN are 10,000 cfs for July through September, 8,000 cfs for December through February, and 5,000 cfs in other months.

These average flows are targets determined by a computer model that has been given certain data sets or variables based on historic flow data. If these variables are inaccurate or erroneous, the model would produce an artificial reading of forecasted water quality conditions and aquatic organisms would bear the consequences. Our concern is for the welfare of the aquatic species located in, near, and downstream of BFN's effluent plume. N-9

We understand TVA has committed to complying with NPDES permit requirements at BFN. However, we find it difficult to understand how BFN can manage bringing Unit 1 back into service and up-rate the three units, when under current operations and during hot weather events, BFN has difficulty meeting NPDES water temperature limits on a consistent basis with units 2 and 3. Although a sixth cooling tower would aid in reducing condenser circulating water temperatures, we fail to see how BFN could operate all three units at 120% power production capacity during these hot weather/high water temperature periods of the year without de-rating or without creating additional cooling systems to cool heated water. It is unclear how these units could be up-rated if cooling capacity at BFN is insufficient. De-rating seems to be the only valid option in this case. Again, we have difficulty understanding the reasoning behind up-rating when, generally, the highest power consumption by the public occurs during the hottest weather periods of the year (i.e. as air conditioning use increases).

During hot weather, high-demand periods in July or August, TVA would be forced to request waivers from ADEM to exceed water quality standards and limitations for temperature designed to protect aquatic life. Such episodic violations are highly likely to occur in the future, especially during low flow, drought years in the Tennessee River. As mentioned earlier, these critical periods of the year create difficult environmental conditions on the aquatic biota in the Tennessee River. Mussels may be especially vulnerable since the July to August period is when mussel metabolism increases and when dissolved oxygen availability decreases. Careful consideration of environmental impacts would need to be made by TVA as these events occur. We believe TVA should closely re-examine opportunities for thermal water storage and/or for storage of excess uptake water during high-temperature, low-flow conditions to prevent episodic lethal conditions for fish (including potential fish host of listed mussels) and invertebrates during such periods of high water use, even if water must be pumped from off-site locations. During

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such periods, there could be significant population-level effects on aquatic invertebrates and fish both near the discharge and downstream.

Higher water temperatures, in concert with nutrient loading into the Tennessee River from point and non-point sources, generally promote the growth of aquatic plants, particularly nuisance and invasive species, and may trigger algal blooms. Federal and state environmental agencies must then employ eradication programs that typically result in herbicidal treatments. These programs are extremely expensive and are difficult to effectively implement.

Maintenance Practices for Transmission Line Rights-of-Way

We are concerned about the maintenance practices employed along BFN's transmission line rights-of-way. Our understanding of TVA's maintenance practices follow the strict guidance and protocols developed in the Guide for Environmental Protection and Best Management Practices for Tennessee Valley Authority Transmission Construction and Maintenance Activities manual. We have reviewed this manual and are comfortable with the protocols developed. We understand TVA's Heritage staff (which consists of biologist, ecologists, and cultural resources staff) reviews all maintenance activities associated with transmission line rights-of-way. We support and strongly recommend that the TVA Heritage staff remain involved in the process of all maintenance proposals associated with BFN's power distribution facilities. We also encourage continued surveys of sites along or adjacent to maintained rights-of-way for rare, threatened, or endangered plants and animals, particularly in any previously un-surveyed portions of the system with unusual habitat conditions.

N-10

We remain concerned about BFN's practice of controlling vegetation in the transmission line rights-of-way at stream crossings, using mowing and herbicide applications to reduce the cover to herbaceous species. This modification to the natural vegetative cover may lead to erosion and sedimentation of streams. We are particularly concerned about this practice at stream crossings where federally-listed mussels may occur, specifically Bear Creek, the designated critical habitat for the federally-listed mussel, Cumberlandian combshell, *Epioblasma brevidens.*

We have provided TVA Heritage staff a table listing acute toxicity of various nonionic surfactants/spreaders used with glyphosate products and toxicity of formulated glyphosate products. We encourage the TVA Heritage staff to work with TVA maintenance staff to ensure that appropriate herbicides and surfactants, with low toxicity to aquatic invertebrates and fish, are utilized and applied by spot methods only near streams, and that EPA label rates are not exceeded.

Recommendations

Effects of plant operation on health of fish and other aquatic organisms in the Tennessee River

N-11

- Reinitiate the ichthyoplankton characterization study done between the years of 1974 and 1979, prior to startup of BFN and continue a similar type study during the initial years of operations of the proposed up-rate of BFN's Units 1, 2, and 3.

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Entrainment and subsequent mortality of aquatic organisms in intake cooling water, and biocides

- Quantify the diversity and abundance of organisms entrained by water withdrawal at all intake pipes and evaluate screening mesh size, low velocity intake, and other techniques to minimize entrainment. Quantification should occur at least monthly for the year of the study and for the year following screen changes. N-12

Water withdrawal, temperature, chlorine, copper, and hydrazine effects in the Tennessee River

- Monitor temperature, dissolved oxygen, alkalinity, pH, TRC, copper, and hydrazine at the downstream end of the mixing zone on a monthly basis to determine if modeling has accurately predicted concentrations. Target bottom waters at those times of the year that have historically produced the lowest river flow and warmest river water temperatures. Conduct a formal risk assessment using EPA methods to assess whether concentrations are protective of sensitive fish and invertebrates, particularly federally-listed mussels, if present. Include low-flow, high-temperature conditions in the risk assessment. N-13 N-15

- If hydrazine is determined to pose a risk to aquatic species (particularly mussels), eliminate discharge of hydrazine by designing a system for separating and containing hydrazine from all discharges to the Tennessee River/Wheeler Reservoir. If copper in bottom sediments appears to occur at concentrations above ecological risk levels, implement a plan to replace copper components at the plant with brass, titanium, or other typical replacement parts used by other nuclear power facilities to reduce copper. N-16 N-17

- Reduce or eliminate discharge of chlorine to the Tennessee River through use of a dechlorination unit for removal of chlorine before discharge. If there is a discharge of chlorine, then at least monitor TRC daily. To provide adequate protection of aquatic life, the permit should establish EPA criterion chronic concentration of 0.011 mg of TRC per liter as a permit limitation for continuous discharges and monitor it daily. If chlorine treatments are intermittent, the criterion for protection of aquatic life from acute toxicity can be substituted. Mechanical cleaning (e.g. robotic) and flushing controls should be considered as an alternative to chlorine. N-18

Maintenance Practices for Transmission Line Rights-of-Way

- Use mowing or prescribed burns as an alternative to herbicide use for controlling vegetation along transmission line rights-of-way, particularly near stream crossings and riparian habitats. Mowing should be timed to avoid periods of nesting ground birds. If herbicides are used, use Roundup Custom or Accord or similar low toxicity, low-solubility herbicides, together with a low-toxicity surfactant such as LI 700 or Agri-Dex in strict adherence to the label. Near streams and other water bodies, evaluate toxicity based on toxicity to aquatic species. Periodically survey to determine if federally-listed plant species have become established in rights-of-way. N-14 N-19 N-20 N-21

- At all stream crossings, especially where federally-listed mussels are known to occur, maintain or plant stream riparian areas with native shrub species and insure that BMPs are installed to control erosion.

Currently, NRC is informally consulting with the Service's Daphne Ecological Services Field Office on the proposed BFN re-license project. NRC has provided to the Daphne FO a biological assessment on the federally-listed species located in the vicinity of BFN's facilities. We are currently reviewing NRC's biological assessment for the proposed BFN re-license proposal and will more fully address impacts of this project on listed species in a separate review. We are not able, at this time, to conclude informal consultation on this project. We continue to cooperatively work with NRC and TVA to gather information on listed species potentially affected by the proposed re-licensing of BFN.

We welcome the opportunity to assist in the design of monitoring plans. Upon our review of all the pertinent water quality data and threatened and endangered species information, we will provide our final comments and consultation under section 7 of the Endangered Species Act. Initiation of formal consultation with the NRC may be necessary after our review of this information.

If you have any questions or need additional information, please contact Mr. Rob Hurt at the Fish and Wildlife Service, in Decatur, Alabama, (256) 353-7243 ext. 29.

Sincerely,

Gregory Hogue
Regional Environmental Officer

cc:
FWS, R4
OEPC, WASO
TVA

9

References:

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MAR-14-2005 10:25

P.02
3/15/05

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 4
ATLANTA FEDERAL CENTER
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February 28, 2005

12/10/04
69FR 71855

(4)

ML050700107

Rules Review and Directives Branch
U.S. Nuclear Regulatory Commission
Mail Stop T6-D59
Washington, D.C. 20555-0001

RE: EPA Review and Comments on
Draft Generic Supplemental Environmental Impact Statement (DGSEIS)
License Renewal of Nuclear Plants, Supplement 21
Regarding Browns Ferry Nuclear Plant, Units 1, 2, and 3
CEQ No. 040563

Dear Sir:

EPA Region 4 reviewed the Draft Generic Supplemental EIS (DGSEIS) pursuant to Section 309 of the Clean Air Act and Section 102 (2)(C) of the National Environmental Policy Act (NEPA). The purpose of this letter is to provide the Nuclear Regulatory Commission (NRC) with EPA's comments regarding potential impacts of the proposed renewal of the Browns Ferry Nuclear Plant Operating Licenses (OLs).

The Tennessee Valley Authority (TVA) submitted an application to renew the Operating License (OLs) for the Browns Ferry Nuclear Plant Units 1, 2, and 3 for an additional 20 years. The proposed action, (license renewal), would provide for continued operation and maintenance of existing facilities and transmission lines.

Based on the review of the DGSEIS, the document received a rating of EC-1, meaning that environmental concerns exist regarding some aspects of the proposed project. Specifically, protecting the environment involves the continuing need for appropriate storage and ultimate disposition of radioactive wastes generated on-site. In addition, the DGSEIS does not include complete information regarding the facility's CWA/NPDES compliance status. P-1 P-2

According to EPA's records, Browns Ferry Nuclear Plant has reported non-compliance regarding total suspended solids and coliform during the last two years. EPA's records also show that the facility was issued a letter of violation/warning by the State with regard to the Clean Water Act on February 17, 2004. However, page 2-8, line 22 mentions that "operations will continue to meet regulatory limits established in the existing NPDES Permit." Page 2-21 discusses the Plant's relationship with ADEM and the NPDES Permit, but does not mention the compliance status nor the letter of violation. The Final GSEIS needs to include information regarding how the facility has been addressing the non-compliance issues.

E-RIDS=ADM-03
Add= M. Masnik
(MTM2)

SISP Review Complete

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MAR-14-2005 10:26 P.03

The DGSEIS acknowledges that OL renewal of the Browns Ferry Nuclear Plant will require continuing radiological monitoring of all plant effluents. Appropriate storage of spent fuel assemblies and radioactive wastes on-site is required, in order to prevent impacts. Page A-11 discusses the Waste Confidence Rule (10 CFR 51.23), in which the Commission generically determined that the spent fuel generated by any reactor can be safely stored onsite for at least 30 years beyond the licensed operating life of the reactor. Ultimately, long-term radioactive waste disposition will require transportation of wastes to a permitted repository site. We note the information on pages 6-4 through 6-6 of the document, regarding the expected availability of Yucca Mountain as a geological repository for spent nuclear fuel and high-level waste.

In conclusion, the document states that the OL renewal would result in fewer environmental impacts than the feasible alternatives for generating power, and the NRC considers impacts of OL renewal to be small. Overall, the impacts as defined in the DGSEIS appear to be within acceptable limits. P-8

Thank you for the opportunity to comment on this document. If we can be of further assistance, please contact Ramona McConney of my staff at (404) 562-9615.

Sincerely,

Heinz Mueller

Heinz J. Mueller, Chief
Office of Environmental Assessment

TOTAL P.03

Doris Mendiola - Comments from Public Citizen and SACE Page 1

RDB received
3/3/05

From: "Michele Boyd" <mboyd@citizen.org>
To: <BrownsFerryEIS@nrc.gov>
Date: 3/2/05 5:36PM
Subject: Comments from Public Citizen and SACE

12/10/04

69FR 71855

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Please find attached comments from Public Citizen and Southern Alliance for Clean Energy on the NRC's Generic Environmental Impact Statement for License Renewal of Nuclear Plants, Supplement 21 Draft Regarding Browns Ferry Nuclear Plant, Units 1, 2, and 3. Also attached are two supplements to these comments: the Nuclear Security Coalition's Petition and Petition Annex to the NRC requesting actions to provide stronger defenses of BWR-Mark I & II containments and spent fuel.

Michele Boyd

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SISP Review Complete

Template = ADM-013

E-RIDS = ADM-03
Call = M. Masnik (MTM2)

March 2, 2005

Chief, Rules Review and Directives Branch
U.S. Nuclear Regulatory Commission
Mail Stop T6-D59
Washington, DC 20555-0001

Re: Comments on the Generic Environmental Impact Statement for License Renewal of Nuclear Plants, Supplement 21 Draft Regarding Browns Ferry Nuclear Plant, Units 1, 2, and 3 (NUREG-1437)

To Whom It May Concern:

The following are the comments of Public Citizen and the Southern Alliance for Clean Energy (SACE) on the NRC's Generic Environmental Impact Statement for License Renewal of Nuclear Plants, Supplement 21 Draft Regarding Browns Ferry Nuclear Plant, Units 1, 2, and 3.

Public Citizen is a national non-profit organization that works to protect citizens and the environment from the dangers posed by nuclear power and seeks policies that will lead to safe, affordable and environmentally sustainable energy. Public Citizen accepts no corporate or government funding.

Southern Alliance for Clean Energy (SACE) is a regional not-for-profit, nonpartisan conservation and energy consumer organization focused on energy policy, including nuclear concerns, for well over twenty years with members throughout the Southeast.

Reactor Design Vulnerabilities
The three Browns Ferry nuclear reactors are all BWR-Mark I GE-4 design, which has numerous inherent security flaws: the spent-fuel pool is elevated above ground level, making it vulnerable from above, below, and from the side; the reactor itself is located above ground level; and the reactor lacks a traditional "containment dome" and instead has a thin steel shell. Of the 104 nuclear reactors in the United States, 34 have these particular vulnerabilities to acts of terrorism. The Nuclear Security Coalition, of which Public Citizen and SACE are members, have submitted a petition to the NRC that requests the NRC to provide stronger defenses of boiling-water reactors with Mark I and II containments and their spent fuel. We have attached the Coalition's NRC petition and petition annex to these comments. Given the serious vulnerabilities of these types of reactors to attack, this petition should be fully considered and acted upon by the Commission before decisions are made about relicensing any of the Mark I and II BWRs, including the three reactors at Browns Ferry. O-1

O-2

Relicensing of Browns Ferry Unit 1
Browns Ferry Unit 1 has been in the non-defined regulatory status of "administrative hold" for nearly 20 years, which is a longer time period than it actually operated. The operating license for Unit 1 should have been revoked after it was shut down in 1985 for failing "to

consistently maintain a documented design basis and to control the plant's configuration in accordance with that basis."[1] To ensure optimal safety at the plant, TVA should now be required to go through NRC's license application process for Unit 1 as required for any new plant. Only after an extended period of operation without any incident or accident following a restart should TVA be allowed to apply for a license extension. To give a license extension to a plant that has not operated in 20 years is utterly absurd. We are further concerned over safety allegations brought forward by former contractors that performed work for the Browns Ferry Unit 1 Restart process—citing that poor practices have occurred and work has been done outside of design specifications. Until the safety allegations can be thoroughly reviewed by the NRC, the restart should not go forward, and consequently, the relicensing of Unit 1 in particular should not be allowed.

High-level radioactive waste

In all likelihood, license renewal at Browns Ferry reactors would exacerbate existing space issues regarding onsite spent fuel, and create 20 years' worth of additional, dangerous high-level waste, with no practicable or thorough means of securing it. The Draft SEIS fails to evaluate the environmental impacts and security threat of indefinitely storing the additional irradiated fuel that will be generated over the 20-year license extension. Each reactor will create annually between 100 and 150 metric tons additional irradiated fuel to the site. Despite the NRC's Waste Confidence Decision, the only site under consideration, Yucca Mountain in Nevada, is far from a done deal. Numerous scientific questions remain about whether the site can safely store waste. Moreover, the Department of Energy (DOE) has not yet submitted its license application to the NRC, although the statutory deadline was more than two years ago. DOE was supposed to begin accepting waste in 1998 and is highly unlikely to meet its revised goal of accepting waste by 2012. O-8

Even if Yucca Mountain is opened, the site cannot hold the high-level radioactive waste that will be generated by existing reactors after 2010. Therefore, in addition to the waste generated by existing reactors, waste created by the reactors over the 20-year extension would also have to remain onsite for an indefinite period of time. The environmental impacts of indefinite storage must be thoroughly evaluated in the Final SEIS. O-3

We would also like to raise concerns over a serious accident that occurred at Browns Ferry on October 24, 2004—32 tons of equipment were dropped onto the refueling floor by a faulty overhead crane. When Browns Ferry exceeds its spent fuel capacity, which certainly will occur if it continues to operate, the overhead crane will likely be used to move and load 100 ton dry storage casks used for storing nuclear waste from the spent fuel pool. The possible devastation that could occur if such a load were dropped is serious, and needs to be addressed well before the reactors are relicensed or Unit 1 is brought back online.

[1] Letter from O. J. Zeringue, Senior Vice President – Nuclear Operations, Tennessee Valley Authority, to United States Nuclear Regulatory Commission, "Response to Request for Information Regarding Adequacy, Availability, and Control of Design Bases Information," February 12, 1997.

Decommissioning
The NRC should evaluate the decommissioning trust fund balances for TVA's Browns Ferry units and how decommissioning will be impacted by extending the operating licenses of all three units. The NRC should also ensure that sufficient decommissioning funds would be in place in order to protect utility ratepayers and taxpayers. According to a General Accounting Office (GAO) report in 2003, all of TVA's nuclear power plants were found to be below the benchmark of sufficiency for decommissioning trust fund balances—with the Browns Ferry units being among nuclear plants with the poorest decommissioning fund status. This is extremely problematic. O-4

Water Use
Nuclear power plants have a wide impact on water quantity and quality. Nuclear power plants release radioactive contaminants and hazardous chemicals into surrounding water resources, contribute greatly to thermal pollution, negatively impact aquatic life, and require enormous volumes of water in order to operate—more water use than any other traditional form of energy production and significantly more water than renewable energy technologies. Browns Ferry itself uses a tremendous amount of water. The SEIS mentions that with Unit 1 back online, the total water withdrawal for all three reactors at Browns Ferry would be 3171 million gallons per day. That is staggering. We disagree with the assumption that only a small amount of water is lost due to evaporation. Though the reactors have limited use of cooling towers, water consumption does occur and should be quantified. Further, in order to reduce the negative impacts to water supplies, year-round use of cooling towers or the technology to install permanent-use cooling towers should be investigated and implemented. The NRC needs to further study this issue to help reduce Browns Ferry's negative impacts to surrounding water resources and provide a more thorough analysis of the benefits to water use and quality from renewable energy supplies than is currently addressed in the SEIS. O-5

Economics
As we pointed out in our scoping comments, TVA is very close to exceeding its congressionally mandated debt ceiling of $30 billion. Currently, TVA has about $25 billion in debt, in addition to $3 billion to $5 billion worth of other obligations that could be considered debt (e.g. leaseback contracts, pre-purchase of electricity, etc.). The restart of Browns Ferry Unit 1 is estimated to cost a total of $1.8 billion. According to NRC regulations related to Supplemental EIS for license renewals [10 CFR 51.95(c)(2)], the SEIS "is not required to include discussion of...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." The solvency of TVA certainly appears to be "essential" to making any meaningful comparison of alternative and should be included in the Final SEIS. O-6

Analysis of Alternatives
The SEIS does not provide a thorough review of energy alternatives or technologies. Some data appears out-of-date and should be revisited using the most current information from independent sources, not just directly from TVA. Further, it is hard to understand how renewable energy technologies, like biomass, solar, and wind, which are not likely to be O-7

targeted by terrorists nor have the capacity, in terms of accidents, to kill thousands of people or permanently contaminate large land areas, can be assessed by the NRC to have a 'large' environmental impact while relicensing all the reactors at Browns Ferry is considered to have a 'small' impact. This assessment flies in the face of common sense.

According to a recent study by the Renewable Energy Policy Project, called *Powering the South: A clean and affordable energy plan for the Southern United States*, Alabama has the ability to significantly reduce electricity consumption through existing, affordable energy efficiency measures.[2] If these measures were adopted, by 2020 Alabama could: save 29 MWh of electricity; reduce electricity demand by 23%; and reduce net electricity costs by $651 million. Reducing energy demand and use saves not only money but also precious water resources. Further, less nuclear waste would be generated. More recent energy efficiency and conservation measures should be studied and implemented before permitting the relicensing of Browns Ferry's three reactors or the restart of Unit 1. O-9

TVA has excellent wind resources within its service area. In fact, they have approximately 29MW of wind currently installed. TVA should be encouraged to invest more in developing this clean, safe energy resource instead of spending billions of dollars on the costs of restarting Unit 1 and extended operation of all three nuclear reactors. There is also potential for biomass energy production in Alabama and TVA's service territory. Clean forms of biomass represent a 'homegrown' energy source that can provide local jobs to rural areas that would also support farmers and the region's economy, while helping expand renewable energy technologies. The use of solar technologies, such as photovoltaics and solar thermal systems, are not as cumbersome or difficult as reflected in the SEIS. The Rancho Seco nuclear plant, which is now closed, provides an example of the land availability at existing nuclear plants. There was minimal information in the SEIS on these options.

We appreciate this opportunity to comment during this scoping process, and trust that our comments will be taken seriously.

Sincerely,

Michele Boyd
Legislative Director
Public Citizen
215 Pennsylvania Ave., SE
Washington, DC 20003

Sara Barczak
Safe Energy Director
Southern Alliance for Clean Energy
3025 Bull Street, Suite 101
Savannah, GA 31405

[2] The report is available at http://www.poweringthesouth.org/figure/pts_repp_book.pdf.

The petition attached to the Public Citizen comment letter was submitted to the NRC by the Nuclear Security Coalition c/o Citizens Awareness Network on August 10, 2004, under a separate cover and is being evaluated by the NRC staff under 10 CFR 2.206 independently of the BFN license renewal. The petition is available from ADAMS at the NRC website http://www.nrc.gov/reading-rm/adams.html under accession number ML050630419.

Appendix B

Contributors to the Supplement

Appendix B

Contributors to the Supplement

The overall responsibility for the preparation of this supplement was assigned to the Office of Nuclear Reactor Regulation, U.S. Nuclear Regulatory Commission (NRC). The statement was prepared by members of the Office of Nuclear Reactor Regulation with assistance from other NRC organizations, Pacific Northwest National Laboratory, Argonne National Laboratory, and Los Alamos National Laboratory.

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(a) Pacific Northwest National Laboratory is operated for the U.S. Department of Energy by Battelle Memorial Institute.
(b) Argonne National Laboratory is operated for the U.S. Department of Energy by the University of Chicago.
(c) Los Alamos National Laboratory is operated for the U.S. Department of Energy by the University of California.

Appendix C

Chronology of NRC Staff Environmental Review Correspondence Related to the Tennessee Valley Authority Application for License Renewal of Browns Ferry Nuclear Power Plant, Units 1, 2, and 3

Appendix C

Chronology of NRC Staff Environmental Review Correspondence Related to the Tennessee Valley Authority Application for License Renewal of Browns Ferry Nuclear Power Plant, Units 1, 2, and 3

This appendix contains a chronological listing of correspondence between the U.S. Nuclear Regulatory Commission (NRC) and the Tennessee Valley Authority (TVA) and other correspondence related to the NRC staff's environmental review, under Title 10 of the Code of Federal Regulations (CFR) Part 51, of TVA's application for renewal of the operating licenses for Browns Ferry Nuclear Power Plant, Units 1, 2, and 3 (BFN). All documents, with the exception of those containing proprietary information, are available electronically from the NRC's Agencywide Document Access and Management System (ADAMS) found on the Internet at the following web address: http://www.nrc.gov/reading-rm/adams.html. The website provides text and image files of NRC's public documents. The ADAMS accession number for each document is included below.

December 31, 2003	Letter from TVA to NRC, BFN, Docket No. 50-259, 50-260, and 50-296, Application for Renewed Operating Licenses (Accession No. ML040060355).
January 7, 2004	Letter from NRC to Mr. J.A. Scalice, TVA, Receipt and Availability of the License Renewal Application for BFN (Accession No. ML040090370).
January 8, 2004	NRC press release announcing the availability of license renewal application for BFN (Accession No. ML040080693).
February 27, 2004	Letter from NRC to Mr. R. Crabtree, National Marine Fisheries Service (NOAA Fisheries), Request for List of Protected Species Within the Area Under Evaluation for the BFN License Renewal (Accession No. ML040610754).
March 4, 2004	Letter from NRC to Mr. J.A. Scalice, TVA, transmitting Determination of Acceptability and Sufficiency for Docketing, Proposed Review Schedule, and Opportunity for a Hearing Regarding the Application from Tennessee Valley Authority for Renewal of the Operating Licenses for BFN (Accession No. ML040650206).

March 4, 2004	Letter from NRC to Mr. J.A. Scalice, TVA, Notice of Intent to Prepare an Environmental Impact Statement and Conduct Scoping Process for License Renewal for the BFN (Accession No. ML040640755).
March 5, 2004	Letter from NRC to Mr. L. Goldman, U.S. Fish and Wildlife Service (FWS), Request for List of Protected Species Within the Area Under Evaluation for the BFN License Renewal (Accession No. ML040680881).
March 8, 2004	Letter from NRC to Dr. L. Warner, State Historic Preservation Office, BFN Operating License Renewal (Accession No. ML040700557).
March 10, 2004	NRC press release announcing for hearing on application for license renewal of BFN (Accession No. ML040700395).
March 11, 2004	Letter from D. Bernhart, NOAA Fisheries, to NRC Protected Species List Request, Proposed Renewal of Operating Licenses for BFN, Limestone County, Alabama (Accession No. ML041330242).
March 17, 2004	Notice of Public Meeting to Discuss Environmental Scoping Process for the BFN License Renewal Application (Accession No. ML040770966).
March 23, 2004	Letter from NRC to the Honorable C. Smith, Principal Chief, Cherokee Nation of Oklahoma, Request for Comments Concerning BFN Operating License Renewal (Accession No. ML040890750).
March 23, 2004	Letter from NRC to the Honorable K. Chambers, Principal Chief, Seminole Nation of Oklahoma, Request for Comments Concerning BFN Operating License Renewal (Accession No. ML040890884).
March 23, 2004	Letter from NRC to the Honorable B. Anoatubby, Governor, Chickasaw Nation, Request for Comments Concerning BFN Operating License Renewal (Accession No. ML040890969).
March 23, 2004	Letter from NRC to the Honorable R.P. Beaver, Principal Chief, Muscogee (Creek) Nation, Request for Comments Concerning BFN Operating License Renewal (Accession No. ML040890973).

March 23, 2004	Letter from NRC to the Honorable M. Hicks, Principal Chief, Eastern Band of Cherokee Indians, Request for Comments Concerning BFN Operating License Renewal (Accession No. ML040890980).
March 23, 2004	Letter from NRC to the Honorable L. Poncho, Chairman, Coushatta Indians, Request for Comments Concerning BFN Operating License Renewal (Accession No. ML040860795).
March 23, 2004	Letter from NRC to the Honorable C. Enyart, Chief, Eastern Shawnee Tribe of Oklahoma, Request for Comments Concerning BFN Operating License Renewal (Accession No. ML040860780).
March 23, 2004	Letter from NRC to the Honorable C. Norris, Chief, Jena Band of Choctaw Indians, Request for Comments Concerning BFN Operating License Renewal (Accession No. ML040860586).
March 23, 2004	Letter from NRC to the Honorable P. Martin, Chief, Mississippi Band of Choctaw Indians, Request for Comments Concerning BFN Operating License Renewal (Accession No. ML040890862).
March 23, 2004	Letter from NRC to the Honorable B.K. McGertt, Town King, Thlopthlocco Tribal Town, Request for Comments Concerning BFN Operating License Renewal (Accession No. ML040860319).
March 23, 2004	Letter from NRC to the Honorable T. Yargee, Chief, Alabama-Quassarte Tribal Town, Request for Comments Concerning BFN Operating License Renewal (Accession No. ML040890959).
March 23, 2004	Letter from NRC to the Honorable L. Wesley, Towns King, Kialagee Tribal Towns, Request for Comments Concerning BFN Operating License Renewal (Accession No. ML040860311).
March 23, 2004	Letter from NRC to the Honorable G.E. Pyle, Chief, Choctow Nation of Oklahoma, Request for Comments Concerning BFN Operating License Renewal (Accession No. ML040860339).
March 23, 2004	Letter from NRC to the Honorable D. Proctor, Chief, United Keetoowah band of Cherokee Indians, Request for Comments Concerning BFN Operating License Renewal (Accession No. ML040890841).

March 23, 2004	Letter from NRC to the Honorable M. Cypress, Chairman, Seminole Indian Tribe, Request for Comments Concerning BFN Operating License Renewal (Accession No. ML040890689).
March 23, 2004	Letter from NRC to the Honorable K. Battiste, Chairman, Alabama-Coushatta Tribe of Texas, Request for Comments Concerning BFN Operating License Renewal (Accession No. ML040890931).
March 23, 2004	Letter from NRC to Mr. E. Barbry Jr., Director, Tunica-Biloxi Tribe, Request for Comments Concerning BFN Operating License Renewal (Accession No. ML040860762).
March 23, 2004	Letter from NRC to Ms. J. Makaseah, Cultural/Historic Preservation Department, Absentee-Shawnee Executive Committee, Request for Comments Concerning BFN Operating License Renewal (Accession No. ML040860705).
March 23, 2004	Letter from NRC to Mr. R. Thrower, Tribal Historic Preservation Office, Poarch Creek Indians, Request for Comments Concerning BFN Operating License Renewal (Accession No. ML040860251).
March 23, 2004	Letter from NRC to the Honorable B. Cypress, Chairman, Miccosukee Indians Tribe, Request for Comments Concerning BFN Operating License Renewal (Accession No. ML040860239).
March 31, 2004	Letter from NRC to Mr. J.A. Scalice, TVA, Review Schedule for Application for Renewal of the Operating Licenses for the Browns Ferry Nuclear Power Plant, Units 1, 2, and 3 (TAC Nos. MC1704, MC1705, and MC1706). (Accession No. ML040910016).
April 28, 2004	Letter from NRC to Mr. J.A. Scalice, TVA, Request for Additional Information Regarding Severe Accident Mitigation Alternatives (SAMAs) for the BFN, License Renewal Application (Accession No. ML041200517).
May 14, 2004	Summary of Scoping Meetings to Support Review of the BFN, License Renewal Application (Accession No. ML041390581).

May 19, 2004	Letter from Mr. L. Goldman, FWS, Daphne, Alabama, to NRC, providing an updated list of protected species within the area under evaluation for the BFN License Renewal (Accession No. ML041550148).
May 20, 2004	Letter from NRC to Mr. J.A. Scalice, TVA, Notice of Extension of the Comment period on the Environmental Scope of the Plant-Specific Supplement to the Generic Environmental Impact Statement (GEIS) Regarding License Renewal for BFN (Accession No. ML041450255).
May 27, 2004	Letter from Mr. M.J. Burzynski, TVA to NRC, Browns Ferry Nuclear Plant (BFN) - Units 1, 2, and 3 - March 30-31, 2004 Meeting Follow-Up - Additional Information for License Renewal Environmental Review (Accession No. ML041530161).
June 25, 2004	Letter from TVA to NRC, Browns Ferry Nuclear Plant (BFN), Units 2 and 3, Change Technical Specifications (TS) for TS-418, Request for License Amendment, Extended Power Uprate (EPU) Operation (Accession No. ML041840301).
June 28, 2004	Letter from TVA to NRC, Browns Ferry Nuclear Plant (BFN), Unit 1, Proposed Change for TS-431, Request for License Amendment, EPU Operation (Accession No. ML042800186).
July 7, 2004	Letter from TVA to NRC, Response to Request for Additional Information Regarding SAMAs to support the Review of the Browns Ferry Nuclear Power Plant, Units 1, 2, and 3, License Renewal Application (Accession No. ML041910423).
July 15, 2004	Letter from NRC to Karl W. Singer, TVA, Issuance of Environmental Scoping Summary Report Associated with the Staff's Review of the Application by Tennessee Valley Authority for Renewal of the Operating Licenses for Browns Ferry Nuclear Power Plant, Units 1, 2, and 3 (TAC Nos. MC1768, MC1769, and MC1770) (Accession No. ML041970726).
August 20, 2004	Letter from NRC to TVA, Request for Additional Clarification Regarding Severe Accident Mitigation Alternatives for the Browns Ferry Nuclear Plant, Units 1, 2, and 3 (TAC Nos. MC1768, MC1769, and MC1770) (Accession No. ML042330233).

September 15, 2004	Letter from NRC to TVA, Summary of Telecommunication with TVA to discuss follow-on Severe Accident Mitigation Analysis (SAMA) Requests for Additional Information, (RAI) (Accession No. ML042590186).
September 30, 2004	Letter from TVA to NRC, Response to Request for Additional Information (RAI) Regarding Severe Accident Mitigation Alternatives for Browns Ferry Nuclear Plant (BFN) Units 1, 2, and 3 (Accession No. ML043860076).
October 20, 2004	E-mail from C. A. McCullough, TVA to R. Palla, NRC, Response to Request for Additional Information Concerning BFN, LR, SAMA, RAI-II, Number of Plant Damage States (Accession No. ML043010285).
October 25, 2004	Letter from NRC to L. Goldman, FWS, Biological Assessment for License Renewal of the Browns Ferry Nuclear Power Plant, and a Request for Informal Consultation (Accession No. ML042990342).
December 1, 2004	Letter from L. Goldman, FWS, to NRC, Acknowledging receipt of the Biological Assessment for License Renewal of the Browns Ferry Nuclear Power Plant (Accession No. ML050690019).
January 25, 2005	Summary of Public Draft Supplemental Environmental Impact Statement Meeting to Support Review of the Browns Ferry Nuclear Plant, Units 1, 2 and 3, License Renewal Application (TAC Nos. MC1768, MC1769, and MC1770) (Accession No. ML0506020210).
February 25, 2005	Letter from John Fornicola, TVA, to NRC, Tennessee Valley Authority Comments on Draft NUREG-1437 Supplement 21 to the Generic Environmental Impact Statement for License Renewal of the Browns Ferry Nuclear Plant, Units 1, 2, and 3 (Accession No. ML050630390).
February 25, 2005	Letter from Gregory Hogue, FWS, to NRC, Comments on Draft SEIS, Supplement 21, for License Renewal of Tennessee Valley Authority's Browns Ferry Nuclear Plant (Accession No. ML050630415).
February 28, 2005	Letter from H.J. Mueller, EPA, to NRC, EPA Review and Comments on Draft Generic Supplemental EIS for License Renewal of Nuclear Plants, Supplement 21 Regarding BFN (Accession No. ML050700107).

March 1, 2005	Email correspondence between Michael Masnik, NRC, and Charles Wilson, TVA, Questions for TVA (Accession No. ML050700296).
March 2, 2005	Email from Michelle Boyd, Public Citizen, to NRC, Comments from Public Citizen and SACE (Accession No. ML050630419).
March 15, 2005	Email correspondence between Michael Sackschewsky, Pacific Northwest National Laboratory, and Charles Wilson, TVA, Environmental noncompliance (Accession No. ML050800336).
March 15, 2005	Fax from Charles Wilson, TVA, to Michael Sackschewsky, Pacific Northwest National Laboratory, ADEM Review of Discharge Monitoring Reports (Accession No. ML050810353).
March 24, 2005	Letter from Michael Masnik, NRC, to Nancy Muse, Comment Response Letter Regarding License Renewal of Browns Ferry Nuclear Plant, Units 1, 2, and 3 (Accession No. ML050800545).
April 29, 2005	Email correspondence between Alicia Williamson, NRC, and Charles Wilson, TVA, Requesting reference material (Accession No. ML051520190).
May 11, 2005	Email correspondence between Brenda Adams, TVA, and Alicia Williamson, NRC, Providing probabilistic risk assessments, individual plant examinations, for BFN Unit 2 (Accession No. ML051520190).

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:

Absentee-Shawnee Executive Committee, Shawnee, Oklahoma

Advisory Council on Historic Preservation, Washington D.C.

Alabama-Coushatta Tribe of Texas, Livingston, Texas

Alabama Department of Conservation, Montgomery, Alabama

Alabama Department of Environmental Quality, Decatur, Alabama

Alabama Department of Environmental Quality, Water Division, Montgomery, Alabama

Alabama Department of Transportation, Montgomery, Alabama

Alabama Economic and Community Development, Office of Water Resources, Montgomery, Alabama

Alabama Historical Commission, Montgomery, Alabama

Alabama-Quassarte Tribal Town, Wetumka, Oklahoma

Century 21 Realtors, Athens, Alabama

Cherokee Nation of Oklahoma, Tahlequah, Oklahoma

Chickasaw Nation, Ada, Oklahoma

Choctaw Nation of Oklahoma, Durant, Oklahoma

City of Athens Chamber of Commerce, Athens, Alabama

City Clerk, Athens, Alabama

Community Development Department, Decatur, Alabama

Coushatta Indian Tribe, Elton, Louisiana

Eastern Band of Cherokee Indians, Cherokee, North Carolina

Eastern Shawnee Tribe of Oklahoma, Seneca, Missouri

Jena Band of Choctaw Indians, Jena, Louisiana

Kialegee Tribal Town, Wetumka, Oklahoma

Limestone County Administrators, Athens, Alabama

Miccosukee Indian Tribe, Miami, Florida

Mississippi Band of Choctaw Indians, Philadelphia, Mississippi

Morgan County Commissioners Office, Decatur, Alabama

Muscogee (Creek) Nation, Okmulgee, Oklahoma

National Oceanic and Atmospheric Administration, St. Petersburg, Florida

Poarch Creek Indians, Atmore, Alabama

Seminole Indian Tribe, Hollywood, Florida

Seminole Nation of Oklahoma, Wewoka, Oklahoma

Thlopthlocco Tribal Town, Okemah, Oklahoma

Tribal Historic Preservation Office, Atmore, Alabama

Tunica-Biloxi Tribe, Office of Cultural and Historic Preservation Department, Marksville, Louisiana

USDA Forest Service, Bankhead National Forest, Double Springs, Alabama

USDA Forest Service, Southern Region, Pineville, Louisiana

U.S. Bureau of Indian Affairs, Washington, D.C.

U.S. Fish and Wildlife Service, Daphne, Alabama

U.S. Fish and Wildlife Service, Decatur, Alabama

United Keetoowah Band of Cherokee Indians, Tahlequah, Oklahoma

Appendix E

Browns Ferry Nuclear Power Plant, Units 1, 2, and 3
Compliance Status and Consultation Correspondence

Appendix E

Browns Ferry Nuclear Power Plant, Units 1, 2, and 3 Compliance Status and Consultation Correspondence

Licenses, permits, consultations, and other approvals obtained from Federal, State, regional, and local authorities for Browns Ferry Nuclear Plant, Units 1, 2, and 3 (BFN) are identified in this appendix.

Correspondence received during the evaluation process of the application for renewal of the operating license for BFN 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 BFN are listed in Table E-2.

Table E-1. Consultation Correspondence Regarding License Renewal for Browns Ferry Nuclear Power Plant, Units 1, 2, and 3

Source	Recipient	Date of Letter
U.S. Nuclear Regulatory Commission (P.T. Kuo)	National Oceanic and Atmospheric Administration Fisheries (R. Crabtree)	February 27, 2004 (Accession No. ML04610754)
U.S. Nuclear Regulatory Commission (P.T. Kuo)	U.S. Fish and Wildlife Service (L. Goldman)	March 5, 2004 (Accession No. ML040680881)
U.S. Nuclear Regulatory Commission (P.T. Kuo)	Alabama Historical Commission (L. Warner)	March 8, 2004 (Accession No. ML0040700557)
National Oceanic Atmospheric Administration Fisheries (D. Bernhart)	U.S. Nuclear Regulatory Commission	March 11, 2004 (Accession No. ML0411330242)
U.S. Nuclear Regulatory Commission (P.T. Kuo)	Cherokee Nation of Oklahoma (The Honorable C. Smith)	March 23, 2004 (Accession No. ML040890750)
U.S. Fish and Wildlife Service (L. Goldman)	U.S. Nuclear Regulatory Commission (M. Masnik)	May 19, 2004 (Accession No. ML041550148)
U.S. Nuclear Regulatory Commission (P.T. Kuo)	U.S. Fish and Wildlife Service (L. Goldman)	October 25, 2004 (Accession No. ML042990342
U.S. Fish and Wildlife Service (L. Goldman)	U.S. Nuclear Regulatory Commission (P.T. Kuo)	December 1, 2004 (Accession No. ML050690019

Table E-2. Federal, State, and Local Licenses, Permits, Consultations, and Other Approvals for the Browns Ferry Nuclear Power Plant, Units 1, 2, and 3

Agency	Authority	Description	Number	Issue Date	Expiration Date	Remarks
NRC	Atomic Energy Act, 10 CFR Part 50	Operating License for Unit 1	Docket Number: 05000259	12/20/1973	12/20/2013	License authorizes operation of Unit 1.
NRC	Atomic Energy Act, 10 CFR Part 50	Operating License for Unit 2	Docket Number: 05000260	08/02/1974	06/28/2014	License authorizes operation of Unit 2.
NRC	Atomic Energy Act, 10 CFR Part 50	Operating License for Unit 3	Docket Number: 05000296	08/18/1976	07/02/2016	License authorizes operation of Unit 3.
ADEM	Clean Water Act, Alabama Water Pollution Control Act	NPDES Permit	AL0022080	12/29/2000	01/31/2006	Permit authorizes effluent discharges to the Tennessee River.
ADEM	Clean Air Act, Alabama Air Pollution Control Act	Air emission permits	708-0003-Z002; 708-0003-Z003	10/5/1978; 08/28/1995	None	Permits cover operation of auxiliary boilers, emergency diesel generators, and gasoline dispensing facility.
ADEM	Alabama Solid Wastes Disposal Act	Construction/ Demolition landfill permit	42-02	05/17/2000	05/16/2005	Permit allows disposition of nonhazardous, nonradioactive wastes in the onsite landfill.
FWS	Section 7 of the Endangered Species Act (16 USC 1536)	Consultation	N/A			Section 7 of the Endangered Species Act requires that Federal agencies, in cooperation with the license applicant, consult with the FWS and/or the NOAA fisheries concerning the potential impacts of a proposed licensing action on threatened or endangered species. Correspondence with FWS related to Section 7 is included in Appendix E.

Table E-2. (contd)

Agency	Authority	Description	Number	Issue Date	Expiration Date	Remarks
Alabama Department of Economic and Community Affairs, Office of Water Resources		Water withdrawal permit	Certificate of Use No. OWR - 1058	01/1/2001	01/1/2006	Permit specifies the maximum capacity of water withdrawn, diverted, or consumed and average daily use.
Alabama Historical Commission	Section 106 of the National Historic Preservation Act (16 USC 470f)	Consultation	Letters from E.A. Brown, Deputy State Historic Preservation Officer, to TVA, dated 01/8/2001 and 05/24/2001			The National Historic Preservation Act requires Federal agencies to take into account the effect of any undertaking on any district, site, building, structure, or object that is included in or eligible for inclusion in the National Register of Historic Places. The Alabama Historical Commission determined that activities related to license renewal will have no effect on significant cultural resources provided that archaeological site 1Li535 and the Cox cemetery are avoided. *Correspondence* is included in Appendix E.

ADEM = Alabama Department of Environmental Management
CFR = Code of Federal Regulations
FWS = Fish and Wildlife Service
NOAA = National Oceanic and Atmospheric Administration
NPDES = National Pollutant Discharge Elimination System
NRC = Nuclear Regulatory Commission
USC = United States Code

February 27, 2004

Dr. Roy Crabtree
Regional Administrator
NOAA Fisheries
Southeast Regional Office
9721 Executive Center Drive North
St. Petersburg, FL 33702

SUBJECT: REQUEST FOR A LIST OF PROTECTED SPECIES WITHIN THE AREA UNDER EVALUATION FOR THE BROWNS FERRY NUCLEAR PLANT LICENSE RENEWAL

Dear Dr. Crabtree:

The U.S. Nuclear Regulatory Commission (NRC) is reviewing an application submitted by the Tennessee Valley Authority (TVA) for the renewal of the operating licenses for Browns Ferry Nuclear Plant Units 1, 2, and 3 (BFN). BFN is located in Limestone County, Alabama, 16 km (10 mi) southwest of Athens, Alabama. As part of the review of the license renewal application, the NRC is preparing a Supplemental Environmental Impact Statement (SEIS) under the provision of the National Environmental Policy Act (NEPA) of 1969, as amended, which includes an analysis of pertinent environmental issues, including endangered or threatened species and impacts to fish and wildlife. This letter is being submitted under the provisions of the Endangered Species Act of 1973, as amended, and the Fish and Wildlife Coordination Act of 1934, as amended.

The proposed action would include the use and continued maintenance of existing plant facilities and transmission lines and would not result in significant new construction or disturbance. Any maintenance activities would be limited to previously disturbed areas. For the specific purpose of connecting BFN to the regional transmission system, there are seven 500-kilovolt (kV) lines and two 161-kV lines. These transmission line corridors are being evaluated as part of the SEIS process. The transmission line corridors traverse Limestone, Morgan, Lawrence, Franklin, and Colbert counties in Alabama; and Union, Lee, Tishomingo, and Itawamba counties in Mississippi. The site boundary and transmission lines are identified in Enclosures 1 and 2. The site boundary and transmission line corridors can also be viewed at http://www.nrc.gov/reactors/operating/licensing/renewal/applications/browns-ferry/env-bfn-2.pdf the NRC's web site on pages E-70 and E-388, respectively.

The plant uses an open-cycle cooling system to dissipate waste heat to the environment. Cooling water is drawn from Wheeler Reservoir on the Tennessee River into the turbine-generator condensers and discharging it back to the reservoir via large submerged diffuser pipes that are perforated to maximize uniform mixing into the flowstream. Mechanical draft helper cooling towers are also used in the summer to reduce the heat load to the reservoir.

To support the environmental impact statement preparation process and to ensure compliance with Section 7 of the Endangered Species Act, the NRC requests a list of species and information on protected, proposed, and candidate species and critical habitat that may be in

Dr. R. Crabtree -2-

the vicinity of BFN and its associated transmission lines. The NRC has requested the same information and list of species from the U.S. Fish and Wildlife Service.

On March 30-31, 2004, the NRC plans to conduct a site audit at the BFN site. In addition, we plan to hold two public NEPA scoping meetings on April 1, 2004, at the Athens State University Student Center Cafeteria Ballroom, 300 Beaty Street, Athens, Alabama 35611-1999. Your staff is invited to attend both the site audit and the public meetings. Additional information on these activities will be forwarded to Mr. David Bernhart of your staff. The NRC staff will also forward to your office a copy of the draft SEIS along with a request for comments.

If you have any questions concerning BFN, the license renewal application, or other aspects of this project, please contact Dr. Michael Masnik, Senior Environmental Project Manager, at (301) 415-1191 or by e-mail at mtm2@nrc.gov.

Sincerely,

/RA/

Pao-Tsin Kuo, Program Director
License Renewal and Environmental Impacts
Division of Regulatory Improvement Programs
Office of Nuclear Reactor Regulation

Docket Nos.: 50-259, 50-260, and 50-296

March 5, 2004

Mr. Larry Goldman
Field Supervisor
U.S. Fish and Wildlife Service
Daphne Field Office
P.O. Drawer 1190
Daphne, AL 36526

SUBJECT: REQUESTS FOR A LIST OF PROTECTED SPECIES WITHIN THE AREA UNDER EVALUATION FOR THE BROWNS FERRY NUCLEAR PLANT LICENSE RENEWAL

Dear Mr. Goldman:

The U.S. Nuclear Regulatory Commission (NRC) is reviewing an application submitted by the Tennessee Valley Authority (TVA) for the renewal of the operating licenses for Browns Ferry Nuclear Plant Units 1, 2, and 3 (BFN). BFN is located in Limestone County, Alabama, 16 km (10 mi) southwest of Athens, Alabama. As part of the review of the license renewal application, the NRC is preparing a Supplemental Environmental Impact Statement (SEIS) under the provision of the National Environmental Policy Act (NEPA) of 1969, as amended, which includes an analysis of pertinent environmental issues, including endangered or threatened species and impacts to fish and wildlife. This letter is being submitted under the provisions of the Endangered Species Act of 1973, as amended, and the Fish and Wildlife Coordination Act of 1934, as amended.

The proposed action would include the use and continued maintenance of existing plant facilities and transmission lines and would not result in significant new construction or disturbance. For the specific purpose of connecting BFN to the regional transmission system, there are seven 500-kilovolt (kV) lines and two 161-kV lines. These transmission line corridors are being evaluated as part of the SEIS process. The transmission line corridors traverse Limestone, Morgan, Lawrence, Franklin, and Colbert counties in Alabama; and Union, Lee, Tishomingo, and Itawamba counties in Mississippi. The site boundary and transmission lines are identified in Enclosures 1 and 2. The site boundary and transmission line corridors can also be viewed at http://www.nrc.gov/reactors/operating/licensing/renewal/applications/browns-ferry/env-bfn-2.pdf the NRC's website at on pages E-70 and E-388, respectively.

The plant uses an open-cycle cooling system to dissipate waste heat to the environment. Cooling water is drawn from Wheeler Reservoir on the Tennessee River into the turbine-generator condensers and discharging it back to the reservoir via large submerged diffuser pipes that are perforated to maximize uniform mixing into the flow-stream. Mechanical draft helper cooling towers are also used in the summer to reduce the heat load to the reservoir.

To support the environmental impact statement preparation process and to ensure compliance with Section 7 of the Endangered Species Act, the NRC requests a list of species and information on protected, proposed, and candidate species and critical habitat that may be in the vicinity of BFN and its associated transmission lines. The NRC has requested the same information and list of species from NOAA Fisheries. In addition, please provide any information you consider appropriate under the provisions of the Fish and Wildlife Coordination Act.

On March 30-31, 2004, we plan to conduct a site audit at the BFN site. We plan to hold two public NEPA scoping meetings on April 1, 2004, at the Athens State University Student Center Cafeteria Ballroom, 300 North Beaty Street, Athens, Alabama 35611-1999. You and your staff are invited to attend both the site audit and the public meetings. Your office will receive a copy of the draft SEIS along with a request for comments. The anticipated publication date for the draft SEIS is November 2004.

If you have any questions concerning BFN, the license renewal application, or other aspects of this project, please contact Dr. Michael Masnik, Senior Environmental Project Manager, at (301) 415-1191 or by e-mail at mtm2@nrc.gov.

Sincerely,
/RA/
Pao-Tsin Kuo, Program Director
License Renewal and Environmental Impacts
Division of Regulatory Improvement Programs
Office of Nuclear Reactor Regulation

Docket Nos.: 50-259, 50-260, and 50-296

March 8, 2004

Dr. Lee Warner
State Historic Preservation Officer
Alabama Historical Commission
468 South Perry Street
Montgomery, AL 36130-0900

SUBJECT: BROWNS FERRY NUCLEAR PLANT LICENSE RENEWAL REVIEW

Dear Dr. Warner:

The U.S. Nuclear Regulatory Commission (NRC) staff is reviewing an application to renew the operating licenses for Browns Ferry Nuclear Plant, Units 1, 2, and 3 (BFN), which is located in Limestone County, Alabama, 16 km (10 mi) southwest of Athens, Alabama. BFN is operated by the Tennessee Valley Authority (TVA). The site boundary is shown on the NRC's web site at http://www.nrc.gov/reactors/operating/licensing/renewal/applications/browns-ferry/env-bfn-2.pdf on page E-70. The application for renewal was submitted by TVA on January 6, 2004, pursuant to NRC requirements at Title 10 of the *Code of Federal Regulations* Part 54 (10 CFR Part 54). The NRC has established that, as part of the staff review of any nuclear power plant license renewal action, a site-specific Supplemental Environmental Impact Statement (SEIS) to its "Generic Environmental Impact Statement for License Renewal of Nuclear Plants" (GEIS), NUREG-1437, will be prepared under the provisions of 10 CFR Part 51, which implements the National Environmental Policy Act of 1969 (NEPA). In accordance with 36 CFR 800.8, the SEIS will include analyses of potential impacts to historic and cultural resources. A draft SEIS is scheduled for publication in November of 2004, and will be provided to you for review and comment.

In the context of the National Historic Preservation Act of 1966, as amended, the NRC staff has determined that the area of potential effect (APE) for a license renewal action is the area at the power plant site and its immediate environs which may be impacted by post-license renewal land disturbing operation or projected refurbishment activities associated with the proposed action. The APE may extend beyond the immediate environs in those instances where post-license renewal land disturbing operations or projected refurbishment activities, specifically related to license renewal, may potentially have an effect on known or proposed historic sites located beyond the immediate environs of the proposed site. This determination is made irrespective of ownership or control of the lands of interest.

We understand that in a letter dated January 8, 2001, after reviewing the TVA issued Draft Environmental Impact Statement for Operating License Renewal of the Browns Ferry Nuclear Plant, you concluded that license renewal activities will have no effect on significant cultural resources, provided that site 1Li535 and the Cox Cemetery are avoided. The Alabama Historical Commission tracking number for this action is 2001-1439.

Dr. L. Warner -2-

On April 1, 2004, the NRC will conduct two public NEPA scoping meetings at the Athens State University Student Center Cafeteria Ballroom, 300 North Beaty Street, Athens, Alabama 35611-1999. You and your staff are invited to attend. Your office will receive a copy of the draft SEIS for review and comment. If you have any questions or require additional information, please contact the Senior Environmental Project Manager for the BFN project, Dr. Michael Masnik, at 301-415-1191 or mtm2@nrc.gov.

Sincerely,
/RA/
Pao-Tsin Kuo, Program Director
License Renewal and Environmental Impacts
Division of Regulatory Improvement Programs
Office of Nuclear Reactor Regulation

Docket Nos.: 50-259, 50-260, and 50-296

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southeast Regional Office
9721 Executive Center Drive North
St. Petersburg, FL 33702
(727) 570-5312, FAX 570-5517
http://caldera.sero.nmfs.gov

MAR 11 '04

Dear Colleague:

The National Marine Fisheries Service (NOAA Fisheries) Protected Resources Division has reviewed your letter pursuant to section 7(a)(2) of the Endangered Species Act (ESA) concerning letter dated 2/27/04: The NRC is reviewing an application submitted by the Tennessee Valley Authority (TVA) for renewal of the operating licenses for Browns Ferry Nuclear Plants Units 1,2,3 (BFN).

____We cannot determine impacts to threatened or endangered species, or designated critical habitat, under NOAA Fisheries' purview because the letter lacks sufficient information to evaluate the project. **Enclosed are guidelines to conduct a proper biological evaluation.**

✓ **As requested, enclosed is a list of federally-protected species under the jurisdiction of NOAA Fisheries for the state of** Alabama. Biological information on federally-protected sea turtles, shortnose and gulf sturgeon, smalltooth sawfish, and other listed species and candidate species can be found at the following website addresses: NOAA Fisheries Southeast Regional Office (http://caldera.sero.nmfs.gov/protect/protect.htm); NOAA Fisheries Office of Protected Resources (http://www.nmfs.noaa.gov/prot_res/prot_res.html); U.S. Fish and Wildlife Service (http://noflorida.fws.gov/SeaTurtles/seaturtle-info.htm), http://www.turtles.org; http://www/seaturtle.org; http://alabama.fws.gov/gs/; http://endangered.fws.gov/wildlife.html#Species; the Ocean Conservancy (http://www.cmc-ocean.org/main.php3); the Caribbean Conservation Corporation (http://www.cccturtle.org/); Florida Fish and Wildlife Conservation Commission (http://floridaconservation.org/psm/turtles/turtle.htm); http://obis.env.duke.edu/data/sp_profiles.php; www.mote.org/~colins/Sawfish/SawfishHomePage.html; www.floridasawfish.com; www.flmnh.ufl.edu/fish/sharks/InNews/sawprop.htm.

____**It is NOAA Fisheries' opinion that the project will have no effect on listed species or critical habitat protected by the ESA under NOAA Fisheries' purview. No further consultation with NOAA Fisheries pursuant to section 7(a)(2) of the ESA is required.** Consultation with NOAA Fisheries, Habitat Conservation Division, pursuant to the Magnuson-Stevens Fishery Conservation and Management Act's requirements for essential fish habitat consultation (16 U.S.C. 1855 (b)(2) and 50 CFR 600.905-.930, subpart K), may be required. Please contact our Habitat Conservation Division at (727) 570-5317.

If you have any questions, please contact the ESA section 7 coordinator, Eric Hawk, at (727) 570-5312, or by e-mail at eric.hawk@noaa.gov.

Sincerely,

Katherine S for

David Bernhart
Acting Assistant Regional Administrator
for Protected Resources

✓ Enclosure
File:1514-22.
O:\forms\no-effect letter.wpd
I/SER/2004/
AL Species List

Endangered and Threatened Species and Critical Habitats under the Jurisdiction of the National Marine Fisheries Service

Alabama

Listed Species	Scientific Name	Status	Date Listed
Marine Mammals			
blue whale	*Balaenoptera musculus*	Endangered	12/02/70
finback whale	*Balaenoptera physalus*	Endangered	12/02/70
humpback whale	*Megaptera novaeangliae*	Endangered	12/02/70
sei whale	*Balaenoptera borealis*	Endangered	12/02/70
sperm whale	*Physeter macrocephalus*	Endangered	12/02/70
Turtles			
green sea turtle	*Chelonia mydas*	Threatened[1]	07/28/78
hawksbill sea turtle	*Eretmochelys imbricata*	Endangered	06/02/70
Kemp's ridley sea turtle	*Lepidochelys kempii*	Endangered	12/02/70
leatherback sea turtle	*Dermochelys coriacea*	Endangered	06/02/70
loggerhead sea turtle	*Caretta caretta*	Threatened	07/28/78
Fish			
Gulf sturgeon	*Acipenser oxyrinchus desotoi*	Threatened	09/30/91

Species Proposed for Listing

None

Designated Critical Habitat

Gulf Sturgeon: Gulf Sturgeon: A final rule designating Gulf sturgeon critical habitat was published on March 19, 2003 (68 FR 13370) and 14 geographic areas (units) among the Gulf of Mexico rivers and tributaries were identified. Maps and details regarding the final rule can be found at alabama.fws.gov/gs

Proposed Critical Habitat

None

3/10/04 11:20 AM

file:///O/FORMS/Species Lists/AL_CAND.htm

Candidate Species[2]	Scientific Name
Fish	
Alabama shad	*Alosa alabamae*
dusky shark	*Carcharhinus obscurus*
Goliath grouper	*Epinephelus itajara*
night shark	*Carcharinus signatus*
saltmarsh topminnow	*Fundulus jenkinsi*
sand tiger shark	*Odontaspis taurus*
speckled hind	*Epinephelus drummondhayi*
Warsaw grouper	*Epinephelus nigritus*

1. Green turtles are listed as threatened, except for breeding populations of green turtles in Florida and on the Pacific Coast of Mexico, which are listed as endangered.

2. Candidate species are not protected under the Endangered Species Act, but concerns about their status indicate that they may warrant listing in the future. Federal agencies and the public are encouraged to consider these species during project planning so that future listings may be avoided.

March 23, 2004

The Honorable Chadwick Smith, Principal Chief
Cherokee Nation of Oklahoma
PO Box 948
Tahlequah, OK 74465

SUBJECT: U.S. NUCLEAR REGULATORY COMMISSION REVIEW OF THE BROWNS FERRY NUCLEAR PLANT LICENSE RENEWAL APPLICATION

Dear Chief Smith:

The U.S. Nuclear Regulatory Commission (NRC) is seeking input for its environmental review of an application from Tennessee Valley Authority (TVA) to renew its operating licenses for the Browns Ferry Nuclear Plant, Units 1, 2, and 3 (BFN), located in Limestone County, Alabama, 16 km (10 mi) southwest of Athens, Alabama. BFN is in close proximity to lands that may be of interest to the Cherokee Nation Tribe. As described below, the NRC process includes an opportunity for public participation in the environmental review. We want to ensure that you are aware of our efforts and, pursuant to 10 CFR 51.28(b), the NRC invites the Cherokee Nation Tribal Community to provide input to the scoping process relating to the NRC's environmental review of the application.

The NRC will hold public scoping meetings for the BFN license renewal supplement to the NRC's "Generic Environmental Impact Statement for License Renewal of Nuclear Plants" (GEIS) (NUREG-1437). These scoping meetings will be held at the Athens State University, Student Center Cafeteria Ballroom, 300 North Beaty Street, Athens, Alabama, on Thursday, April 1, 2004. There will be two sessions to accommodate interested parties. The first session will convene at 1:30 p.m. and will continue until 4:30 p.m., as necessary. The second session will convene at 7:00 p.m., with a repeat of the overview portions of the meeting, and will continue until 10:00 p.m., as necessary. Additionally, the NRC staff will host informal discussions one hour before the start of each session. No formal comments on the proposed scope of the supplement to the GEIS will be accepted during the informal discussions. To be considered, comments must be provided either at the transcribed public meetings or in writing. The application and the environmental review process are described below.

Under NRC regulations, the original operating license for a nuclear power plant is issued for up to 40 years. The license may be renewed for up to an additional 20 years if NRC requirements are met. The current operating licenses for BFN will expire in 2013, 2014, and 2016 respectively. TVA submitted an environmental report as part of its application for renewal of the BFN operating license on January 6, 2004. The application is electronically available for inspection from the Publicly Available Records (PARS) component of NRC's Agencywide Documents Access and Management System (ADAMS). ADAMS is accessible at http://www.nrc.gov/reading-rm/adams.html, which provides access through the NRC's Public Electronic Reading Room (PERR) link. If you do not have access to ADAMS or if there are problems in accessing the documents located in ADAMS, contact the NRC's Public Document Room (PDR) Reference staff at 1 (800) 397-4209, (301) 415-4737, or by e-mail to pdr@nrc.gov. In addition, the application can be viewed on the Internet at

Chief C. Smith 2

http://www.nrc.gov/reactors/operating/licensing/renewal/applications.html.

A paper copy of the document can be viewed at the NRC's PDR, located at One White Flint North, 11555 Rockville Pike (first floor), Rockville, Maryland, 20852-2738 and at the Athens-Limestone Public Library, 405 East South Street, Athens, Alabama, 35611-1999. Also, the GEIS assesses the scope and impact of environmental effects that would be associated with license renewal at any nuclear power plant site. A copy of this document can also be found on the NRC's website or at the NRC's PDR.

The NRC is gathering information for the document that will be a BFN-specific supplement to the GEIS. The supplement will contain the results of the review of the environmental impacts on the area surrounding the BFN site that are related to terrestrial ecology, aquatic ecology, hydrology, cultural resources, and socioeconomic issues (among others) and will contain a recommendation regarding the environmental acceptability of the license renewal action.

Please submit any written comments the Cherokee Nation Tribal Community may have to offer on the scope of the environmental review by April 26, 2004. Comments should be submitted either by mail to the Chief, Rules and Directives Branch, Division of Administrative Services, *Mail Stop T-6D59, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555-0001*, or by e-mail to BrownsFerryEIS@nrc.gov.

At the conclusion of the scoping process, the NRC staff will prepare a summary of the significant issues identified, the conclusions reached, and will mail a copy to you.

The NRC will prepare a draft supplemental environmental impact statement (SEIS) for public comment, and will hold another set of public meetings in the site vicinity to solicit comments on the draft. A copy of the draft SEIS will be sent to you for your review and comment. After consideration of public comments received on the draft, the NRC will prepare a final SEIS. If you need additional information regarding the environmental review process, please contact Dr. Michael Masnik, Senior Environmental Project Manager, at (301) 415-1191.

Sincerely,

/RA/
Pao-Tsin Kuo, Program Director
License Renewal and Environmental Impacts Program
Division of Regulatory Improvement Programs
Office of Nuclear Reactor Regulation

Docket Nos.: 50-259, 50-260, and 50-296

United States Department of the Interior

FISH AND WILDLIFE SERVICE
P.O. Drawer 1190
Daphne, Alabama 36526

IN REPLY REFER TO:

04-0760

May 19, 2004

U.S. Nuclear Regulatory Commission
Division of Regulatory Improvement Programs
Attn: Dr. Michael Masnik
Washington, D.C. 20555-0001

Dear Dr. Masnik:

This letter is in response to your letter, dated March 4, 2004, notifying our agency of the Nuclear Regulatory Commission's (NRC) plan to prepare a Supplemental Environmental Impact Statement (SEIS) for the Browns Ferry Nuclear Plant Operations License Renewal, Limestone County, Alabama. The following comments are provided in accordance with the Fish and Wildlife Coordination Act, as amended (16 U.S.C. 661-667e), the Migratory Bird Treaty Act (16 U.S.C. 703, *et seq.*) and section 7 of the Endangered Species Act, as amended (16 U.S.C. 1531-1543).

According to your letter, the proposed action would include the use and continued maintenance of the existing plant facilities and transmission lines. However, you indicated that very little new construction or ground disturbance would occur as a result of the proposed action. The entire Tennessee River system and the 5-county area traversed by the transmission lines provides habitat to a number of terrestrial and aquatic federally listed species. A county list of these species may be found on our website at the following address, http://daphne.fws.gov/es/specieslst.htm. The SEIS should address the type of ground disturbance and maintenance needed for the transmission lines. If the maintenance involves the use of chemicals or mowing to maintain the rights-of-way in a herbaceous environment, further consultation with the Service will be required to determine the extent, if any, these applications will have on listed species.

The U.S. Fish and Wildlife Service, Daphne, Alabama Field Office has concerns with the thermal plume that will be created if the maximum operating power level is increased for the facility. Thermal plume could impact aquatic organisms, particularly the rough pigtoe (*Pleurobema plenum*), an endangered mussel found in the vicinity of the discharge. The Service requests that surveys for threatened and endangered mussels be conducted and thermal plume models be produced pursuant to the preparation of the SEIS, and provided to this office for review.

The Service appreciates the early coordination on this project and we look forward to working with you during the preparation of the SEIS. If you have questions or comments, please direct them to

PHONE: 251-441-5181 www.fws.gov FAX: 251-441-6222
SHIPPING ADDRESS: 1208-B Main Street, Daphne, AL 36526

Mr. Bruce Porter, at (251)441-5864 or via email bruce_porter@fws.gov.

Sincerely,

Larry E. Goldman
Field Supervisor

cc: Mr. Jon M. Loney,
Environmental Policy and Planning
Tennessee Valley Authority
400 West Summit Hill Drive
Knoxville, Tennessee 37902-1499

October 25, 2004

Mr. Larry Goldman
Field Supervisor
U.S. Fish and Wildlife Service
P.O. Drawer 1190
Daphne, AL 36526

SUBJECT: BIOLOGICAL ASSESSMENT FOR LICENSE RENEWAL OF THE BROWNS FERRY NUCLEAR POWER PLANT, AND A REQUEST FOR INFORMAL CONSULTATION

Dear Mr. Goldman:

The U.S. Nuclear Regulatory Commission (NRC) staff has prepared the enclosed biological assessment (Enclosure 1) to evaluate whether the proposed renewal of the Browns Ferry Nuclear Plant, Units 1, 2, and 3 (BFN) operating licenses for a period of an additional 20 years would have adverse effects on listed species. The proposed action (license renewal) is not a major construction activity. BFN is located on the north shore of Wheeler Reservoir in Limestone County, Alabama, at Tennessee River Mile (TRM) 294.

By letter dated March 5, 2004, the NRC requested a list of Federally threatened or endangered species that may be in the vicinity of BFN and its associated transmission lines. In a letter dated May 19, 2004, the U.S. Fish and Wildlife Service (FWS) directed the NRC to the following Website, http://daphne.fws.gov/es/specieslst.htm, for a list of Federally listed threatened or endangered species to evaluate in a biological assessment (BA). The FWS Website listed 11 terrestrial and 38 aquatic Federally protected species as potentially occurring in counties containing the BFN site, transmission line and rights-of-way, and Wheeler Reservoir. Your letter dated May 19, 2004, also expressed concerns related to the operation of BFN and the potential impact on the rough pigtoe; specifically, potential impacts resulting from the plant operating at maximum power levels.

For documentation purposes, the NRC has included all terrestrial and aquatic species found on the aforementioned FWS Website in the enclosed BA. This BA provides an evaluation of the potential impact of renewing the BFN operating licenses for an additional 20 years of operation on the forty-five listed species and four candidate species identified in Tables 1, 2, and 3 of the BA.

The NRC has determined that the proposed action has no effect on the red-cockaded woodpecker (*Picoides borealis*), the American hart's tongue fern (*Asplenium scolopendrium* var. *americanum*), and 29 of the aquatic species (Table 3). In addition, the staff has determined that the proposed action may affect, but is not likely to adversely affect, the bald eagle (*Haliaeetus*

L. Goldman

leucocephalus), gray bat (*Myotis grisescens*), Indiana bat (*Myotis sodalis*), Price's potato bean (*Apios priceana*), leafy prairie clover (*Dalea foliosa*), Eggert's sunflower (*Helianthus eggertii*), fleshy-fruited gladecress (*Leavenworthia crassa*), lyrate bladder-pod (*Lesquerella lyrata*), Tennessee yellow-eyed grass (*Xyris tennesseensis*), Anthony's riversnail (*Athearnia anthonyi*), slender campeloma (*Campeloma decampi*), armored snail (*Pyrgulopsis pachyta*), spectaclecase (*Cumberlandia monodonta*), Cumberlandian combshell (*Epioblasma brevidens*), pink mucket (*Lampsilis abrupta*), slabside pearlymussel (*Lexingtonia dolabelloides*), rough pigtoe (*Pleurobema plenum*), and the slackerwater darter (*Etheostoma boschungi*). The site contains no critical habitat for any protected species. However, some areas within the transmission line rights-of-way have recently been designated critical habitat for the Cumberlandian combshell. TVA has designed and implemented maintenance procedures for its transmission line rights-of-way that protect all listed species and their habitats.

We are placing this BA in our project files and are requesting your concurrence with our determination. In reaching its conclusion, the NRC staff relied on information provided by the licensee, on research performed by NRC staff, and information from the FWS (i.e., including current listings of species provided by FWS, Daphne, Alabama Field Office).

If you have any questions regarding this BA or the staff's request, please contact Dr. Michael Masnik, Senior Project Manager, at 301-415-1191 or by email at mtm2@nrc.gov.

Sincerely,

/RA/

Pao-Tsin Kuo, Program Director
License Renewal and Environmental Impacts Program
Division of Regulatory Improvement Programs
Office of Nuclear Reactor Regulation

Docket Nos.: 50-259, 50-260, and 50-296

Enclosure: As stated

cc w/encl.: See next page

Biological Assessment

Browns Ferry Nuclear Power Plant
License Renewal Review

Limestone County, Alabama

October 2004

Docket Numbers 50-259, 50-260, and 50-296

U.S. Nuclear Regulatory Commission
Rockville, Maryland

Biological Assessment of the Potential Effects on Endangered or Threatened Species from the Proposed License Renewal for the Browns Ferry Nuclear Plant

1.0 Introduction

The U.S. Nuclear Regulatory Commission (NRC) licenses the operation of domestic nuclear power plants in accordance with the Atomic Energy Act of 1954, as amended, and NRC implementing regulations. The Tennessee Valley Authority (TVA) operates Browns Ferry Nuclear Power Plant, Units 1, 2, and 3 (BFN) pursuant to NRC operating license (OL) numbers DPR-33, DPR-52, DPR-68, which expire on December 20, 2013, June 28, 2014, and July 2, 2016, respectively.

TVA has prepared an Environmental Report (ER) (TVA 2003) in conjunction with its application for renewal of the BFN OLs, as provided for by the following NRC regulations:

- Title 10 of the Code of *Federal Regulations*, Part 54, "Requirements for Renewal of Operating Licenses for Nuclear Power Plants," Section 54.23, Contents of application - environmental information (10 CFR 54.23).

- Title 10 of the Code of Federal Regulations, Part 51, "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions," Section 51.53, Postconstruction environmental reports, Subsection 51.53(c), Operating license renewal stage (10 CFR 51.53(c)).

The renewed OLs would allow up to 20 additional years of plant operation beyond the current licensed operating term.

No major refurbishment or replacement of important systems, structures, or components are expected during the 20-year BFN license renewal term. In addition, no construction activities are expected to be associated with license renewal.

In a letter dated March 5, 2004, the staff requested comments from the U.S. Fish and Wildlife Service (FWS) on the OL renewal application for BFN (NRC 2004). Specifically, the staff requested a list of species and information on protected, proposed, and candidate species and critical habitat that may be in the vicinity of BFN and its associated transmission line rights-of-way. In a letter from the FWS dated May 19, 2004 (FWS 2004e), the staff was directed to an FWS website (http://daphne.fws.gov/es/specieslst.htm) for a list of species to include in this biological assessment (BA). A total of 11 terrestrial and 38 aquatic species were listed for the counties within which the BFN site and its transmission line rights-of-way are located, and for Wheeler Reservoir, which serves as the source of cooling water for BFN. The FWS expressed specific concern (FWS 2004) over the potential impact of all three BFN units operating at maximum power levels on the rough pigtoe (*Pleurobema plenum*).

2.0 Proposed Action

The proposed Federal action is the renewal of the OLs for BFN. In response to the increasing demands for bulk power, TVA seeks to use existing facilities to the greatest extent possible to meet requirements for electric power. TVA is pursuing this approach because: (1) it ensures that future power needs can be met; (2) it avoids the large capital expenditures associated with construction of new generating facilities; and (3) it avoids the environmental impacts resulting from siting and constructing new power generating facilities. Consistent with this approach, TVA proposes to continue operation of BFN after expiration of the current OL for each unit. Implementing the proposed action is dependent on the staff determining that renewal of the OLs for BFN is the best course of action. Renewal of the current OLs would permit operation of the units for an additional 20 years beyond their current (original) 40-year operating license period.

In July 2004, the TVA submitted extended power uprate (EPU) applications to increase the licensed power levels of each of the three units to 3952 megawatts thermal (MW(t)) (i.e., to 120 percent of the originally licensed power levels), thereby bringing the combined total power level for the three units to 11,856 MW(t). In a separate environmental assessment, NRC is currently evaluating the potential environmental impacts of the proposed EPUs at BFN. If approved, the EPUs would take effect during the existing license term and would continue during the 20-year term of the renewed OLs. This BA was prepared to evaluate the potential environmental impacts of operating Units 1, 2, and 3 at 120 percent of their originally licensed power levels for an additional 20 years beyond the current license term for each unit.

Continued maintenance activities on the transmission line rights-of-way that are used to connect BFN to the electric power grid would be required if the proposed action is adopted. The TVA Transmission and Power Supply-Transmission Operations and Maintenance organization conducts maintenance activities on transmission lines and rights-of-way in the TVA system. These activities include, but are not restricted to, maintenance of vegetation in each right-of-way, replacement of poles or towers, installation of lightning arresters and counterpoise, and upgrading existing equipment. Regular maintenance activities are conducted on a 3-to-5-year cycle (Muncy et al. 1999).

3.0 The Plant

3.1 Plant Description

The three-unit BFN plant, including the intake and discharge canals, is enclosed by a security fence. Primary access to the plant area is by way of an access road through a security gate. The plant has the following principal physical structures in the central site area: reactor containment building, turbine building, radioactive waste building, service building, intake pumping station, transformer yard, 161-kV and 500-kV switchyards, off-gas stack, sewage treatment facilities, and administration and maintenance buildings. The hot and cold water discharge channels and mechanical draft cooling towers are located northwest of the central site area, while the training center, employee physical fitness center, materials storage and procurement complex, and structures from a former aquatic research laboratory are located to the east of the central site area (see Figure 1).

3.2 Reactor Systems

BFN has two active nuclear reactor units (Units 2 and 3) and one inactive unit (Unit 1). Each unit includes a boiling water reactor (BWR) and a steam-driven turbine generator manufactured by General Electric Company. Work began in 2002 to bring Unit 1 up to current standards, and operation of the reactor is currently scheduled to resume in 2007.

The nuclear steam supply system at BFN is typical of General Electric BWRs. Each nuclear system includes a single-cycle, forced-circulation, General Electric BWR that produces steam for direct use in a steam turbine. The design employs a pressure suppression primary containment that houses the reactor vessel, the reactor coolant recirculating loops, and other branch connections of the reactor primary system. The pressure suppression system consists of a dry well, a pressure suppression chamber that stores a large volume of water, connecting vents between the dry well and the pressure suppression chamber, isolation valves, containment cooling systems, and other service equipment. Cooling systems are provided to remove heat from the reactor core, the dry well, and the water in the pressure suppression chamber, thus providing continuous cooling of the primary containment under accident conditions. Appropriate isolation valves are actuated during this period to ensure confinement of radioactive material, which might otherwise be released from the reactor containment during the course of an accident.

The secondary containment substructure consists of poured-in-place, reinforced concrete exterior walls that extend up to the refueling floor. The refueling room floor is also constructed of reinforced, poured-in-place concrete. The secondary containment structure completely encloses the primary containment dry wells, fuel storage and handling facilities, and essentially all of the core standby cooling systems for the three units. During normal operation and when isolated, the secondary containment is maintained at a negative pressure relative to the building exterior.

3.3 Cooling and Auxiliary Water Systems

Wheeler Reservoir on the Tennessee River is the source for cooling water and most of the auxiliary water systems for BFN (see Figure 2). Potable water is supplied by the City of Athens Utilities Water Department in Athens, Alabama. Groundwater is not used at the site. Figure 1 shows the general layout of the buildings and structures at the site.

The intake forebay is separated from Wheeler Reservoir by a gate structure with three bays that are each 12 m (40 ft) wide by about 7.3 m (24 ft) high (TVA 1972). Each bay includes a 6-m (20-ft)-high gate that can be raised or lowered depending on the operational requirements of the plant. The flow velocity through the openings varies depending on the gate position. When the gates are in their full-open position and the plant is operated in either the open mode (once-through) or cooling tower helper mode, the average flow velocity through the openings is about 0.2 m/s (0.6 fps) for the operation of one unit, 0.34 m/s (1.1 fps) for the operation of two units, and 0.52 m/s (1.7 fps) for the operation of all three units (TVA 2003). These flow velocities are based on an intake flow per unit of about 46,300 L/s (734,000 gpm), which is 46.3 m^3/s (1635 cfs).

The intake pumping station includes 18 bays (i.e., six bays per reactor unit), each with a traveling screen. Each bay has a net opening size of about 2.6 m by 6 m (8.75 ft by 20 ft). The maximum average flow velocity through each bay is about 0.49 m/s (1.6 fps) and is independent of the reservoir surface elevation. The maximum average velocity through a clean screen with net openings of 0.95 cm by 0.95 cm (3/8 in. by 3/8 in.) is about 0.64 m/s (2.1 fps) (TVA 2003). Flow velocities through the intake pump station bays and traveling screens are independent of the number of units in operation and the reservoir elevation.

The BFN units are normally cooled by pumping water from Wheeler Reservoir into the turbine generator condensers and discharging it back to the reservoir via three large submerged diffuser pipes that are perforated to maximize uniform mixing into the flow stream. These pipes range in diameter from 5.2 m to 6.2 m (17 ft to 20.5 ft). The flow exits each discharge pipe through 7800 5-cm (2-in.) ports (TVA 2003). This straight-through flow path is known as "open cycle" or "open mode" operation. As originally designed, the maximum thermal discharge from the once-through cooling water system is directed into the Wheeler Reservoir, with a temperature increase across the intake and discharge of 13.9°C (25°F) (TVA 1972). The flow exits the diffusers and mixes with the reservoir flow. At the edge of the discharge mixing zone, the water temperature is required to be less than 5.6°C (10°F) above ambient (ADEM 2003).

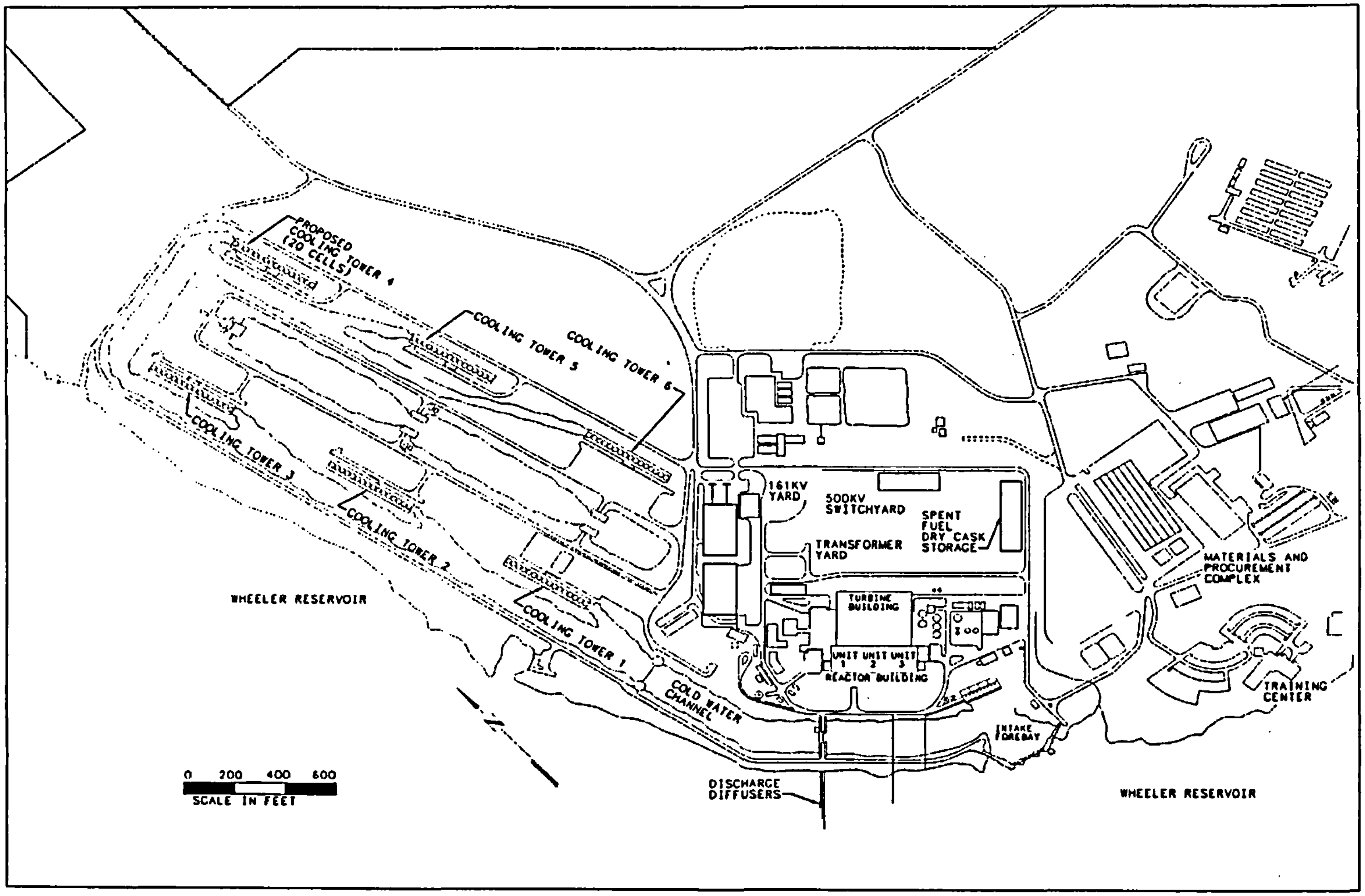

Figure 1. Browns Ferry Nuclear Power Plant, Units 1, 2, and 3 Site Features

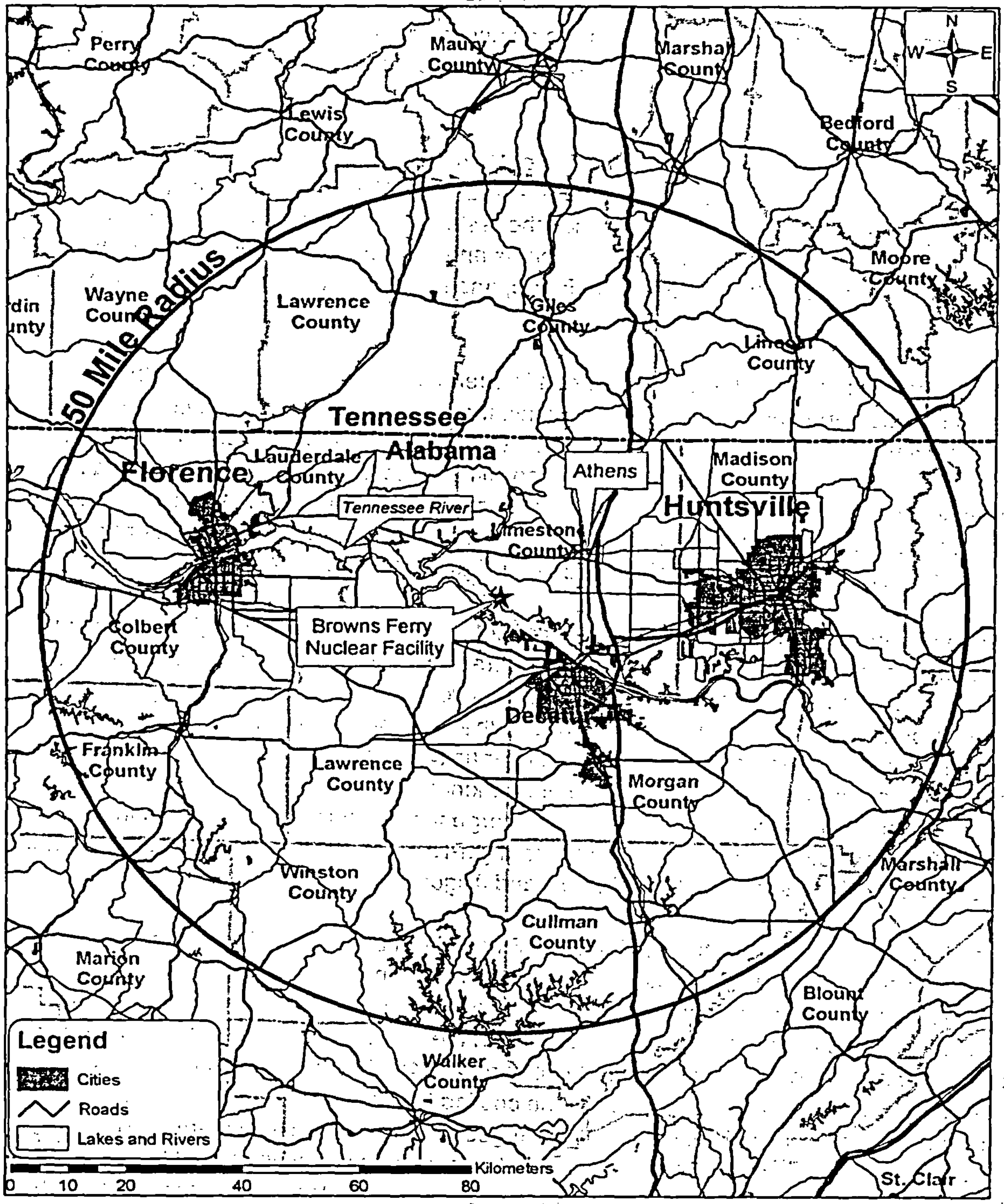

Figure 2. Brown's Ferry Nuclear Power Plant, Units 1, 2, and 3 Site and Surrounding Area

Through various gates, some of this cooling water can also be directed through mechanical draft cooling towers to reduce its temperature as necessary to comply with environmental regulations. This flow path is known as the "helper mode," and the cooling towers are referred to as "helper towers."

The capacity also exists to recycle cooling water from the cooling towers directly back to the intake structure without being discharged to the reservoir. This flow path, known as the "closed mode" of operation, has not been used since the restart of Units 2 and 3 because of difficulties in achieving temperature limits in summer months and problems with equipment reliability. TVA does not anticipate using this mode in the future, and no procedures for operating in this mode currently exist.

In recent years, only Units 2 and 3 have been in operation, but because of a combination of system upgrades and improved flow calibrations, the measured total per-unit condenser circulating water (CCW) flow rate in open mode (with three CCW water pumps per unit) has increased. The condenser tubes were replaced with stainless steel tubing that have a larger internal diameter and lower flow resistance. This modification increased flow through the condenser by approximately 6 percent. TVA estimates total intake for three-unit operation in open mode to be 139 m^3/s (4907 cfs) or 12,000 m^3/d (3171 MGD) (TVA 2003).

Because of various system limitations, BFN cannot pass all the CCW through the cooling towers when operating in the helper mode. The fraction of cooling water that cannot be passed through the cooling towers is routed directly to the river. Almost all of the cooling water that passes through the cooling towers is returned to the river, but a small amount is lost to the atmosphere during operation. If cooling tower capacity is increased during the license renewal term, this consumptive use could increase proportionately. The cooling towers are only operated when necessary to meet thermal discharge temperature limits specified in the National Pollutant Discharge Elimination System (NPDES) permit, typically a few weeks during the hottest part of the summer (typically July and August).

For the last 6 years, during which Units 2 and 3 have both been in service, the greatest amount of time cooling tower operation has been required has been about 8 percent of a year (TVA 2003). Increased thermal power limits proposed for Units 2 and 3 will result in an additional increase of approximately 2.2°C (4°F) in the circulating water temperature leaving the main condenser (for each operating unit) (Hopping 2004). This increase in water discharge temperature will result in increased use of the cooling tower during summer periods to maintain compliance with discharge limitations. No changes to the plant intake system or to the individual unit intake flow rates are expected to be required as a result of the Units 2 and 3 EPU project, and operations will continue to meet regulatory limits established in the existing NPDES permit.

Simulations with the near-field hydrothermal model were conduced for the period 1985 through 2002, excluding 2 years (1989 and 1990) for which no river ambient temperature data are available (TVA 2003). TVA varied both the use of the helper towers and unit power levels to maintain discharge temperatures to within NPDES permit limits. Model results showed that, with Units 2 and 3 operating at 120 percent power, the cooling towers will be used on average approximately 5.3 percent of the time, and derating will be required approximately 0.10 percent of the time (i.e., 6.2 days over the 16-year simulation period). On average, with all three units at 120 percent power, use of the cooling towers will increase to approximately 7.2 percent of the time and derating will increase to approximately 0.29 percent of the time (i.e., 17 days over the 16-year simulation). The simulation of three unit operation at 120 percent power assumed the construction and operation of an additional sixth 20 cell cooling tower. The licensee has committed placing the new tower in operation prior to the first summer following the return of Unit 1 to service (TVA 2004c).

The residual heat removal service water (RHRSW) system consists of four pairs of pumps located on the intake structure for pumping raw river water to the heat exchangers in the RHRSW system and four additional pumps for supplying water to the emergency equipment cooling water (EECU) system. The EECU system distributes cooling water supplied by the RHRSW system to essential equipment during normal and accident conditions.

The impacts evaluated in this BA include those from operation of all three of the BFN reactor units, each at 120 percent of the original licensed thermal power level. TVA has stated (TVA 2002a) that "no changes are expected to be required to the plant intake system or to the individual unit intake flow rates as a result of the EPU project." TVA also indicated that existing thermal discharge limits would be met by increased use of the helper towers, and if necessary, derating one or more units.

4.0 Environmental Setting

The proposed license renewal will apply to all three units at BFN, which is located on the north shore of Wheeler Reservoir in Limestone County, Alabama, at Tennessee River Mile (TRM) 294. The BFN site is approximately 48 km (30 mi) west of Huntsville, Alabama; 16 km (10 mi) northwest of Decatur, Alabama; and 16 km (10 mi) southwest of Athens, Alabama (Figure 2). The power plant is located on a 340-ha (840-ac) tract owned by the Federal government and held in custody by TVA, a corporate agency and instrumentality of the United States.

4.1 Terrestrial Resources

BFN is located within the Highland Rim section of the Interior Low Plateau Physiographic Province. Botanically, the site is within the Mississippian Plateau section of the Western Mesophytic Forest Region (EPA 2004). In this region of northern Alabama, native forest communities generally consist of mixed oak forests that vary in composition in relation to topography and soils. Historically, upland forests in the vicinity of the site were characterized by mixtures of southern red oak (*Quercus falcata*), black oak (*Q. velutina*), post oak (*Q. stellata*), and white oak (*Q. alba*), with dogwood (*Cornus* spp.) commonly present in the understory. The clearing of forested lands for agriculture has converted many of these forest communities to early successional habitats, allowing introduced plant species to replace representative native plant communities.

The site is situated in an area where the land is used primarily for agriculture (TVA 2003). The countryside includes open pasture lands, scattered farmsteads, few residents, and little industry within several miles. The south and west side of the BFN site abuts Wheeler Reservoir, and has a shoreline of approximately 3772 m (12,375 ft), with 58 percent of the shoreline stabilized with riprap. The remaining 42 percent of the shoreline of the site is partially eroded and is composed of mixed upland forest vegetation. The stabilized shoreline adjacent to the BFN facilities is primarily vegetated by young (approximately 4-to-5-year-old) black willow (*Salix nigra*), common hackberry (*Celtis occidentalis*), sumac (*Rhus* spp.), and exotic species such as Chinese privet (*Ligustrum sinense*), Japanese honeysuckle (*Lonicera japonica*), and trumpet creeper (*Campsis radicans*). The remainder of the shoreline just west of the facility is vegetated with a young mixed upland forest scattered with a few large, old specimens (approximately 80-plus years) of oaks and loblolly pine (*Pinus taeda*). Young plants associated with the upland forest include black locust (*Robinia pseudoacacia*), sweetgum (*Liquidambar styraciflua*), sassafras (*Sassafras albidum*), cottonwood (*Populus* spp.), elm (*Ulmus* spp.), common hackberry, and black cherry (*Prunus serotina*). Common understory vegetation in the forested area includes Chinese privet, spleenwort (*Asplenium* spp.), Virginia creeper (*Parthenocissus quinquefolia*), and poison ivy (*Toxicodendron radicans*).

Invasive exotic plant species are a concern in the area. TVA reports approximately 19 invasive species in the area with a special emphasis on Chinese privet, Japanese honeysuckle, Japanese knotweed (*Polygonum cuspidatum*), and Nepal grass (*Microstegium vimineum*) (TVA 2003).

There are approximately 10 ha (25 ac) and 5 ha (12 ac) of National Wetlands Inventory and U.S. Army Corps of Engineers-classified wetlands, respectively, occurring at the BFN site (TVA 2003). These areas include forested wetlands, emergent (marsh) wetlands, and scrub-shrub/emergent wetlands (based on 1980s aerial photography). The wetland ecological communities identified at the site are dominated by plant species that are common in the region, including black willow, buttonbush (*Cephalanthus occidentalis*), sedges (*Carex lupulina, C. vulpinoidea, Rhyncospora corniculata*), rushes (*Juncus* spp., *J. brachycarpus*), water hemlock (*Conium maculatum*), and smartweeds (*Polygonum* spp.). These wetlands occur in areas that have been previously disturbed by clearing and agriculture, and areas that are mowed periodically. These types of wetlands commonly occur on previously disturbed former or presently used agricultural land, and the dominant vegetation species occurring within them are common in the region.

The vegetation communities described above are not unusual for the area and provide no sensitive or rare forms of wildlife habitat. Wildlife habitat on the site can be broadly classified as upland and riparian/wetland. Animal species commonly associated with upland communities include white-tailed deer (*Odocoileus virginianus*), cottontail rabbit (*Sylvilagus floridanus*), Virginia opossum (*Didelphis virginiana*), hispid cotton rat (*Sigmodon hispidus*), song sparrow (*Melospiza melodia*), eastern bluebird (*Sialia sialis*), northern mockingbird (*Mimus polyglottus*), turkey vulture (*Cathartes aura*), tufted titmouse (*Baeolophus bicolor*), American toad (*Bufo americanus*), spring peeper (*Pseudacris crucifer*), black racer (*Coluber constrictor constrictor*), and eastern box turtle (*Terrapene carolina*) (TVA 2003). Riparian communities can support a unique assemblage of wildlife including muskrat (*Ondatra zibethicus*), beaver (*Castor canadensis*), raccoon (*Procyon lotor*), wood duck (*Aix sponsa*), belted kingfisher (*Ceryle alcyon*), barred owl (*Strix varia*), American woodcock (*Scolopax minor*), Carolina wren (*Thryothorus ludovicianus*), prothonotary warbler (*Protonotaria citrea*), eastern phoebe (*Sayornis phoebe*), bullfrog (*Rana catesbeiana*), green frog (*Rana clamitans*), eastern newt (*Notophthalmus viridescens*), southern two-lined salamander (*Eurycea cirrigera*), common snapping turtle (*Chelydra serpentina serpentina*), and northern water snake (*Nerodia sipedon*) (TVA 2003). Some water holes along Wheeler Reservoir are used by American alligators (*Alligator mississippiensis*) in the winter. Invasive terrestrial animals that are expected to occur in the project vicinity include European starling (*Sturnus vulgaris*), house sparrow (*Passer domesticus*), and rock dove (*Columba livia*).

BFN is connected to the TVA system network by seven 500-kilovolt (kV) transmission lines via the 500-kV switchyard (TVA 2003). One line is to the Madison substation; two are to the Trinity substation; one line each are to the West Point, Maury, and Union substations; and one line is to the Limestone 500-kV substation. There are two additional 161-kV lines, one to the Athens substation and one to the Trinity substation. All lines occupy portions of four rights-of-way; three that terminate at the Maury, Trinity, and Athens substations, Alabama, and one that terminates at the Union substation in Union County, Mississippi (Figure 3). In all, there are approximately 257 km (160 mi) of transmission line rights-of-way associated with BFN. The rights-of-way pass through Colbert, Franklin, Lawrence, Limestone, and Morgan Counties, Alabama, and Itawamba, Lee, Tishomingo, and Union Counties, Mississippi.[a] The Maury, Trinity, and Athens transmission line rights-of-way are found in the Eastern Highland Plain ecoregion, while the 175-km (109-mi)-long Union right-of-way traverses the Eastern Highland Plain and Transition Hills, crosses into Mississippi and passes through the Fall Line Hills, Flatwoods/Blackland Prairie Margins, and Blackland Prairie ecoregions (EPA 2004).

[a] Prentis County, Mississippi is not included. Species accounted for in adjacent counties.

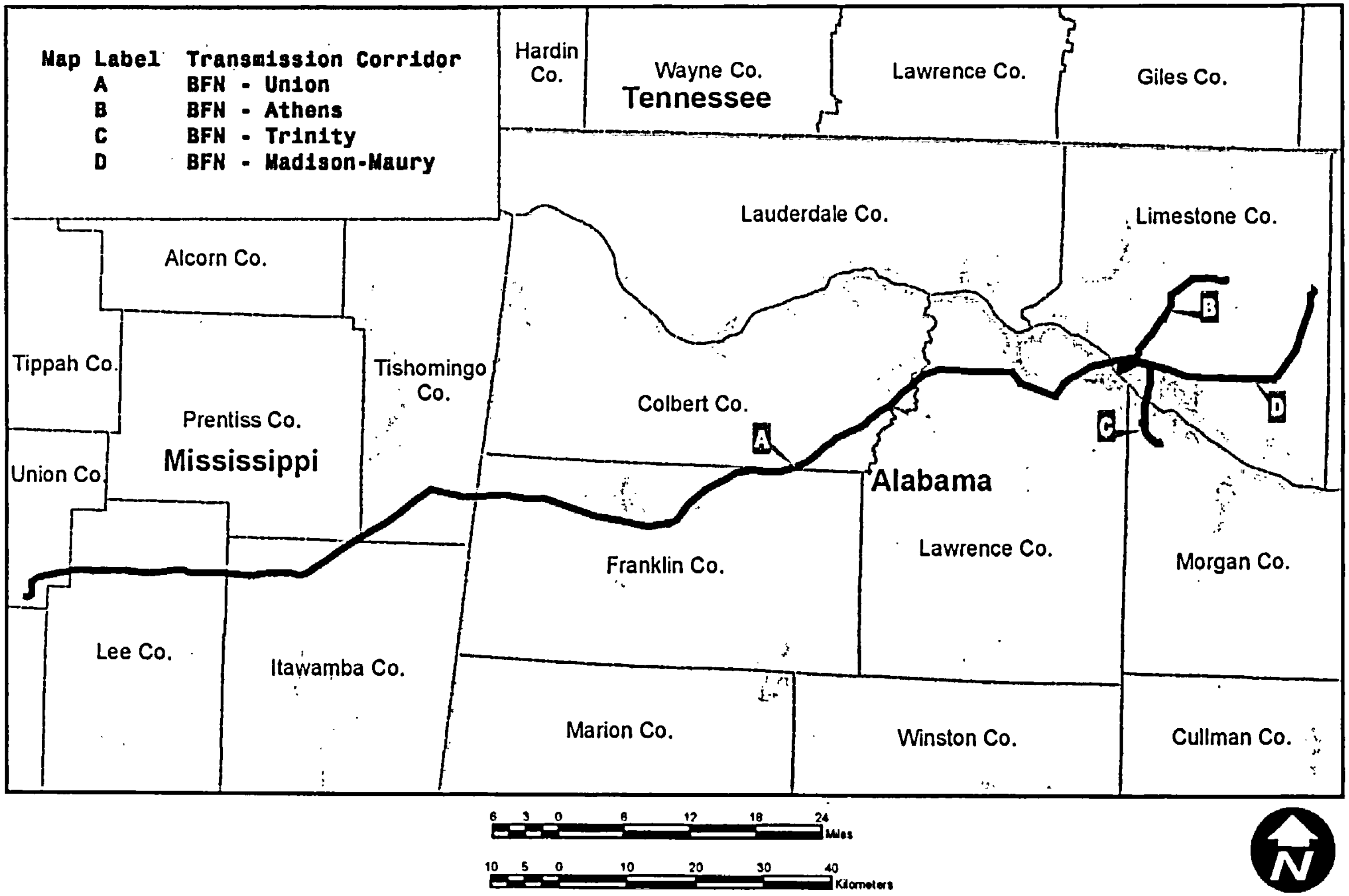

Figure 3. Browns Ferry Nuclear Power Plant, Units 1, 2, and 3 and Its Associated Transmission Lines and Rights-of-Way

Transmission line maintenance activities are reviewed for potential resource issues by technical specialists in the TVA Regional Natural Heritage and Cultural Resources programs (Muncy et al. 1999). A 1.6-km (1.0-mi) buffer area on either side of each transmission line right-of-way is reviewed for the presence of terrestrial species, while a 16.1-km (10-mi) buffer area is used for aquatic species (TVA 2003). The TVA Regional Natural Heritage program maintains a database of more than 27,000 occurrence records for protected plants, animals, caves, National Wetland Inventory wetlands, cultural resources, and areas of management concern for the entire TVA Power Service Area. TVA also conducts fieldwork to inventory and protect threatened and endangered species and environmentally sensitive areas on public lands it administers. Activities conducted by project staff members include monitoring species populations, educating the public, and managing and maintaining habitats (including caves) at TVA-managed sites.

Transmission line rights-of-way are regularly surveyed and video taped from a helicopter. Video tapes can then be used to search for sensitive habitat types before field crews are dispatched. Access routes and restrictions for maintenance activities are determined based on knowledge of the species or resources to be protected. Vehicles and equipment are restricted from a site when habitat-sensitive resources are present (Class 2 restrictions). Within Class 2 restricted areas, all vegetation clearing and herbicide applications are done by hand. Class 1 restrictions allow hand or mechanical clearing and herbicide use for vegetation control on transmission line rights-of-way. There is no broadcast application of herbicides. Herbicide application is carefully controlled and personnel who apply the herbicides are trained, licensed, and follow manufacturer's guidelines, U.S. Environmental Protection Agency (EPA) guidelines, and State regulations. The streamside management zone is maintained to (1) slow and spread surface-water flow so particulate matter will be trapped and filtered before reaching the stream channel, (2) protect stream bank integrity, and (3) protect water temperature in the stream.

4.2 Aquatic Resources

The aquatic resources in the vicinity of BFN are primarily associated with the Wheeler Reservoir portion of the Tennessee River. Wheeler Reservoir is the source and receiving body for the BFN cooling system (TVA 2003). Other aquatic habitats include several tributaries to Wheeler Reservoir: Paint Rock and Flint Rivers in the upper reach; Indian, Cotaco, and Flint Creeks in the middle reach; and Limestone, Piney, Swan, Fox, Mallard, Spring, First, and Second Creeks and the Elk River in the lower section. Elk River, the largest of these tributaries, flows into Wheeler Reservoir about 16 km (10 mi) downstream of BFN. Guntersville Reservoir is upstream of Wheeler Reservoir, while Wilson Reservoir is downstream. All three reservoirs are run-of-the-river impoundments on the Tennessee River.

The seven transmission lines located in four rights-of-way associated with BFN cross a number of streams ranging in size from small intermittent streams to the Tennessee River. Rivers and larger streams crossed by or near the transmission lines include Limestone, Piney, Swan, Round Island, Big Nance, Town, Spring, Cedar, Little Bear, and Bear Creeks in Alabama; and Bear, Little Brown, Donivan, Twentymile, Mantachie, Mud, and Bridge Creeks and the Tennessee-Tombigbee Waterway in Mississippi. Transmission line right-of-way maintenance activities in the vicinity of stream and river crossings employ best management practices to minimize erosion and shoreline disturbance while encouraging vegetative cover (TVA 2003).

A total of 63 fish species plus hybrid sunfish, hybrid striped bass x white bass (*Morone saxatilis* x *M. chrysops*), and hybrid walleye x sauger (*Stizostedion vitreum* x *S. canadense*) were collected from 1995 through 2002 in the vicinity of BFN (TVA 2002b, 2003). A total of 72 fish species were identified in impingement samples collected between 1974 and 1977 (TVA 1978). Important commercial fish species that occur in Wheeler Reservoir include blue catfish (*Ictalurus furcatus*), channel catfish (*I. punctatus*), flathead catfish (*Pylodictis olivaris*), bigmouth buffalo (*Ictiobus cyprinellus*), smallmouth buffalo (*I. bubalus*), and common carp (*Cyprinus carpio*). Gizzard shad (*Dorosoma cepedianum*) and threadfin shad (*D. petenense*) are the dominant forage species in Wheeler Reservoir (TVA 2003). Threadfin shad has been the dominant species numerically in Wheeler Reservoir since 1990 (Baxter and Buchanan 1998). Game fish species include largemouth bass (*Micropterus salmoides*), smallmouth bass (*M. dolomieui*), spotted bass (*M. punctulatus*), black crappie (*Pomoxis nigromaculatus*), white crappie (*P. annularis*), bluegill (*Lepomis macrochirus*), longear sunfish (*L. megalotis*), redear sunfish (*L. microlophus*), sauger, striped bass, hybrid striped bass, yellow bass (*Morone mississippiensis*), and yellow perch (*Perca flavescens*).

Historically, 39 mussel species occurred in Wheeler Reservoir. Thirty-one of these species were considered riverine (i.e., those that evolved in free-flowing reaches), with 19 of these species now considered non-reproducing riverine species within Wheeler Reservoir (Ahlstedt and McDonough 1992). In 1982, 12 mussel species were collected during a survey for the proposed barge facility at BFN (Pryor 1982), and 11 species were collected across the river during a survey for a proposed barge terminal for the Mallard-Fox Creek Development Project (Carroll 1982). The washboard (*Megalonaias nervosa*) was the most common species collected during both surveys. It is currently the predominant species that is commercially harvested (TVA 2003). The Ohio pigtoe (*Pleurobema cordatum*) was previously the most valuable commercial species, but its numbers have decreased because of habitat alterations due to impoundment (Ahlstedt and McDonough 1992). None of the species collected were Federally or State protected.

In 1991, 24 species of mussels were collected from Wheeler Reservoir, with six species represented by weathered, empty shells (Ahlstedt and McDonough 1992). The 24 species included all species previously collected near BFN in the two 1982 collections by Pryor and Carroll. It was estimated that 460 million mussels or 2.33 mussels/m^2 (0.22 mussels/ft^2)

occurred in the reservoir in 1991 (Ahlstedt and McDonough 1992). The most common species (and estimated number within Wheeler Reservoir) collected in 1991 were the elephant-ear (*Elliptio crassidens,* 116 million), washboard (88 million), pink heelsplitter (*Potamilus alatus,* 56 million), and threehorn wartyback (*Obliquaria reflexa,* 44 million) (Ahlstedt and McDonough 1992). In addition to the habitat alteration resulting from reservoir creation, over-harvesting and periods of drought (e.g., from 1983 to 1988) may have affected reproduction and/or survival of most thick-shelled mussel species in Wheeler Reservoir (Ahlstedt and McDonough 1992). Water-quality impairments and loss of necessary fish hosts have also contributed to the decline of mussel populations. The biodiversity of mussel communities in the mainstem Tennessee River reservoirs is anticipated to continue the long-term downward trend in terms of abundance and diversity (TVA 2004a).

In 1998, 17 mussel species were collected on the east channel of Wheeler Reservoir near Hobbs Island, over 64 river kilometers (40 river miles) upstream of BFN, between TRMs 336.4 and 335.5. The two most common mussel species were the elephant-ear and the Ohio pigtoe. Two Federally endangered species were also collected: one specimen of the rough pigtoe (*Pleurobema plenum*) and 16 specimens of the pink mucket (*Lampsilis abrupta*) (Yokely 1998). In 1999, 16 native mussel species were collected in the vicinity of BFN: 14 species at TRM 298 upstream of BFN and 12 species at TRM 292 downstream of BFN. None of these were Federally listed species (TVA 2003). Eleven commercial mussel species have been reported near BFN from TRM 305 to TRM 275 (Ahlstedt and McDonough 1992).

Two areas of Wheeler Reservoir are designated as State-protected mussel sanctuaries where commercial mussel fishing is not permitted. One sanctuary extends from Guntersville Dam (TRM 349) downstream to the mouth of Shoal Creek (TRM 347); the second extends from the upstream end of Hobbs Island (TRM 337) downstream to Whitesburg Bridge (TRM 333) (TVA 2003). In the reservoir overbanks, mussels are generally spread over large areas and are not concentrated in mussel beds (TVA 2003).

5.0 Evaluation of Threatened and Endangered Species

A review of the TVA Regional Natural Heritage database indicates that no Federally listed species of animals or plants have been reported from areas within 4.8 km (3.0 mi) of the BFN site (TVA 2003). However, there are 49 species (11 terrestrial and 38 aquatic species) that are listed as threatened, endangered, or candidate species by FWS that occur, at least historically, within the portion of the Tennessee River that encompasses Wheeler Reservoir or within one or more of the counties of Alabama and Mississippi within which the BFN transmission lines are located.

5.1 Terrestrial Species

There are 11 terrestrial species that are listed as threatened or endangered by the FWS and that potentially occur in the vicinity of BFN or along the transmission line rights-of-way (Table 1). All 11 Federally listed species have been reported from counties that contain BFN transmission line rights-of-way (Table 1).

Table 1. Federally Listed and Candidate Terrestrial Species for Colbert, Franklin, Lawrence, Limestone, and Morgan Counties, Alabama, and Itawamba, Lee, Tishomingo, and Union Counties, Mississippi, Occurring Near Browns Ferry Nuclear Power Plant, Units 1, 2, and 3 and Along the Transmission Line Rights-of-Way.

Scientific Name	Common Name	Status[a]	County Listings AL[b]	County Listings MS[c]	Habitat
			Birds		
Haliaeetus leucocephalus	bald eagle	T	Fr	It Ti	Coastlines, lakes, rivers and other water bodies
Picoides borealis	red-cockaded woodpecker	E	La	--	Open pine forests, generally at least 80 to 120 years old
			Mammals		
Myotis grisescens	gray bat	E	Co Fr La Li Mo	Ti	Restricted to cave or cave-like habitats. Gray bats roost and form maternity colonies in caves located along rivers and reservoirs
Myotis sodalis	Indiana bat	E	Co La Li Mo	Ti	Hibernate in caves during winter months but can be found in hollow trees and under loose tree bark during the summer
			Plants		
Apios priceana	Price's potato bean	T	--	Le	Open mixed hardwood forests often on floodplains, in or near riparian areas
Asplenium scolopendrium var. *americanum*	American hart's-tongue fern	T	Mo	--	Around the openings to limestone caves and sinkholes
Dalea foliosa	leafy prairie-clover	E	Fr La Mo	--	Cedar glades in northern Alabama and central Tennessee

Table 1. (contd)

Scientific Name	Common Name	Status[(a)]	County Listings AL[(b)]	County Listings MS[(c)]	Habitat
Helianthus eggertii	Eggert's sunflower	T	Co Fr La Li Mo	--	Barrens habitats within the Interior Plateau Ecoregion of Kentucky, Tennessee, and Alabama
Lesquerella lyrata	lyrate bladder-pod	T	Co Fr La	--	Disturbed glade habitats
Xyris tennesseensis	Tennessee yellow-eyed grass	E	Fr	--	Moist to wet, limestone-derived soils in open or lightly wooded sites
Leavenworthia crassa	Fleshy-fruited gladecress	C	La Mo	--	Endemic to limestone glades in Lawrence and Morgan Counties

(a) Status: C = candidate, E = endangered, T = threatened;.
(b) AL counties: Co = Colbert; Fr = Franklin; La = Lawrence; Li = Limestone; Mo = Morgan;.
(c) MS counties: It = Itawamba; Le = Lee; Ti = Tishomingo; – – = not listed.

Sources: FWS 2000b, 2004a; NatureServe 2004.

Bald Eagle (*Haliaeetus leucocephalus*)

The bald eagle is reported to occur in Franklin County, Alabama, and Itawamba and Tishomingo Counties, Mississippi. Bald eagles prefer habitat along coastlines, lakes, rivers and other water bodies that provide their primary food source – fish and waterfowl (NatureServe 2004). Eagles generally nest in tall trees or on cliff faces near water and away from human disturbance. Bald eagles are known in the area around BFN, but there is no known nesting habitat within 4.8 km (3.0 mi) of the site. Nesting sites on other TVA property are managed using FWS guidelines (FWS 1987a). Transmission line rights-of-way are likely to be within foraging areas for this species, particularly those that cross Wheeler Reservoir and the Tennessee-Tombigbee Waterway. The TVA reports incidents of eagle mortality associated with transmission lines but no mortality has been observed on BFN-associated lines.

Construction and maintenance of transmission line rights-of-way are designed to minimize environmental impacts, and transmission line right-of-way maintenance activities are reviewed for potential resource issues by TVA (Muncy et al. 1999). Access routes and activity restrictions are determined based on knowledge of the eagles in the area. Mechanical clearing and herbicide use may be used for vegetation control in transmission line rights-of-way. Access routes and activity restrictions are determined based on knowledge of the eagles in the area. Herbicide application is carefully controlled and personnel who apply the herbicides are trained, licensed, and follow manufacturer's guidelines, EPA guidelines, and State regulations. The staff reviewed TVA maintenance activities and determined that continued operation of BFN over the 20-year license renewal term may affect, but is not likely to adversely affect, bald eagles.

Red-Cockaded Woodpecker (*Picoides borealis*)

The red-cockaded woodpeckers is reported to occur in Lawrence County, Alabama, but not within at least 4.8 km (3.0 mi) of the transmission line rights-of-way. Red-cockaded woodpeckers inhabit open pine forests that are at least 80 to 120 years old (NatureServe 2004). Hardwood forests, or pine forests with a hardwood understory are usually avoided. There is no woodpecker habitat within 4.8 km (3.0 mi) of BFN, and it is unlikely that there is any suitable habitat along the BFN transmission line rights-of-way.

Because there is no habitat on the BFN site or transmission line rights-of-way, the staff determined that continued operation of BFN over the 20-year license renewal term will have no effect on the red-cockaded woodpecker.

Gray Bat (*Myotis grisescens*)

The gray bat is reported to occur in Colbert, Franklin, Lawrence, Limestone, and Morgan Counties, Alabama, and in Tishomingo County, Mississippi. Gray bats are colonial and are restricted to cave or cave-like habitats (NatureServe 2004). They roost, and the females form maternity colonies in caves located along rivers and reservoirs over which they feed. During the winter, gray bats congregate and hibernate in a limited number of caves across the southeast. Although no suitable habitat for this species occurs within 4.8 km (3.0 mi) of BFN, gray bats likely forage along the Tennessee River, adjacent to the plant site. Some of the BFN transmission line rights-of-way are likely to be within foraging areas for this species.

Construction and maintenance of transmission line rights-of-way are designed to minimize environmental impacts and transmission line right-of-way maintenance activities are reviewed for potential resource issues by the TVA (Muncy et al. 1999). Access routes and activity restrictions are determined based on knowledge of gray bats in the area. Mechanical clearing and herbicides may be used for vegetation control in transmission line rights-of-way. Herbicide application is carefully controlled and personnel who apply the herbicides are trained, licensed, and follow manufacturer's guidelines, EPA guidelines, and State regulations.

The staff reviewed TVA maintenance activities and determined that continued operation of BFN over the 20-year license renewal term may affect, but is not likely to adversely affect, the gray bat.

Indiana Bat (*Myotis sodalis*)

The Indiana bat is reported to occur in Colbert, Lawrence, Limestone, and Morgan Counties, Alabama, and in Tishomingo County, Mississippi. Indiana bats are colonial and hibernate in caves during winter months, but they can be found in hollow trees and under loose tree bark during the summer, where they form small maternity colonies (NatureServe 2004). Indiana bats forage for insects primarily in riparian and upland forests. Roosting and foraging habitat for Indiana bats is very limited on the BFN site. Water sources are composed of water lagoons, sedimentation ponds, and drainage canals, and forested habitats are primarily small woodlots of poor quality. No suitable Indiana bat habitat is known to occur within 4.8 km (3.0 mi) of the BFN site. Some of the BFN transmission line rights-of-way are likely to be within foraging areas for this species.

Construction and maintenance of transmission line rights-of-way are designed to minimize environmental impacts, and may improve foraging habitat for Indiana bats. Transmission line right-of-way maintenance activities are reviewed for potential resource issues by the TVA (Muncy et al. 1999). Access routes and activity restrictions are determined based on knowledge of Indiana bats in the area. Mechanical clearing and herbicides may be used for vegetation control in transmission line rights-of-way. Herbicide application is carefully controlled and personnel who apply the herbicides are trained, licensed, and follow manufacturer's guidelines, EPA guidelines, and State regulations.

Because there is no habitat for Indiana bats on the BFN site, and after reviewing the TVA maintenance activities, which may improve habitat along transmission line rights-of-way, the staff determined that continued operation of BFN over the 20-year license renewal term may affect, but is not likely to adversely affect, the Indiana bat.

Price's Potato Bean (*Apios priceana*)

Price's potato bean is reported to occur in Lee County, Mississippi. This species is found in open mixed hardwood forests, often on flood plains in or near riparian areas (NatureServe 2004). Although thought to be somewhat dependent on disturbances that maintain an early successional environment, it is also reported to be sensitive to some management activities such as logging, cattle grazing, and highway rights-of-way maintenance. No populations of Price's potato bean are known to exist within 4.8 km (3.0 mi) of BFN, but suitable habitat could be found along the BFN transmission line rights-of-way.

Construction and maintenance of transmission line rights-of-way are designed to minimize environmental impacts (Muncy et al. 1999), and may improve habitat for this species. Transmission line rights-of-way maintenance activities are reviewed for potential resource issues by the TVA (Muncy et al. 1999). Access routes and activity restrictions are determined based on knowledge of Price's potato bean in the area. Mechanical clearing and herbicide use may be used for vegetation control on transmission line rights-of-way. Herbicide application is carefully controlled and personnel who apply the herbicides are trained, licensed, and follow manufacturer's guidelines, EPA guidelines, and State regulations.

Because there is no habitat for Price's potato bean on the BFN site, and after reviewing the TVA maintenance activities, which may improve habitat along transmission line rights-of-way, the staff determined that continued operation of BFN over the 20-year license renewal term may affect, but is not likely to adversely affect, Price's potato bean.

American Hart's-Tongue Fern (*Asplenium scolopendrium* var. *americanum*)

American hart's-tongue fern is reported to occur in Morgan County, Alabama. In the southern portions of its range, this fern is found only around the openings to limestone caves and sinkholes (NatureServe 2004). No populations have been recorded within 4.8 km (3.0 mi) of BFN, and no suitable cave habitat has been identified along the BFN transmission line rights-of-way.

Because it does not occur at the BFN site or along BFN-associated transmission line rights-of-way, the staff has determined that continued operation of BFN over the 20-year license renewal term will have no effect on the American hart's tongue fern.

Leafy Prairie Clover (*Dalea foliosa*)

Leafy prairie clover is reported to occur in Franklin, Lawrence, and Morgan Counties, Alabama. This species is found in association with cedar glades in northern Alabama and central Tennessee. No populations of leafy prairie clover are known from within 4.8 km (3.0 mi) of BFN, but suitable habitat could be found along the transmission line rights-of-way. The leafy prairie clover has been found within 4.8 km (3.0 mi) of the Union transmission line in Colbert County, Alabama (TVA 2004b).

Construction and maintenance of the transmission line rights-of-way are designed to minimize environmental impacts, and transmission line rights-of-way maintenance activities are reviewed for potential resource issues by TVA (Muncy et al. 1999). Access routes and activity restrictions are determined based on knowledge of leafy prairie clover in the area. Mechanical clearing and herbicides may be used for vegetation control on transmission line rights-of-way. Herbicide application is carefully controlled and personnel who apply the herbicides are trained, licensed, and follow manufacturer's guidelines, EPA guidelines, and State regulations.

There is no habitat on the BFN site but suitable habitat could exist along a portion of the Union transmission line in Colbert County, Alabama. After reviewing the TVA maintenance activities, the staff determined that continued operation of BFN over the 20-year license renewal term may affect, but is not likely to adversely affect, the leafy prairie clover.

Eggert's Sunflower (*Helianthus eggertii*)

Eggert's sunflower is reported to occur in Colbert, Franklin, Lawrence, Limestone, and Morgan Counties, Alabama. This species is found in barrens habitat within the Interior Plateau Ecoregion of Kentucky, Tennessee, and Alabama (NatureServe 2004). No populations have been recorded within 4.8 km (3.0 mi) of BFN. Populations may occur along the BFN transmission line rights-of-way because the species is reported to respond favorably to management activities such as burning and mowing (NatureServe 2004).

Construction and maintenance of transmission line rights-of-way are designed to minimize environmental impacts (Muncy et al. 1999), and may improve habitat for this species. Transmission line right-of-way maintenance activities are reviewed for potential resource issues by the TVA (Muncy et al. 1999). Access routes and activity restrictions are determined based on knowledge of the Eggert's sunflower in the area. Mechanical clearing and herbicides may be used for vegetation control on transmission line rights-of-way. Herbicide application is carefully controlled and personnel who apply the herbicides are trained, licensed, and follow manufacturer's guidelines, EPA guidelines, and State regulations.

Because there is no habitat on the BFN site and after reviewing the TVA maintenance activities, which may improve habitat along transmission line rights-of-way, the staff determined that continued operation of BFN over the 20-year license renewal term may affect, but is not likely to adversely affect, the Eggert's sunflower.

Fleshy-Fruited Gladecress (*Leavenworthia crassa*)

The fleshy-fruited gladecress is listed as a candidate species by FWS and is reported to occur in Lawrence and Morgan Counties, Alabama. Reportedly endemic to Lawrence and Morgan Counties, this species inhabits limestone glades and has been identified from only six sites (NatureServe 2004). No populations have been recorded within 4.8 km (3.0 mi) of BFN, but suitable habitat could be found along the BFN transmission line rights-of-way.

Construction and maintenance of transmission line rights-of-way are designed to minimize environmental impacts (Muncy et al. 1999), and may improve habitat for this species. Transmission line right-of-way maintenance activities are reviewed for potential resource issues by the TVA (Muncy et al. 1999). Access routes and activity restrictions are determined based on knowledge of fleshy-fruited gladecress in the area. Mechanical clearing and herbicide use may be used for vegetation control on transmission line rights-of-way. Herbicide application is carefully controlled and personnel who apply the herbicides are trained, licensed, and follow manufacturer's guidelines, EPA guidelines, and State regulations.

Because there is no habitat on the BFN site and after reviewing the TVA maintenance activities, which may improve habitat along transmission line rights-of-way, the staff determined that continued operation of BFN over the 20-year license renewal term may affect, but is not likely to adversely affect, the fleshy-fruited gladecress.

Lyrate Bladder-Pod (*Lesquerella lyrata*)

Lyrate bladder-pod is reported to occur in Colbert, Franklin, and Lawrence Counties, Alabama. The species in known from only two populations in Franklin and Colbert Counties (FWS 2004b). The plant is an annual in the mustard family and is found in disturbed glade habitats. No populations have been recorded within 4.8 km (3.0 mi) of BFN, but suitable habitat could be found along the BFN transmission line rights-of-way.

Construction and maintenance of transmission line rights-of-way are designed to minimize environmental impacts (Muncy et al. 1999), and may improve habitat for this species. Transmission line right-of-way maintenance activities are reviewed for potential resource issues by the TVA (Muncy et al. 1999). Access routes and activity restrictions are determined based on knowledge of lyrate bladder-pod in the area. Mechanical clearing and herbicide use may be used for vegetation control on transmission line rights-of-way. Herbicide application is carefully controlled and personnel who apply the herbicides are trained, licensed, and follow manufacturer's guidelines, EPA guidelines, and State regulations.

Because there is no habitat on the BFN site and after reviewing the TVA maintenance activities, which may improve habitat along transmission line rights-of-way, the staff determined that continued operation of BFN over the 20-year license renewal term may affect, but is not likely to adversely affect, the lyrate bladder-pod.

Tennessee Yellow-Eyed Grass (*Xyris tennesseensis*)

Tennessee yellow-eyed grass is reported to occur in Franklin County, Alabama. This species is found in moist-to-wet, limestone-derived soils in open or lightly wooded sites (NatureServe 2004). No populations are known to exist within 4.8 km (3.0 mi) of BFN, but suitable habitat could be found along the BFN transmission line rights-of-way. It has been found within 4.8 km (3.0 mi) of the Union transmission line in Franklin County, Alabama (TVA 2004b).

Construction and maintenance of transmission line rights-of-way are designed to minimize environmental impacts (Muncy et al. 1999), and may improve habitat for this species.

Transmission line right-of-way maintenance activities are reviewed for potential resource issues by the TVA (Muncy et al. 1999). Access routes and activity restrictions are determined based on knowledge of Tennessee yellow-eyed grass in the area. Mechanical clearing and herbicides may be used for vegetation control on transmission line rights-of-way. Herbicide application is carefully controlled and personnel who apply the herbicides are trained, licensed, and follow manufacturer's guidelines, EPA guidelines, and State regulations.

Because there is no habitat on the BFN site and after reviewing the TVA maintenance activities, which may improve habitat along transmission line rights-of-way, the staff determined that continued operation of BFN over the 20-year license renewal term may affect, but is not likely to adversely affect, the Tennessee yellow-eyed grass.

5.2 Aquatic Species

A total of 38 Federally listed aquatic species on the FWS website are identified as potentially occurring in the project area (i.e., Wheeler Reservoir or in streams crossed by transmission line rights-of-way associated with the BFN site). Nine of these species have a reasonable potential of occurring in the project area and are discussed in Section 5.2.1 below. The remaining 29 species are only briefly discussed in Section 5.2.2 because of presumed extinction or extripation from the project area, no recent records of collection, or because the habitat of the project area is clearly unsuitable for the species.

5.2.1 Species Potentially Occurring in the Project Area

Nine aquatic species are listed as threatened, endangered, or candidate species by FWS and have a reasonable potential to occur in the project area (i.e., Wheeler Reservoir or within streams crossed by the transmission lines associated with BFN) (Table 2).

Anthony's Riversnail (*Athearnia anthonyi*)

Anthony's riversnail is Federally listed as endangered throughout its entire range (FWS 1994), except where proposed for establishment as a nonessential experimental population in the free-flowing reach of the Tennessee River from the base of Wilson Dam downstream to the back-waters of Pickwick Reservoir (about 19 km [12 mi]) and the lower 8 km (5 mi) of all tributaries to this reach in Colbert and Lauderdale Counties, Alabama (FWS 2001). It was known to occur in Alabama, Georgia, and Tennessee. It has been extirpated from most of its historic range due to pollution, siltation, and habitat modification or destruction. Many populations were lost when the Tennessee River and the lower reaches of its tributaries were impounded (FWS 1994). Only two populations of Anthony's riversnail are known to survive. The largest of these occurs in the Tennessee River, Jackson County, Alabama, and Marion County, Tennessee, a short distance downstream of Nickajack Dam. This population also extends a short distance into the

Table 2. Federally Listed and Candidate Aquatic Species Potentially Occurring in Wheeler Reservoir or Streams Crossed by the Browns Ferry Nuclear Power Plant, Units 1, 2, and 3 Transmission Line Rights-of-Way.

Scientific Name	Common Name	Status[a]	County Listings[b] AL	County Listings[b] MS	Habitat
Snails					
Athearnia anthonyi	Anthony's riversnail	E	Co Li	--	Large rivers and lower reaches of large creeks on cobble/boulder substrates near riffles.
Campeloma decampi	slender campeloma	E	Li	--	Large creeks in soft sediments (sand or mud) or detritus.
Pyrgulopsis pachyta	armored snail	E	Li	--	Shallow, still water along the edge of pools on tree roots and detritus of creeks.
Mussels					
Cumberlandia monodonta	spectaclecase	C	Co La Li Mo	--	Large rivers with swiftly flowing water, among boulders in patches of sand, cobble, or gravel in areas where current is reduced.
Epioblasma brevidens	Cumberlandian combshell	E	Co Fr Li	Ti	Coarse sand to mixtures of gravel, cobble and boulder-sized rocks in medium to large rivers; tends to occur at depths less than 1m (3 ft).
Lampsilis abrupta	pink mucket	E	Co La Li Mo	--	Larger rivers in gravel or sand.
Lexingtonia dolabelloides	slabside pearlymussel	C	Co Fr Li	Ti	Moderate to high gradient riffles in medium to large rivers.
Pleurobema plenum	rough pigtoe	E	Co La Li Mo	--	Medium to large rivers in sand or gravel.
Fish					
Etheostoma boschungi	slackwater darter	T	Li	--	Gravel-bottomed pools and runs of creeks and small rivers.

(a) Co = Colbert; Fr = Franklin; It = Itawamba; La = Lawrence; Li = Limestone; Mo = Morgan; Ti = Tishomingo; – = not listed.
(b) Status: C = candidate, E = endangered, T = threatened.
Sources: ADCNR 2003; Cummings and Mayer 1992; FWS 1990b, 2000b, 2004c; Johnson and Wehrle 2004; MMNS 2002; MNHP 2002; NatureServe 2004; NCWRC 2004; Page and Burr 1991; TVA 2003, 2004a.

lower section Sequatchie River, Marion County, Tennessee (FWS 1997b). This population occurs well upstream from the BFN site. The other surviving population is restricted to a relatively short reach of lower Limestone Creek, Limestone County, Alabama (FWS 1997b). Limestone Creek is crossed at three locations by a BFN transmission line and is closely paralleled by the transmission line along two stream segments (TVA 2004b). However, the BFN transmission line does not cross or parallel the lower section of Limestone Creek where the snail is known to occur. Anthony's riversnail inhabits large rivers and the lower reaches of larger creeks, occurring on cobble/boulder substrates in the vicinity of riffles. However, it does not always occur in strongly flowing sections (NatureServe 2004). At the two sites in Limestone Creek where Anthony's riversnail is known to occur, its density reaches several hundred individuals per square meter. However, both Sequatchie and Limestone Creeks have been severely impacted in the past, and continue to be impacted, by siltation and other sources of pollution (e.g., pesticide spraying and mining effluents). A single catastrophic pollution event could potentially destroy all populations of the snail within a creek (FWS 1994, 1997b). A recovery plan for Anthony's riversnail has been prepared (FWS 1997b).

The staff visited the site and reviewed the life history information about Anthony's riversnail. Based on this information, and that previously described for the TVA transmission line rights-of-way maintenance procedures, the staff concludes that continued operation of BFN over the 20-year license renewal term may affect, but is not likely to adversely affect, Anthony's riversnail.

Slender Campeloma (*Campeloma decampi*)

The slender campeloma is Federally listed as endangered throughout its entire range (FWS 2000a). It is known to occur in only several isolated populations along Limestone, Piney, and Round Island Creeks in northern Alabama (NatureServe 2004). All three creeks are crossed by BFN transmission lines. Piney Creek is crossed once, while Round Island and Limestone Creeks are each crossed three times. Segments of Round Island and Limestone Creeks are also closely paralleled by the transmission lines. The slender campeloma has been found within 4.8 km (3.0 mi) of the Trinity, Maury, and Athens transmission lines in Limestone County, Alabama (TVA 2004b). The slender campeloma typically burrows in soft sediment or detritus. Impacts to slender campeloma include siltation and other pollutants from poor land-use practices and waste discharges (FWS 2000a).

The staff visited the site and reviewed the life history information about the slender campeloma. On the basis of this information and information previously described for the TVA transmission line right-of-way maintenance procedures, the staff concludes that continued operation of BFN over the 20-year license renewal term may affect, but is not likely to adversely affect, the slender campeloma.

Armored Snail (*Pyrgulopsis pachyta*)

The armored snail (or armored marstonia) is Federally listed as endangered throughout its entire range (FWS 2000a). It is known to occur in Alabama from several isolated sites in Limestone and Piney Creeks near Mooresville, Alabama (NatureServe 2004). Piney Creek was formerly a tributary of Limestone Creek before the construction of Wheeler Reservoir (NatureServe 2004). The BFN transmission lines cross both of these streams. BFN transmission lines cross Limestone Creek at three locations and closely parallels along two segments of the creek. Both streams are crossed several miles upstream from Mooresville. The armored snail has been collected within 4.8 km (3.0 mi) of the Maury transmission line in Limestone County, Alabama (TVA 2004b). The armored snail is found in shallow, still water along the edge of pools on tree roots and detritus. It probably also occurs on mud (NatureServe 2004). Impacts to the armored snail include siltation and other pollutants from poor land-use practices and waste discharges (FWS 2000a).

The staff visited the site and reviewed the life history information about the armored snail. On the basis of this information and information previously described for the TVA transmission line right-of-way maintenance procedures, the staff concludes that continued operation of BFN over the 20-year license renewal term may affect, but is not likely to adversely affect, the armored snail.

Spectaclecase (*Cumberlandia monodonta*)

The spectaclecase is a candidate for Federal listing. Its historic range includes Alabama, Arkansas, Iowa, Indiana, Illinois, Kentucky, Missouri, Nebraska, Ohio, Tennessee, Virginia, and Wisconsin (FWS 2004c). It has been largely reduced to a relatively few disjunct sites. The mussels at some of the sites may no longer be capable of reproduction because of loss of fish hosts or adverse environmental conditions (e.g., hypolimnetic releases from reservoirs) (NatureServe 2004). In Alabama, the spectaclecase is known from Limestone and Morgan Counties. The spectaclecase is usually found in areas with a strong current. In medium-sized rivers, it prefers coarse substrates such as cobble, gravel, or cracks in bedrock. In large rivers, substrates used are typically finer and include sand or mud. The spectaclecase may be associated with shoals, bars, and islands (NatureServe 2004). It is often found in small clusters of the same-aged individuals (NatureServe 2004). Fish hosts for the spectaclecase are unknown (Schulz and Marbain 1998). Live specimens have been collected in the main stem of the Tennessee River in Colbert, Lauderdale, Limestone, and Morgan Counties as recently as 2000. Recent collections in the mainstem of the Tennessee River have been made in the tailwaters downstream of dams. Weathered shells were collected in the Elk River, Limestone County, Alabama, in 1998 and 1974 (Butler 2002).

The staff visited the site and reviewed the life history information about the spectaclecase. On the basis of this information and information previously described for the TVA transmission line right-of-way maintenance procedures, the staff concludes that continued operation of BFN over the 20-year license renewal term may affect, but is not likely to adversely affect, the spectaclecase.

Cumberlandian Combshell (*Epioblasma brevidens*)

The Cumberlandian combshell is Federally listed as endangered throughout its entire range (FWS 1997a), except where proposed for establishment as a nonessential experimental population in the free-flowing reach of the Tennessee River from the base of Wilson Dam downstream to the backwaters of Pickwick Reservoir (about 19 km [12 mi]) and the lower 8 km (5 mi) of all tributaries to this reach in Colbert and Lauderdale Counties, Alabama (FWS 2001). A draft recovery plan has been prepared for the species (FWS 2003). The Cumberlandian combshell is known to occur in Alabama, Kentucky, Tennessee, and Virginia (FWS 1997a). The Cumberlandian combshell is now restricted to populations in limited areas of five drainages, and some of these may no longer be reproducing. The species was eliminated from much of its historic range by impoundments. Existing populations are in decline due to pollution (especially from mining activities), impoundments, and siltation (FWS 1997a). It was last collected from Muscle Shoals (the area now incorporated within the upper reaches of Pickwick Reservoir through Wilson Reservoir and into Wheeler Reservoir) in 1925 (Garner 1997). The Cumberlandian combshell is typically associated with riffle and shoal areas in medium and large rivers in substrates of coarse sand to cobble. It has been apparently eliminated from the main stem of the Tennessee and Cumberland Rivers (FWS 2004d). In Alabama, moribund specimens were found in the late 1990s in Bear Creek, a tributary of the Tennessee River (NatureServe 2004). Fish hosts for the Cumberlandian combshell include darters and sculpins (Schulz and Marbain 1998). Critical habitat has been designated for the species within the Tennessee and Cumberland River basins, including a portion of Bear Creek that flows through Colbert County, Alabama, and Tishomingo County, Mississippi (FWS 2004d). One of the BFN transmission lines crosses Bear Creek in Tishomingo County, Mississippi, within the proposed reach of critical habitat.

The staff visited the site and reviewed the life history information about the Cumberlandian combshell. On the basis of this information, information previously provided on the aquatic resources within the Wheeler Reservoir, and information previously described for the TVA transmission line right-of-way maintenance procedures, the staff concludes that continued operation of BFN over the 20-year license renewal term may affect, but is not likely to adversely affect, the Cumberlandian combshell.

Pink Mucket (*Lampsilis abrupta*)

The pink mucket is Federally listed as endangered throughout its entire range (FWS 1976). It is known to occur in Alabama, Arkansas, Illinois, Indiana, Kentucky, Louisiana, Missouri, Ohio, Pennsylvania, Tennessee, Virginia, and West Virginia (NatureServe 2004). It is apparently surviving and reproducing in river segments that have been altered by impoundments; however, its range has diminished (e.g., it has been extirpated from Ohio, Pennsylvania, and Illinois) (NatureServe 2004). Within Alabama, the pink mucket occurs in Colbert, Lauderdale, Limestone, Madison, Marshall, and Morgan Counties (NatureServe 2004). Suitable hosts for the glochidia of the pink mucket include freshwater drum, largemouth bass, smallmouth bass, spotted bass, sauger, and walleye (Fuller 1974; Barnhart et al. 1997). Use of mostly piscivorous hosts by this mussel is consistent with the display of a relatively large fish-like lure used by the mussel to attach hosts (Barnhart et al. 1997). The pink mucket inhabits areas of large rivers with swift currents at depths ranging from 0.5 to 8.0 m (1.6 to 26.2 ft) and mixed sand/gravel/cobble substrate (Barclay 2004). They are generally collected in the tailwater areas downstream from the Tennessee River drainage dams (Barclay 2004). Therefore, it is unlikely that the pink mucket exists in Wheeler Reservoir in the areas near or downstream from BFN. The pink mucket has been found within 4.8 km (3.0 mi) of the Union transmission line in Lawrence County, Alabama (TVA 2004b). Sixteen specimens of the pink mucket were collected near Hobbs Island (over 64 km [40 mi] upstream of BFN) in 1998 (Yokely 1998). Past and ongoing threats to the pink mucket include habitat loss and modification from dams and dredging, water quality degradation, and commercial over-harvesting (NatureServe 2004). The zebra mussel would also pose a threat to the pink mucket in areas where they co-exist.

The staff visited the site and reviewed the life history information about the pink mucket. On the basis of this information, information previously provided on the aquatic resources in Wheeler Reservoir, and information previously described for the TVA transmission line right-of-way maintenance procedures, the staff concludes that continued operation of BFN over the 20-year license renewal term may affect, but is not likely to adversely affect, the pink mucket.

Slabside Pearlymussel (*Lexingtonia dolabelloides*)

The slabside pearlymussel is a candidate for Federal listing. Its historic range includes Alabama, Kentucky, Tennessee, and Virginia (FWS 2004c). Most surviving individuals are restricted to two or three populations; and the long-term viability of all extant occurrences is questionable (NatureServe 2004). It historically occurred in the Cumberland River, although it is now extirpated from the entire Cumberland River system. The slabside pearlymussel was once prevalent in the Tennessee River system. Historically, it was fairly common from Muscle Shoals (the area is now incorporated within the upper reaches of Pickwick Reservoir through Wilson Reservoir and into Wheeler Reservoir) to the Tennessee River headwater tributaries in Virginia and the Duck River drainage. It was last collected from Muscle Shoals in 1963 (Garner 1997). Remaining populations occur in a number of tributary streams of the Tennessee River system, but not in the main stem of the Tennessee River (NatureServe 2004). Bear Creek is the only one of these streams that is crossed by a BFN transmission line. Fish hosts for the slabside pearlymussel include the smallmouth bass and, possibly, various minnow species (Schulz and Marbain 1998). Threats to the species include channel alterations, impoundments, siltation, pollution, commercial clamming, and gravel and coal mining (NatureServe 2004). It is generally found in areas of moderate to swift current velocities with substrates ranging from coarse sand to heterogenous assemblages of larger-sized particles (NatureServe 2004).

The staff visited the site and reviewed the life history information about the slabside pearlymussel. On the basis of this information, information previously provided on the aquatic resources within the Wheeler Reservoir, and information previously described for the TVA transmission line rights-of-way maintenance procedures, the staff concludes that continued operation of BFN over the 20-year license renewal term may affect, but is not likely to adversely affect, the slabside pearlymussel.

Rough Pigtoe (*Pleurobema plenum*)

The rough pigtoe is Federally listed as endangered throughout its entire range (FWS 1976). It has a wide, but very fragmented, distribution in Alabama, Indiana, Kentucky, Pennsylvania, Tennessee, and Virginia (NatureServe 2004). The distribution of the rough pigtoe in Alabama includes Colbert, Lauderdale, Limestone, and Morgan Counties. Within the Tennessee River, the rough pigtoe is currently present in tailwaters downstream of Pickwick, Wilson, and Guntersville Dams (NatureServe 2004). The rough pigtoe occurs in medium to large rivers in sand, gravel, and cobble substrates in shoals, although it is occasionally found on flats and muddy sand (NatureServe 2004). It does not occur in the impounded sections of rivers (FWIE 1996). Therefore, it is unlikely that the rough pigtoe exists in Wheeler Reservoir in the areas near or downstream from BFN. One specimen was collected near Hobbs Island (over 64 km [40 mi] upstream of BFN) in 1998 (Yokely 1998). Possible host fish for the rough pigtoe are bluegill and rosefin shiner (*Lythrurus ardens*) (Schulz and Marbain 1998). The long-term viability of most populations is in jeopardy, particularly for those in large rivers where zebra mussels are established (NatureServe 2004). Other threats to the rough pigtoe include impoundments, channelization, dredging, industrial and residential discharges, siltation, herbicide and fertilizer run-off, loss of fish hosts, and natural predators (NatureServe 2004).

The staff visited the site and reviewed the life history information about the rough pigtoe. On the basis of this information and information previously described for the TVA transmission line right-of-way maintenance procedures, the staff concludes that continued operation of BFN over the 20-year license renewal term may affect, but is not likely to adversely affect, the rough pigtoe.

Slackwater Darter (*Etheostoma boschungi*)

The slackwater darter is Federally listed as threatened throughout its entire range (FWS 1977b). Critical habitat was also designated for the species (FWS 1977b). It is known to occur in Alabama and Tennessee. The slackwater darter occupies five tributaries of the Tennessee River: Buffalo River and upper Shoal Creek in Lawrence County, Tennessee; Flint River, Madison County, Alabama; Swan Creek, Limestone County, Alabama, and Cypress Creek, Lauderdale County, Alabama (NatureServe 2004). Swan Creek is crossed by the Maury transmission line. The slackwater darter has been found within 4.8 km (3.0 mi) of the Trinity and Maury transmission lines in Limestone County, Alabama (TVA 2004b). Critical habitat for the slackwater darter includes many of the permanent and intermittent streams that are tributaries to Cypress Creek in Lauderdale County, Alabama, and Wayne County, Tennessee (FWS 1977b). None of these streams are located near BFN transmission lines. The slackwater darter typically occurs in gravel-bottomed pools in sluggish areas of creeks and small rivers that are not more than 12 m (39 ft) wide and 2 m (6.6 ft) deep. They often inhabit slow waters beneath undercut banks or accumulations of leaf litter or detritus. Spawning occurs in very shallow (5 to 10 cm [2 to 4 in.]) clear, flowing seepage water characterized by the presence of *Juncus* spp. and *Eleocharis* spp. in fields and open woods. Threats to the species include habitat loss and degradation. In some locations, the heavy use of groundwater causes seepage areas used for spawning to dry up (NatureServe 2004).

The staff visited the site and reviewed the life history and distribution of the slackwater darter. On the basis of this information and information provided by TVA, the staff concludes that continued operation of BFN over the 20-year license renewal term may affect, but is not likely to adversely affect, the slackwater darter.

5.2.2 Additional Aquatic Species

In addition to the nine species discussed above, there are 29 additional Federally listed aquatic species (including one candidate species) whose distribution includes, or historically included, the Wheeler Reservoir portion of the Tennessee River or other streams, rivers, or caves within the counties of Alabama and Mississippi within which the BFN transmission lines occur (Table 3). However, these 29 species would not currently be expected to occur within Wheeler Reservoir near or downstream of BFN (i.e., the portions of the Tennessee River that could be affected by BFN operations) or within the streams crossed by the transmission lines associated with BFN. The rationale for this determination is based on the following: (1) the species are presumed extinct; (2) the species are presumed to be extirpated from the region; (3) there are no recent records of the species in the BFN project area; (4) there are no collection records for the species from pertinent locations; and/or (5) project areas of concern do not have appropriate habitat for the species (e.g., county records are for streams or caves that are not crossed by the BFN transmission lines). The notes column of Table 3 provides the rationale for each species. The staff reviewed the design, operation, and location of the intake and discharge structures at BFN and the impingement and entrainment data collected during plant operation. The staff also visited the site and reviewed the life history information about these 29 species. On the basis of this information, information previously provided on the aquatic resources within the Wheeler Reservoir, and information previously described for the TVA transmission line rights-of-way maintenance procedures, the staff concludes that continued operation of BFN over the 20-year license renewal term would have no effect on these species. Therefore, these species are not evaluated in any detail in this BA.

Table 3. Federally Listed Aquatic Species in Northwestern Alabama and Northeastern Mississippi that are Considered Unlikely to be Present Near the Browns Ferry Nuclear Power Plant, Units 1, 2, and 3 Site or Its Transmission Line Rights-of-Way.

Scientific Name (Common Name)	Status[b]	County Listings[a] AL	County Listings[a] MS	Notes
		Mussels		
Cyprogenia stegaria (fanshell)	E	Co	--	Relatively deep water in gravelly substrates with moderate currents in medium to large rivers. Last collected in Muscle Shoals[c] circa 1976 to 1978. Live specimen last reported from Wheeler Reservoir in 1979. Possibly extirpated from Alabama.
Dromus dromas (dromedary pearlymussel)	E	Co Li Mo	--	Sand and gravel substrates in riffles and shoals of medium to large rivers. Last collected in Muscle Shoals in 1931. Only current Tennessee River records are from Meigs County, Tennessee. Possibly extirpated from Alabama.
Epioblasma capsaeformis (oyster mussel)	E	Co	--	Usually in small- to medium-sized rivers in substrates of coarse sand to boulder substrates in moderate to swift currents. Last collected from Muscle Shoals circa 1925. No longer present in the mainstem of the Tennessee River. Presumed extirpated from Alabama.
Epioblasma florentina florentina (yellow-blossom pearlymussel)	E	Co	--	Riffle and shoal areas of small-sized to medium-sized streams. Last collected from Muscle Shoals circa 1925. Not collected anywhere since 1970. Possibly extinct.
Epioblasma florentina walkeri (tan riffleshell)	E	Li	--	Headwaters, riffles, and shoals in sand and gravel substrates. Only one reproducing population known (Indian Creek of the upper Clinch River, Virginia). Presumed extirpated from Alabama.
Epioblasma penita (Southern combshell)	E	--	It	Riffles or shoals of medium-sized rivers with sandy gravel to gravel-cobble substrates in moderate to swift current. Currently limited to the East Fork Tombigbee River, Sipsey River, and Buttahatchie River, well south of the BFN project area. Presumed extripated from Alabama.
Epioblasma torulosa torulosa (tubercled blossom pearlymussel)	E	Co Li Mo	--	Sandy gravel substrates in riffles and shoals in rapid currents of medium to large rivers. Last collected from Muscle Shoals in 1931. Presumed extirpated from Alabama, species possibly extinct.
Epioblasma turgidula (turgid blossom pearlymussel)	E	Co Fr	--	Sand and gravel substrates of shallow, fast-flowing streams. Last collected from Muscle Shoals circa 1925. Not collected anywhere since the mid-1960s, possibly extinct.

Table 3. (contd)

Scientific Name (Common Name)	Status[b]	County Listings[a] AL	County Listings[a] MS	Notes
Fusconaia cor (shiny pigtoe)	E	Co	--	Shoals and riffles in clear streams with moderate to fast current. Last collected from Muscle Shoals circa 1925. No recent collections from the Tennessee River or its tributaries that are crossed by the BFN transmission lines. Currently exists in the North Fork of the Holston River, the Clinch and Powell Rivers in Tennessee, and in the Paint Rock River in Alabama.
Fusconaia cuneolus (finerayed pigtoe)	E	Fr Li	--	Firm cobble and gravel substrates of clear, high-gradient streams. Last collected from Muscle Shoals circa 1925. No recent collections from the Tennessee River or its tributaries that are crossed by the BFN transmission lines. Currently persists in Clinch and Powell Rivers, the North Fork of the Holston River, and in the Paint Rock River.
Hemistena lata (cracking pearlymussel)	E	Co Li	--	Sand, gravel and cobble substrates in swift currents or mud and sand in slower currents of medium to large rivers. Last collected from Muscle Shoals circa 1925. Presumed extirpated from Alabama. May exist in the Clinch River, Tennessee.
Lampsilis perovalis (orangenacre mucket)	T	--	It	Medium and large rivers in gravel/cobble or gravel/coarse sand substrates. Survives in a few Tombigbee, Black Warrior, and Alabama River tributaries well south of the BFN transmission lines.
Lampsilis virescens (Alabama lampmussel)	E	Co Fr	--	Sand and gravel substrates in shoal areas of medium to large rivers. Last collected from Muscle Shoals circa 1925. Extirpated from most of its range. Only one live specimen found in recent years from Paint Rock River drainage in Jackson County, Alabama, well upstream from the BFN project area.
Lemiox rimosus (birdwing pearlymussel)	E	Co Li	--	Riffle areas with sand and gravel substrates in moderate to fast currents of creeks to medium-sized rivers. Last collected from Muscle Shoals circa 1925. Presumed extirpated from Alabama. Only a few known occurrences in the Clinch, Powell, Elk, and Duck Rivers in Tennessee and Virginia.

Table 3. (contd)

Scientific Name (Common Name)	Status[b]	County Listings[a] AL	County Listings[a] MS	Notes
Obovaria retusa (ring pink)	E	Co Li Mo	--	Gravel and sand bars of large rivers. Last collected from Muscle Shoals in 1992. Empty shells collected from Wheeler Reservoir in 1991. Possibly extirpated from Alabama.
Plethobasus cicatricosus (white wartyback pearlymussel)	E	Co	--	Gravel substrates of large rivers. No living specimens found in the Tennessee River since the 1960s, although fresh dead specimens collected in 1979 and 1982 downstream of Pickwick Dam near Savannah, Tennessee. Possibly extinct.
Plethobasus cooperianus (orangefoot pimpleback)	E	Co Li Mo	--	Sand, gravel, and cobble substrates in riffles and shoals in deep water and steady current of large rivers. Last collected from Muscle Shoals in 1978. Possibly extirpated from Alabama.
Pleurobema clava (clubshell)	E	Co	--	Medium to large rivers in clean gravel or mixed gravel and sand. Last collected from Muscle Shoals circa 1925. Presumed extirpated from Alabama.
Pleurobema curtum (black clubshell)	E	--	It	Sandy gravel to gravel-cobble substrates in riffles and shoals with moderate to fast currents in medium to large rivers. Current range limited to the East Fork Tombigbee River. Possibly extinct.
Pleurobema decisum (southern clubshell)	E	--	It	Sand and gravel substrates of medium to large rivers. Very few viable populations occur in the Sipsey River (Tombigbee River drainage), Chewacla Creek (Tallapoosa River drainage), and the Conasauga River (upper Coosa River drainage); all three waterbodies located well outside the BFN project area. It does not occur in the Tennessee River drainage.
Pleurobema perovatum (ovate clubshell)	E	--	It	Moderate gradient pools and riffles of medium to large rivers. Currently found in Tombigbee River tributaries and Chewacla Creek in the Tallapoosa River drainage. It does not occur in the Tennessee River drainage.
Pleurobema taitianum (heavy pigtoe)	E	--	It	Riffles and shoals on sandy gravel to gravel-cobble substrates in areas of moderate to fast currents of medium to large rivers. Not known from the Tennessee River drainage. Currently only found in the Alabama River in Dallas and Lowndes Counties, Alabama.

Table 3. (contd)

Scientific Name (Common Name)	Status[b]	County Listings[a] AL	MS	Notes
Ptychobranchus subtentum (fluted kidneyshell)	C	Li	--	Small to medium rivers in areas with swift current or riffles; larger rivers in shoal areas. Last collected from Muscle Shoals circa 1925. Presumed extirpated from Alabama.
Quadrula intermedia (Cumberland monkeyface)	E	Co Li	--	Sand and gravel substrates in shallow riffle and shoal areas of headwater streams to bigger rivers at depths to 0.6 m (2 ft). Last collected from Muscle Shoals circa 1925. Possibly extirpated from Alabama.
Toxolasma cylindrellus (pale lilliput)	E	Co	--	Firm rubble, gravel, and sand substrates in shallow riffles and shoals of clean, fast-flowing streams. Currently known only from the Paint Rock River drainage in Jackson County, Alabama, well upstream from the BFN project area.
Villosa trabalis (Cumberland bean)	E	Mo	--	Sand, gravel, and cobble substrates in waters of moderate to swift currents and depths less than 1m (3 ft) in medium to large rivers. Last collected from Muscle Shoals circa 1925. Presumed extirpated from Alabama.
		Shrimp		
Palaemonias alabamae (Alabama cave shrimp)	E	Co	--	Silt-bottom pools in caves. Currently known to occur in two caves in Madison County, Alabama. No BFN transmission lines occur near these caves.
		Fishes		
Cyprinella monacha (spotfin chub)	E	Co	--	Rocky riffles and runs of clean small to medium riffles. Currently only known to exist in Tennessee and North Carolina. It is possibly extirpated from Alabama.
Etheostoma wapiti (boulder darter)	E	Li	--	Fast, rocky riffles of small to medium rivers. Presently restricted to the Elk River in Tennessee and Alabama, and Richland and Indian Creeks in Giles County, Tennessee. No BFN transmission lines cross these waterbodies.

(a) Co = Colbert; Fr = Franklin; It = Itawamba; La = Lawrence; Li = Limestone; Mo = Morgan. Ti = Tishomingo; -- = not listed.
(b) Status: C = candidate, E = endangered, T = threatened.
(c) Muscle Shoals is the area now incorporated within the upper reach of Pickwick Reservoir, through Wilson Reservoir, and into Wheeler Reservoir.

Sources: ADCNR 2003; Ahlstedt and McDonough 1992; Cummings and Mayer 1992; FWS 1976, 1977a, b, 1987b, 1988a, b, 1989a, b, 1990a, b, c, 1993a,b, 1997a, 2000b, 2004c; Garner 1997; Johnson and Wehrle 2004; MMNS 2002; MNHP 2002; NatureServe 2004; NCWRC 2004; Page and Burr 1991; Rogers et al. 2001; TVA 2003, 2004a.

6.0 Conclusions

The staff identified nine terrestrial and nine aquatic species listed as threatened, endangered, or candidate under the Endangered Species Act that have a reasonable potential to occur in the vicinity of BFN or along the transmission line rights-of-way (including Wheeler Reservoir near and downstream of BFN and within streams crossed by the BFN transmission lines). Two terrestrial species were evaluated and determined that they would not occur in the project area. In addition, 29 aquatic species listed by FWS were identified by the staff as having no reasonable potential to occur in the project areas and were not evaluated in detail.

None of the terrestrial or aquatic species are known to inhabit areas within 4.8 km (3.0 mi) of BFN. The transmission line rights-of-way may cross or contain suitable habitat for some of these species, including designated critical habitat for the Cumberlandian combshell. Given this possibility, TVA has designed and implemented maintenance procedures for its transmission line rights-of-way that protect listed species and their habitats.

The staff determined that license renewal for BFN would have no effect on the red-cockaded woodpecker, the American hart's tongue fern, and 29 of the aquatic species. License renewal may affect, but is not likely to adversely affect, the bald eagle, gray bat, Indiana bat, Price's potato bean, leafy prairie clover, Eggert's sunflower, fleshy-fruited gladecress, lyrate bladder pod, Tennessee yellow-eyed grass, Anthony's riversnail, slender campeloma, armored snail, spectaclecase, Cumberlandian combshell, pink mucket, slabside pearlymussel, rough pigtoe, and the slackwater darter.

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IN REPLY REFER TO:
04-0760b

December 1, 2004

Mr. Pao-Tsin Kuo, Program Director
License Renewal and Environmental Impacts
Division of Regulatory Improvement Programs
Office of Nuclear Reactor Regulation
United States Nuclear Regulatory Commission
Washington, D.C. 20555-0001

Dear Mr. Kuo:

Thank you for your letter of October 25, 2004, providing the biological assessment for the review of re-licensing for an additional 20 year period of the Browns Ferry Nuclear Plant (BFN) Units 1, 2, and 3 (BFN), located in Limestone County, Alabama, on the north bank of the Tennessee River. The Service has also received the Generic Environmental Impact Statement for License Renewal of Nuclear Plants regarding Browns Ferry Nuclear Plant, Units 1,2,and 3. We are providing the following comments in accordance with the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. et seq.) and the Endangered Species Act of 1973 (87 Stat. 884, as amended; 16 U.S.C. 1531 et seq.).

We have prepared this letter to acknowledge we have received your BA and the Draft Supplemental Environmental Impact Statement (SEIS) prepared for this project. As soon as our ongoing review of both documents and discussions with colleagues is completed, we will provide our final comments, as well as make a determination about whether formal consultation under section 7 of the Endangered Species Act will be necessary.

On December 1, 2004, Mr. Rob Hurt, Daphne FO biologist, contacted Dr. Michael Masnik, of your office, via the telephone, to discuss the status of our review of this project. Dr. Masnik informed Mr. Hurt of the public meeting scheduled at Athens State University in Athens, Alabama on January 25, 2005 and requested his attendance at one of the two sessions planned that day. Dr. Masnik also offered to meet with Mr. Hurt and other Service staff on January 26, 2005 to further discuss details of the project if needed.

We appreciate the opportunity to review the BFN re-license proposal and to work with your agency on this project. If you have any questions or need additional information, please contact Mr. Rob Hurt at (256) 353-7243 ext. 29. In correspondence, please refer to the reference number above.

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Sincerely,

Larry E. Goldman
Field Supervisor

cc: Mr. Chuck Wilson, TVA-Nuclear, Chattanooga, TN
Ms. Peggy Shute, TVA, Knoxville, TN
Dr. Michael Masnik, US NRC, Washington, D.C.

Appendix F

GEIS Environmental Issues Not Applicable to Browns Ferry Nuclear Power Plant, Units 1, 2, and 3

Appendix F

GEIS Environmental Issues Not Applicable to Browns Ferry Nuclear Power Plant, Units 1, 2, and 3

Table F-1 lists those environmental issues listed in the *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (GEIS) (NRC 1996; 1999)[(a)] and Title 10 of the Code of Federal Regulations (CFR) Part 51, Subpart A, Appendix B, Table B-1, that are not applicable to Browns Ferry Nuclear Plant, Units 1, 2, and 3 (BFN) because of plant or site characteristics.

Table F-1. GEIS Environmental Issues Not Applicable to Browns Ferry Nuclear Power Plant, Units 1, 2, and 3

ISSUE—10 CFR Part 51, Subpart A, Appendix B, Table B-1	Category	GEIS Sections	Comment
SURFACE WATER QUALITY, HYDROLOGY, AND USE (FOR ALL PLANTS)			
Altered salinity gradients	1	4.2.1.2.2 4.4.2.2	The BFN cooling system does not discharge to an estuary.
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 used at BFN.
Impingement of fish and shellfish	1	4.3.3	This issue is related to heat-dissipation systems that are not used at BFN.
Heat shock	1	4.3.3	This issue is related to heat-dissipation systems that are not used at BFN.

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

Table F-1. (contd)

ISSUE—10 CFR Part 51, Subpart A, Appendix B, Table B-1	Category	GEIS Sections	Comment
GROUNDWATER USE AND QUALITY			
Groundwater-use conflicts (potable and service water, and dewatering; plants that use >100 gpm)	2	4.8.1.1 4.8.2.1	BFN does not use groundwater.
Groundwater-use conflicts (Ranney wells)	2	4.8.1.4	BFN does not have or use Ranney wells.
Groundwater quality degradation (Ranney wells)	1	4.8.2.2	BFN does not have or use Ranney wells.
Groundwater quality degradation (saltwater intrusion)	1	4.8.2.1	BFN does not currently use groundwater and is not near a saltwater body.
Groundwater quality degradation (cooling ponds in salt marshes)	1	4.8.3	This issue is related to a heat-dissipation system that is not installed at BFN.
Groundwater quality degradation (cooling ponds at inland sites)	2	4.8.3	This issue is related to a heat-dissipation system that is not installed at BFN.
TERRESTRIAL RESOURCES			
Cooling pond impacts on terrestrial resources	1	4.4.4	This issue is related to a heat-dissipation system that is not installed at BFN.

F.1 References

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

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

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

Appendix G

NRC Staff Evaluation of Severe Accident Mitigation Alternatives (SAMAs) for Browns Ferry Nuclear Plant, Units 1, 2, and 3 in Support of the License Renewal Application Review

Appendix G

NRC Staff Evaluation of Severe Accident Mitigation Alternatives (SAMAs) for Browns Ferry Nuclear Plant, Units 1, 2, and 3 in Support of the License Renewal Application Review

G.1 Introduction

Tennessee Valley Authority (TVA) submitted an assessment of SAMAs for Browns Ferry Nuclear Plant (BFN) Units 1, 2, and 3 as part of the Environmental Report (ER) (TVA 2003). This assessment considers all three Browns Ferry units, each operating at 120 percent of its original licensed power level. Ideally, this assessment would take advantage of a plant-specific Probabilistic Safety Assessment (PSA) that considers operation of all three units at 120 percent of their original licensed power. However, such a PSA is not currently available. Because of the progressive screening nature of the SAMA evaluation, TVA relied on the available PSA information, along with engineering knowledge of the plant, to form a basis for the three-unit SAMA assessment. This assessment was based on the most recent PSA for Unit 2 and Unit 3 available at that time, insights from a Multiple-Unit PSA performed in 1995 to bound the effects of three-unit operation, a plant-specific offsite consequence analysis performed using the MELCOR Accident Consequence Code System 2 (MACCS2) computer program, and insights from the Browns Ferry individual plant examination of external events (IPEEE) (TVA 1995a, 1996, 1997). In identifying and evaluating potential SAMAs, TVA considered SAMA candidates that addressed the major contributors to core damage frequency (CDF) and large early release frequency (LERF), as well as generic SAMAs considered in analyses performed for other operating plants that have submitted license renewal applications. TVA identified 135 potential SAMA candidates. This list was reduced to 43 unique SAMA candidates by eliminating SAMAs that were not applicable to BFN because of design differences, SAMAs that had already been implemented, SAMAs that were similar in nature and could be combined with another SAMA, or those that cost more than $6 million to implement. TVA assessed the costs and benefits associated with each of the remaining SAMAs and concluded in the ER that none of the candidate SAMAs evaluated would be cost-beneficial for BFN.

Based on a review of the SAMA assessment, the U.S. Nuclear Regulatory Commission (NRC) issued a request for additional information (RAI) to TVA by letter dated April 28, 2004 (NRC 2004). Key questions concerned the mapping of key plant damage states to release categories, reasons for the relatively large reduction in CDF since the individual plant examination (IPE), dominant risk contributors at BFN and the SAMAs that address these contributors, the rationale for increasing the Units 2 and 3 CDFs to account for Unit 1 operation; the sequence-specific impact of Unit 1 operation on the candidate SAMAs, consideration of the potential impact of external events, and details on certain SAMAs. TVA submitted additional information by letter dated July 7, 2004 (TVA 2004a) including summaries of peer review comments and their impact on the SAMA analysis, a description of the various changes to the PSA model since the IPE, an explanation of how key plant damage states were mapped to release categories, a cross reference of the major contributors to CDF to candidate SAMAs, and discussions of the impact of the operation of Unit 1 and the impact of external events. TVA's responses addressed the staff's concerns.

Based on its review, the staff concluded that the contribution to risk from fire events would be higher than assumed in TVA's SAMA analysis. The staff adjusted TVA's risk reduction estimates to account for the contribution to risk (and risk reduction) from fire events, and found that none of the candidate SAMAs would be cost-beneficial.

An assessment of SAMAs for BFN is presented below.

G.2 Estimate of Risk for BFN

TVA's estimates of offsite risk at BFN are summarized in Section G.2.1. The summary is followed by the staff's review of TVA's risk estimates in Section G.2.2.

G.2.1 TVA's Risk Estimates

Two distinct analyses are combined to form the basis for the risk estimates used in the SAMA analysis: (1) the BFN PSA Unit 2 and Unit 3 models, and (2) a supplemental analysis of offsite 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 PSA models available at the time of the ER, referred to as the Extended Power Uprate (EPU) PSA for Unit 2 and the EPU PSA for Unit 3. (A PSA for Unit 1 was not available at the time of the SAMA analysis.) The PSAs include a Level 1 analysis to determine the CDF from internally initiated events and a Level 2 analysis to assess containment performance during severe accidents. The scope of the BFN PSAs does not include external events.

The baseline CDFs for the purpose of the SAMA evaluation are approximately 2.6 x 10^{-6}/yr for Unit 2 and 3.4 x 10^{-6}/yr for Unit 3. The CDFs are based on the risk assessment for internally initiated events at EPU conditions (i.e., 120 percent of original licensed power level). TVA did not include the contribution to risk from external events within the BFN risk estimates. 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, transients and loss of offsite power-initiated events are dominant contributors to the CDF.

Table G-1. BFN Core Damage Frequency

Initiating Event or Accident Class	Unit 2 CDF (Per Year)	Unit 2 % Contribution to CDF	Unit 3 CDF (Per Year)	Unit 3 % Contribution to CDF
Transients	1.6×10^{-6}	63	1.8×10^{-6}	52
Loss of offsite power (LOOP)	4.8×10^{-7}	19	1.1×10^{-6}	32
Support system failures	2.2×10^{-7}	8	2.3×10^{-7}	7
Internal flooding	1.0×10^{-7}	4	1.6×10^{-7}	5
Loss of coolant accidents (LOCAs)	5.3×10^{-8}	2	5.4×10^{-8}	2
Stuck open relief valves	4.7×10^{-8}	2	5.8×10^{-8}	2
Interfacing system LOCA (ISLOCA)	4.6×10^{-8}	2	4.6×10^{-8}	1
Total CDF (from internal events)	2.6×10^{-6}	100	3.4×10^{-6}	100

Bypass events (i.e., ISLOCA) contribute 2 percent or less to the total internal events CDF. Anticipated transients without scram (ATWS) events and station blackout (SBO) events are not specifically identified in the internal events CDF breakdown. In response to an RAI, TVA stated that the ATWS CDF is estimated to be 2.3 x 10-7/yr for each unit, and the SBO CDF is 3.7×10^{-8}/yr for Unit 2 and 3.9×10^{-8}/yr for Unit 3 (TVA 2004a). SAMAs to address ATWS and SBO events were considered in the SAMA evaluation.

The Level 2 analysis used the plant damage state (PDS) assignment rules developed for the BFN IPE to assign each of the Level 1 accident sequences that lead to core damage to a PDS in the PDS matrix from the BFN IPE. The assignment rules consider the status of containment (intact, bypassed, not isolated/failing early, or failing late), the status of key plant systems (drywell sprays, suppression pool cooling, torus vent, and reactor protection system) and other conditions (vessel pressure and water on drywell floor) at the time of core damage in assigning each sequence to one of 37 possible PDSs. These PDSs are then condensed into a reduced set of eight key plant damage states (KPDSs). TVA states that this mapping is done conservatively on the basis of phenomenological parameters except in a few cases for which PDSs with very low relative frequencies are mapped to nonconservative KPDSs. TVA states that the overall result is a conservative estimate of risk.

Each of these KPDSs was then mapped directly to a single release category for which the release fractions and other parameters were determined by Modular Accident Analysis Program (MAAP) analyses of representative sequences. This mapping of KPDSs to release categories on a one-to-one basis was done conservatively to simplify the analysis. For example, the fraction of the KPDS that includes the dominant CDF sequences not be expected to lead to containment failure are all assumed to lead to early containment failure for the purpose of determining the fission product release fractions. This approach leads to sequences, which would normally be categorized as having no containment failure, that dominate the offsite risk.

The offsite consequences and economic impact analyses use the MACCS2 code to determine the offsite risk impacts on the surrounding environment and public. Inputs for this analysis include plant-specific and site-specific input values for core radionuclide inventory, source term and release characteristics, site meteorological data, projected population distribution (within an 80-km [50-mi] radius) for the year 2036, emergency response evacuation modeling, and economic data.

In its ER, TVA estimated the dose to the population within an 80-km (50-mi) radius of the BFN site to be approximately 0.0164 person-Sv (1.64 person-rem)/yr for Unit 2, and approximately 0.0195 person-Sv (1.95 person-rem)/yr for Unit 3. The breakdown of the total population dose by containment release mode is summarized in Table G-2. The apparent conclusion that population dose is dominated by events involving no containment failure results from the aforementioned assumption. Except for this, early containment failure resulting from ATWS events dominates the population dose risk.

Table G-2. Breakdown of Population Dose by Containment Release Mode for BFN

	Unit 2		Unit 3	
Containment Release Mode	**Population Dose (Person-rem[1] Per Year)**	**% Contribution**	**Population Dose (Person-rem[a] Per Year)**	**% Contribution**
Early containment failure or Containment isolation failure	0.636	39	0.706	36
Bypass	0.009	<1	0.009	<1
Late containment failure	0.111	7	0.156	8
No containment failure[b]	0.882	54	1.072	55
Total Population Dose	**1.64**	**100**	**1.95**	**100**

(a) One person-rem = 0.01 person-Sv
(b) Release mode is dominated by KPDSs that are assigned to release categories for which containment is assumed to fail.

The CDF described about and the population dose risk for BFN Units 2 and 3 are based on the assumption that Unit 1 is in extended lay-up and not operating. The proposed operation of Unit 1 would increase the CDF and risk for Units 2 and 3 because of the decreased availability of equipment shared between units, including diesel generators, the residual heat removal (RHR) service water system, and the emergency cooling water system. The estimation of the CDF for Unit 1, and the impact of Unit 1 operation on the CDF for Units 2 and 3 are accounted for in the SAMA analysis by applying a multiplier to the estimated SAMA benefits for Units 2 and 3. This analysis is discussed further in Section G.6.

G.2.2 Review of TVA's Risk Estimates

TVA's determination of offsite risk at BFN is based on the following major elements:

- the Level 1 and 2 risk models that form the bases for the IPE for Unit 2 (TVA 1992)
- the major modifications to the IPE models that have been incorporated in the BFN Unit 2 and Unit 3 PSAs
- the MACCS2 analyses performed to translate fission product source terms and release frequencies from the Level 2 PSA models into offsite consequence measures.

Each of these elements was reviewed to determine the acceptability of TVA's risk estimates for the SAMA analysis, as summarized below.

The staff's review of the BFN Unit 2 IPE is described in an NRC report dated September 28, 1994 (NRC 1994). In that review, the staff evaluated the methodology, models, data, and assumptions used to estimate the CDF and characterize containment performance and fission product releases. The staff concluded that TVA's analysis met the intent of Generic Letter 88-20 (NRC 1988a), with the exception of TVA's response to two parts of the containment performance improvement (CPI) program recommendations. Although the staff reviewed certain aspects of the IPE in more detail than others, it primarily focused on the licensee's ability to examine BFN Unit 2 for severe accident vulnerabilities and not specifically on the detailed findings or quantification estimates. Overall, the staff believed that TVA demonstrated an overall appreciation of severe accidents and had an understanding of the most likely severe accident sequences that could occur at BFN Unit 2.

There have been several revisions to the BFN PSA since the IPE was submitted. A comparison of internal events risk profiles between the IPE and the PSA used in the SAMA analysis indicates a decrease of almost 95 percent in the total CDF for Unit 2 (from 4.8 x 10-5/yr to 2.6×10^{-6}/yr). The reduction is attributed to plant and modeling improvements that have been implemented at BFN since the IPE was submitted. A summary listing of those changes that resulted in the greatest impact on the total CDF was provided in the ER and in response to RAIs (TVA 2003, 2004a, 2004b), and are provided in Table G-3. As noted in this table, model changes to address the two CPI issues identified in the staff's Safety Evaluation Report (SER) for the IPE were also incorporated in the updated PRA.

Table G-3. Level 1 PSA Summary

Level 1 PSA Version	Unit Operating Status	Summary of Changes from Prior Version	Mean CDF (per year)
Unit 2 IPE Rev. 0 1992 (TVA 1992)	Unit 2 operating, Units 1 and 3 in lay-up	Original IPE submittal, addressed only single unit operation	4.8×10^{-5} (Unit 2)
Unit 2 IPE Rev. 1A 1995 (TVA 1995c)	Unit 2 operating, Units 1 and 3 in lay-up	- Used plant-specific diesel generator failure rates - Credited powering of the Unit 2 4 KV shutdown boards - Used the electric power recovery curves from NUREG/CR-5032 (NRC 1988b)	7.6×10^{-6} (Unit 2)
Multiple-unit PSA 1995 (TVA 1995b)	All units operating	- Modeled multiple-unit initiators (e.g., loss of offsite power) - Changed success criteria for shared systems (e.g., residual heat removal service water) - Addressed and closed out the two containment performance improvement program (CPI) open items from the Unit 2 IPE SER	2.8×10^{-5} (Unit 2)
Unit 2 PSA with Unit 3 operating May 1996 (NRC 1997b)	Units 2 and 3 operating, Unit 1 in lay-up	- Refined the model for floods in the turbine building	5.4×10^{-6} (Unit 2)
Unit 3 PSA with Unit 2 operating June 1996 (NRC 1997b)	Units 2 and 3 operating, Unit 1 in lay-up	- Responded to staff request for a Unit 3 PSA	9.2×10^{-6} (Unit 3)
PSA Rev. 0 2002	Units 2 and 3 operating, Unit 1 in lay-up	- Used revised transient initiating event frequencies from NUREG/CR-5750 (NRC 1999) - Used updated plant-specific component failure rates, and - Used revised common cause failure parameters - Reevaluated human error probability - Resolved BWROG certification facts and observations	1.3×10^{-6} (Unit 2) 1.9×10^{-6} (Unit 3)

Table G3. (contd)

Level 1 PSA Version	Unit Operating Status	Summary of Changes from Prior Version	Mean CDF (per year)
EPU PSA 2004 (TVA 2004b)	Units 2 and 3 operating at uprated (120 percent) conditions , Unit 1 in lay-up	- Eliminated credit for the control rod drive (CRD) system alone as makeup to the reactor pressure vessel at high pressure	2.6×10^{-6} (Unit 2) 3.4×10^{-6} (Unit 3)
PSA Rev. 2 August 2004 (TVA 2004b)	Unit 1 at uprated (120 percent) conditions, with Units 2 and 3 in service at uprated conditions	- Incorporated all applicable design changes planned for implementation up to Unit 1 restart	1.86×10^{-6} (Unit 1)

At the time the SAMA analysis was performed, TVA did not have a completed PSA model for Unit 1. TVA completed the PSA model for Unit 1 in August 2004, and subsequently provided a summary report to the staff describing the Unit 1 PSA results (TVA 2004b). The initial conditions of the Unit 1 PSA model are based on Unit 1 operating at EPU power with Units 2 and 3 in service at EPU operating conditions. The CDF for Unit 1 is 1.86×10^{-6}/yr. This compares to the CDF ascribed to Unit 1 in the SAMA analysis of approximately 1×10^{-5}/yr. The breakdown of the Unit 1 CDF by initiating event is similar to that shown in Table G-1 for Units 2 and 3.

The results of the recently completed Unit 1 PSA suggest that the use of the multipliers to estimate the impacts of multiple-unit operation in the SAMA analysis is conservative. These results indicate than either multiple-unit operation reduces the CDF for Units 1 and 2 (rather than increase the CDF, as assumed in the SAMA analysis), or that the CDF for Unit 1 is noticeably lower than that for Unit 2. The staff has not reviewed the details of the Unit 1 PSA, and cannot validate the stated values. However, even if the Unit 1 CDF is substantially greater than the value estimated in the Unit 1 PSA, it would likely be bounded by the benefits assumed in the SAMA analysis (which were based on applying a multiplier of four to the benefit estimates for Unit 2 CDF, as discussed in Section G.6).

The CDF value for BFN is comparable to the CDF values reported in the IPEs for other boiling water reactor (BWR) facilities. Figure 11.2 of NUREG-1560 shows that the IPE-based total internal events CDF for BWR 3/4 plants ranges from 1×10^{-6} to 8×10^{-5} /yr (NRC 1997a). It is recognized that other plants have reduced the values for CDF subsequent to the IPE submittals because of modeling and hardware changes. The current internal events CDF results for BFN remain comparable to other plants of similar vintage and characteristics.

The staff considered the peer reviews performed for the BFN PSA, and the potential impact of the review findings on the SAMA evaluation. In 1997, the Unit 2 PSA (with Unit 3 operating) was reviewed by the Boiling Water Reactor Owners Group (BWROG) Peer Review Team. The results of the review are summarized in response to an RAI (TVA 2004a). The following areas were deemed sufficiently important to require enhancement in the model:

- use of plant-specific data for system unavailabilities
- incorporation of common cause miscalibration of low pressure interlock
- additional containment features (e.g., external ring header) and loading issues (e.g., high blowdown)
- reassessment of the truncation value used quantification process
- incorporation of containment flood and reactor pressure vessel vent into the Level 2, along with a definition of LERF consistent with the PSA Application Guide.

According to TVA, the areas noted above have all been resolved in the PSA model used for the SAMA analysis (TVA 2004a).

Improvements were needed in three additional PSA elements. These elements were in the areas of thermal hydraulic analysis, data analysis, and containment performance analysis. The Peer Review Team recommended that five specific model enhancements be implemented to address these three elements. A subsequent self assessment by TVA concluded that the facts and observations associated with the three elements have been resolved.

Given that the BFN PSA has been peer reviewed and the recommended enhancements to resolve known issues have been incorporated, that TVA satisfactorily addressed staff questions regarding the PSA (TVA 2004a, b), that the PSA reflects the current designs of the units and the planned EPU condition, and that the CDF is in the range of contemporary CDFs for similar BWR plants, the staff concludes that the Level 1 PSA model is of sufficient quality to represent the risk from the plant given the operational configuration assumed for the PSAs (i.e., Units 2 and 3 operating and Unit 1 in a defueled lay-up condition).

TVA submitted an IPEEE by letters dated July 24, 1995 (TVA 1995a), June 28, 1996 (TVA 1996), and July 11, 1997 (TVA 1997). TVA did not identify any fundamental weaknesses or vulnerabilities to severe accident risk in regard to the external events related to fire, high winds, floods, and other external events. However, a number of areas were identified for improvement in both the seismic and fire areas. In a letter dated June 22, 2000 (NRC 2000), the staff concluded that the submittal met the intent of Supplement 4 to Generic Letter 88-20, and that the licensee's IPEEE process is capable of identifying the most likely severe accidents and severe accident vulnerabilities.

The IPEEE uses a focused scope Electric Power Research Institute (EPRI) seismic margins analysis. This method is qualitative and does not provide numerical estimates of the CDF contributions from seismic initiators. TVA found that based on the EPRI assessment methodology, all of the high confidence low probability of failure (HCLPF) values were at least equal to the 0.3g review level earthquake used in the IPEEE except for two 4-kV/480-V transformers located in the Units 1 and 2 diesel generator building. These transformers were to be replaced as part of TVA's long-term polychlorinated biphenyls and asbestos removal program. In response to an RAI, TVA indicated that these transformers are still scheduled to be removed. Specific HCLPF values for other structures or components are not provided in the IPEEE; however, TVA stated that there are no other structures or components with HCLPF values less than the review level earthquake acceleration of 0.3g.

In a subsequent submittal by TVA for another risk-informed application (TVA 2004c), TVA used a published simplified methodology to estimate the seismic CDF as 2.5 x 10^{-6}/yr. This is based on the assumption that the plant HCLPF is equal to that for the two transformers mentioned above (0.26g).

The staff considered the impact of seismic events on the SAMA analysis from two aspects. First, would any seismic-specific SAMA be expected to be cost-beneficial, and second, would the benefit of non-seismic SAMAs be increased significantly because of their impact on seismic sequences. For the first situation, using the simplified methodology used by TVA (TVA 2004c), an increase in plant HCLPF value from 0.3g (assuming the previously limiting transformers have been removed) to 0.35g reduces the seismic CDF by approximately 0.7 x 10^{-6}/yr or approximately 30 percent of the Unit 2 CDF resulting from internal events. From information provided in the ER (Table IV-8), this would correspond to an averted cost-benefit in the range of \$20,000 to \$80,000, depending on the discount rate used. Increases in the seismic capacity of the plant would involve modifications and reanalysis of multiple components because it is expected that there are numerous components whose current HCLPF values are in the 0.3g to 0.35g range. The costs associated with the modifications and analyses would be well in excess of the estimated benefits, even when the impacts of alternative seismic hazard curves (i.e., the Lawrence Livermore National Laboratory [LLNL] curves rather than the EPRI curves), multiple-unit operation, and analysis uncertainties are considered. Based on this, the staff concludes that it is unlikely that any cost-effective seismic SAMAs would be found.

For the second situation, the additional benefit of internal-event SAMAs caused by their impact on seismic-initiated sequences are most likely realized in relatively low-g seismic events that are of sufficient magnitude to result in either non-recoverable LOOP events or other more ordinary transient events similar to those evaluated in the internal-events PSA. Plant power generation interruptions caused by seismic events might start to occur in the peak ground acceleration range of 0.15g to 0.2g (BFN has an operating basis earthquake of 0.1g). The exceedance frequency for these magnitude earthquakes is approximately 5 x 10^{-5}/yr. For a seismic LOOP event, the CDF can be estimated using this frequency and the conditional core damage probability for a non-recoverable SBO. This is estimated to be on the order of 1×10^{-3}, giving a CDF of 5×10^{-8}/yr. This is small compared to the internal-events CDFs for BFN of 3×10^{-6}/yr. While the seismic SBO CDF estimated above is the same order of magnitude as the internal-events SBO CDF, the frequencies are so low that a cost-beneficial SBO related SAMA would not be expected. This conclusion is supported by the analysis of SAMA B04, "add dedicated blackout diesel generator," which indicates that this would not be cost effective even if the benefit is doubled because of the benefit from seismic events. For non-SBO sequences, the seismic transient initiating event frequency estimated above of 5×10^{-5}/yr is several orders of magnitude lower than the internal initiating event frequencies; therefore, the added benefit because of seismic sequences for the non-SBO SAMA is expected to be small.

Based on the above assessment, the staff concludes that the opportunity for seismic-related SAMAs has been adequately explored and that there are no cost-beneficial, seismic-related SAMA candidates.

The BFN fire analysis employed the fire-induced vulnerability evaluation (FIVE) methodology for screening of compartments. The licensee's overall approach in the IPEEE fire analysis is similar to other fire analysis techniques, employing a graduated focus on the most important fire zones using qualitative and quantitative screening criteria. The fire zones or compartments were subjected to at least two screening phases. In the first phase, a compartment was screened out if it was found to not contain any safety-related equipment or reactor trip initiators. In the second phase, a CDF criterion of 1×10^{-6}/yr was applied. The licensee used the PSA model (TVA 1994) of internal events to quantify the CDF resulting from a fire-initiating event. The conditional core damage probability (CCDP) was based on the equipment and systems unaffected by the fire. The CDF for each zone was obtained by multiplying the frequency of a fire in a given fire zone by the conditional core damage probability associated with that fire zone. The screening methodology applied by the licensee makes fewer and fewer conservative assumptions (e.g., equipment that may survive the fires in the area) until a fire zone is screened out. The fire CDF (based on a summation of the fire zone CDFs) was estimated in the staff's Safety Evaluation Report (SER) to be less than 1.24×10^{-5}/yr for Unit 2 and 7.5×10^{-6}/yr for Unit 3, which are about factors of five and two higher than the internal events CDF used in the SAMA analysis, respectively. The fire zones that contributed more than 1×10^{-6}/yr are:

- 1.1×10^{-6} for Unit 2, Zone 2 - 5 621 ft and North 639 ft
- 5.6×10^{-6} for Units 1 and 2, Control Room
- 3.0×10^{-6} for Unit 3, Control Room

In light of these values, the staff asked TVA to assess the impact on the initial and final screenings if the internal events risk reduction estimates were increased by a factor that would bound the risk from fire and seismic events (NRC 2004). In response to the NRC RAI, TVA stated that such an assessment is inappropriate because it contains an implicit assumption that the systems, structures, and components important to the risk from internal events have equivalent importance to the risk from fire and seismic events (TVA 2004a). Additionally, TVA stated that the CDF values in NUREG-1742 (NRC 2002) (used by the staff to estimate the ratio of external to internal events risk) should be considered as upper bound values only, and that the mean CDF resulting from fire-related initiating events in each of the fire areas is judged to be considerably lower than these values (TVA 2004a).

The staff agrees that the BFN fire analysis contains numerous conservatisms and that a more realistic assessment could result in a substantially lower fire CDF. Based on evaluations of past ERs submitted in support of license renewal applications, the staff believes that a more realistic fire CDF is likely to be a factor of two to three less than the screening values used in the FIVE methodology. Given a factor of three reduction, the resulting fire CDF would be comparable to the internal events CDF used in the SAMA analysis. This would justify use of a multiplier of two to the averted cost estimates (for internal events) to represent the additional SAMA benefits in external events. The staff's review is described in Section G.6.2.

The BFN IPEEE evaluated high winds, floods, and other events (transportation and nearby facility accidents) using the progressive screening approach recommended in NUREG-1407 (NRC 1991). Based on this evaluation, the licensee determined that the risk from high winds, floods, and other events were not significant vulnerabilities at the plant.

The staff reviewed the process used by TVA to extend the containment performance (Level 2) portion of the PSA to an assessment of offsite consequences (essentially a Level 3 PSA). This included consideration of the source terms used to characterize fission product releases for the applicable containment release category and the major input assumptions used in the offsite consequence analyses. The MACCS2 code was used to estimate offsite consequences. Plant-specific input to the code includes the BFN reactor core radionuclide inventory, source terms for each release category, site-specific meteorological data, projected population distribution within an 80-km (50-mile) radius for the year 2036, and emergency evacuation modeling. This information is provided in Attachment E to the ER (TVA 2003).

The reactor core inventory input to the MACCS2 code was developed for an average bundle thermal power level of 5.28 MW(t), which is representative of EPU conditions. Three fission product inventories were used: (1) General Electric Uprated, Framatome Commercial, and Framatome Blended low-enriched uranium. The fission product inventory for each radionuclide group is provided in Table II-3 of Attachment E to the ER (TVA 2003).

TVA grouped the key plant damage states into a set of eight release categories based on their expected source term results. The release fractions for each of the release categories are reported in Table II-4 of Attachment E to the ER (TVA 2003). The staff concludes that the process used to assign release categories and source terms is consistent with typical PSA practices and is acceptable for use in the SAMA analysis.

TVA used site-specific meteorological data obtained from the plant meteorological tower, processed from hourly measurements for the calendar year 1980. In response to an RAI, TVA stated that the 1980 data is representative, although precipitation in 1980 was slightly higher than average. TVA further stated that use of more recent data would not yield a more accurate prediction of weather for the term of license renewal (TVA 2004a).

The population distribution TVA used as input to the MACCS2 analysis is given in Tables II-1 and II-2 of Attachment E to the ER (TVA 2003). The population distribution is based on the U.S. Census Bureau data from 1990 and 2000. The data were linearly extrapolated to 2036. Sectors with a negative growth rate were estimated to have the same population as in the year 2000 (TVA 2004b). The staff considers the methods and assumptions for estimating population reasonable and acceptable for purposes of the SAMA evaluation.

The emergency evacuation model was modeled as a single evacuation zone extending 16 km (10 mi) from the plant. It was assumed that 95 percent of the population evacuates radially at an average speed of 0.234 m/s beginning 120 minutes after the alarm (TVA 2004a). 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.

Economic data were specified for the area surrounding the plant to a distance of 80 km (50 miles). The agricultural economic data were obtained from *Statistical Abstracts of the United States, 1998* (TVA 2004b). The values obtained from the reference document were inflated to the year 2016 using both 7-percent and 3-percent discount factors.
The staff concludes that the methodology used by TVA to estimate the offsite consequences for BFN provides an acceptable basis from which to proceed with an assessment of risk reduction potential for candidate SAMAs. Accordingly, the staff based its assessment of offsite risk on the CDF and offsite doses reported by TVA.

G.3 Potential Plant Improvements

The process for identifying potential plant improvements, an evaluation of that process, and the improvements evaluated in detail by TVA are discussed in this section.

G.3.1 Process for Identifying Potential Plant Improvements

TVA's process for identifying potential plant improvements (SAMAs) consisted of the following elements:

- review of the major contributors to CDF and LERF for Units 2 and 3 in the current for BFN PSA

- review of other NRC and industry documentation discussing potential plant improvements (e.g., NUREG-1560)
- review of generic SAMAs from past submittals in support of original licensing and license renewal activities for other operating nuclear power plants.

Based on this process, an initial set of 135 candidate SAMAs was identified, as reported in the ER. Of these SAMAs, 20 are specific to BFN, and 115 are generic SAMAs from past submittals. All BFN-specific SAMAs were assumed to pass the Phase 1 screening and were explicitly evaluated in Phase 2. For the 115 generic SAMAs, TVA performed a qualitative screening and eliminated SAMAs from further consideration using the following criteria:

- the SAMA is not applicable at BFN or for a BWR 4/Mark I design because of design differences
- the SAMA had already been implemented at BFN
- the SAMA is similar in nature to and could be combined with another SAMA
- the SAMA costs more than $6 million to implement (the maximum avoided cost for completely eliminating severe accidents, including the effects of multiple-unit operation and uncertainties).

Based on this screening, 92 SAMAs were eliminated. Of the 92 SAMAs eliminated, 45 were eliminated because they were not applicable to BFN, 19 were eliminated because they already had been implemented at BFN, 15 were similar to and combined with other SAMAs, 11 exceeded $6 million in cost, and two were eliminated for other reasons (TVA 2003). A benefit analysis was performed for each of the 43 remaining SAMA candidates.
The 43 remaining SAMAs were further evaluated and subsequently eliminated in the final screening, as described below in Sections G.4 and G.6.1.

G.3.2 Review of TVA's Process

TVA's efforts to identify potential SAMAs focused primarily on areas associated with internal initiating events. The initial list of SAMAs generally addressed the accident categories that are dominant CDF and LERF contributors at BFN.

The preliminary review of BFN's SAMA identification process raised some concerns regarding the completeness of the set of SAMAs identified and the inclusion of plant-specific risk contributors. The staff requested clarification regarding the portion of risk represented by the dominant risk contributors. Because a review of the importance ranking of basic events in the PSA could identify SAMAs that may not be apparent from a review of the top cut sets, the staff also questioned whether an importance analysis was used to confirm the adequacy of the SAMA identification process. In response to the RAI, TVA stated that the reviews of the importance rankings and a review of the highest frequency CDF and LERF sequences from the Unit 2 and Unit 3 PSA models were used to identify groups of sequences contributing to CDF and LERF. TVA provided tables that cross referenced the 10 CDF and LERF significant groups with important human actions and systems (TVA 2004a). TVA also provided a cross reference of the significant groups to the SAMAs evaluated in the ER. TVA explained that if an appropriate generic SAMA did not address the plant-specific risk contributor, a BFN-specific SAMA was developed (TVA 2004a).

While TVA did identify BFN-specific candidate SAMAs for fire (B16), earthquakes (B17), and high winds, floods, transportation, and other extreme external events (B19), none were quantitatively evaluated because of the findings of the IPEEE that no vulnerabilities existed and/or that all outliers had been satisfactorily resolved as part of the IPEEE or related programs. Even though no BFN-specific external events SAMAs were quantitatively evaluated, candidate SAMAs selected because of their potential risk reduction on the risk from internal events will, in most cases, also reduce the risk due to external event initiators. The use of a multiplier of two to the benefits estimated for the internal events for these SAMAs in part addresses the lack of BFN-specific SAMAs for external events.

The staff notes that the set of SAMAs submitted is not all inclusive because additional, possibly even less expensive, design alternatives can always be postulated. However, the staff concludes that the benefits of any additional modifications are unlikely to exceed the benefits of the modifications evaluated and that the alternative improvements would not likely cost less than the least expensive alternatives evaluated, when the subsidiary costs associated with maintenance, procedures, and training are considered.

The staff concludes that TVA used a systematic and comprehensive process for identifying potential plant improvements for BFN, and that the set of potential plant improvements identified by TVA is reasonably comprehensive and, therefore, acceptable. This search included reviewing insights from the IPE and IPEEE and other plant-specific studies, reviewing plant improvements considered in previous SAMA analyses, and using the knowledge and experience of its personnel. While explicit treatment of external events in the SAMA identification process was limited, it is recognized that the 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

TVA evaluated the risk-reduction potential of the 43 Phase 2 SAMAs that were applicable to BFN. Many of the SAMA evaluations were performed in a bounding fashion in that the SAMA was assumed to completely eliminate the risk associated with the proposed enhancement. Such bounding calculations over-estimate the benefit and are conservative.

For a majority of the Phase 2 SAMAs, new PSA models that incorporate individual SAMAs were developed and quantified. For several of the SAMAs, information from the PSA (e.g., system importance measures) was used to estimate their potential benefit. The CDF and population dose reductions were estimated using the EPU PSAs for Units 2 and 3. The new models or changes made to models to quantify the impact of SAMAs are detailed in Section VI of Attachment E to the ER (TVA 2003) and in response to an RAI (TVA 2004a). Table G-4 lists the assumptions considered to estimate the risk reduction for each of the 43 Phase 2 SAMAs, the estimated risk reduction in terms of percent reduction in CDF and population dose, and the estimated total benefit (present value) of the averted risk. The determination of the benefits for the various SAMAs is further discussed in Section G.6.

The staff reviewed TVA's bases for calculating the risk reduction for the various plant improvements and concludes that the rationale and assumptions for estimating risk reduction are reasonable and generally conservative (i.e., the estimated risk reduction is higher than what would actually be realized). Accordingly, the staff based its estimates of averted risk for the various SAMAs on TVA's risk reduction estimates reported in the ER, but applied a multiplier of two to the associated benefits to account for benefits in external events as discussed in Section G.6.2.

Table G-4. SAMA Cost/Benefit Screening Analysis

Phase 2 SAMA	Assumptions	% Risk Reduction (Unit 2) / (Unit 3) CDF	Population Dose	Total Baseline Benefit ($)(1)	Estimated Cost(2) ($)
B01 Improve reliability of automatic depressurization system (ADS).	The failure probability of top event "operator depressurizes the reactor vessel" was set to zero.	58 / 45	34 / 24	1,481,000	4,500,000
B02 Improve reliability of high-pressure coolant injection (HPCI) and reactor core isolation cooling (RCIC) by adding redundant train.	The failure probability of top events "start and short-term operation of HPCI and RCIC" were set to zero.	57 / 50	32 / 31	1,489,000	21,900,000
B03 Improve reliability of safety relief valves (SRVs) by replacing valves with more reliable design.	The failure probability of top event "hardware unavailability of SRVs" was set to zero.	<1 / <1	0 / 0	6,600	21,900,000
B04 Add dedicated blackout diesel generator.	The failure probability of top event "diesel B or 3EB" was set to zero.	12 / 24	7 / 17	406,000	8,800,000
B05 Improve procedures and training to control pressure during ATWS.	The failure probability of top event "operator depressurizes vessel" was set to zero.	1 / 1	0 / <1	16,000	146,000(3)
B06 Automate standby liquid control (SLC) initiation to mitigate failure of SLC due to operator error during ATWS conditions.	The failure probability of top event "operator initiates SLC injection" was set to zero.	3 / 3	31 / 26	611,000	1,870,000
B07 Improve reliability of SLC by adding redundant train.	The failure probability of top event "hardware unavailability of SLC injection" was set to zero.	1 / 1	6 / 6	129,000	4,500,000

Table G-4. (contd)

Phase 2 SAMA	Assumptions	% Risk Reduction (Unit 2) / (Unit 3)		Total Baseline Benefit ($)(1)	Estimated Cost(2) ($)
		CDF	Population Dose		
B08A Decrease frequency of Interfacing Systems loss-of-coolant accident (ISLOCA) through major hardware modifications to prevent overpressurization.	The ISLOCA initiating event frequency was set to zero.	2 / 1	<1 / <1	39,000	21,900,000
B08B Decrease frequency of ISLOCA through improved procedures and training or minor hardware modifications.	ISLOCA frequency is reduced by 50 percent.	1 / 1	0 / <1	20,000	146,000(3)
B09 Improve suppression pool cooling reliability for transients by adding redundant train or additional cross-tie capability.	The failure probability of top events "heat exchangers A and B, RHR pumps A and B, and the alignment to suppression pool cooling" were set to zero.	12 / 17	7 / 12	363,000	21,900,000
B10 Automate torus cooling on high torus temperature to avoid lack of torus cooling due to operator error.	The failure probability of top event "operator initiates torus cooling" was set to zero.	5 / 5	3 / 3	143,000	1,870,000
B11 Improve direct current (DC) reliability through increase/improved procedures to load shed.	The failure probability of top events "battery boards 1, 2, and 3" were set to zero.	2 / 1	1 / 1	54,000 [11,000](4)	146,000(3)
B12 Improve level control through improved procedures and training.	The failure probability of top event "operator controls low pressure injection" was set to zero.	<1 / <1	1 / 2	36,000	146,000(3)

Table G-4. (contd)

Phase 2 SAMA	Assumptions	% Risk Reduction (Unit 2) / (Unit 3)		Total Baseline Benefit ($)[1]	Estimated Cost[2] ($)
		CDF	Population Dose		
B13 Improve suppression pool cooling by adding redundant train.	The failure probability of top events "heat exchangers A, B, C, and D, RHR pumps A, B, C, and D; operator initiates suppression pool cooling mode; and switch to suppression pool cooling mode" were set to zero.	3 / 2	1 / 1	67,000	8,800,000
B14 Reduce frequency of excessive loss-of-coolant accident (LOCA) by increasing reactor pressure vessel inspection frequency.	The "Excessive LOCA" initiating event frequency was set to zero.	<1 / <1	2 / 2	40,000	465,000
B15 Add motor-driven startup feedwater pump.	A new top event, "startup feedwater pump" was inserted in the event model. The unavailability of the startup feedwater pump if offsite power is available was set to 4.2×10^{-3}.	50 / 35	29 / 22	1,254,000	21,900,000
B16 Mitigate fire risk by adding new fire barriers, new cable routing, and training and procedures.	No quantitative assessment was performed.	not assessed	not assessed	not assessed	>21,900,000
B17 Mitigate earthquake effects by strengthening structures and equipment.	No quantitative assessment was performed.	not assessed	not assessed	not assessed	>21,900,000
B18 Implement internal flood prevention and mitigation enhancements.	The frequency of all internal flood initiators were set to zero.	4 / 5	2 / 4	118,000	>21,900,000

Table G-4. (contd)

Phase 2 SAMA	Assumptions	% Risk Reduction (Unit 2) / (Unit 3)		Total Baseline Benefit ($)[1]	Estimated Cost[2] ($)
		CDF	Population Dose		
B19 Mitigate effects of high winds, floods, transportation, and other external events.	No quantitative assessment was performed.	not assessed	not assessed	not assessed	not estimated
G01 Increase CRD pump lube oil capacity.	No quantitative assessment was performed.	not assessed	not assessed	not assessed	not estimated
G02 Replace emergency core cooling system (ECCS) pump motor with air-cooled motors.	The dependency on all RHR and core spray pumps on emergency equipment cooling water (EECW) was eliminated. All split fractions associated with RHR pumps and core spray system were reduced by 20 percent.	8 / 9	4 / 6	217,000	26,400,000
G03 Implement procedures to stagger CRD pump use after a loss of service water (SW).	No quantitative assessment was performed.[5]	not assessed	not assessed	not assessed	146,000[3]
G04 Develop/enhance procedural guidance for use of cross-tied component cooling or SW pumps.	Actions necessary to align the swing pumps for EECW service are assumed to occur with a probability of 1. Reactor building closed cooling water (RBCCW) is assumed to be successful if raw cooling water (RCW) is available. The frequency of the initiator loss of RBCCW is set to zero.	2 / 2	2 / 2	74,000	146,000[3] [377,000][4]
G05 Enhance procedures and operator training in support system failure sequences, with emphasis on anticipating problems and coping.	Each of the split fractions associated with recovery of key support systems was assumed to improve by a factor of three.	<1 / <1	0 / 0	900	146,000[3]

Table G-4. (contd)

Phase 2 SAMA	Assumptions	% Risk Reduction (Unit 2) / (Unit 3)		Total Baseline Benefit ($)[1]	Estimated Cost[2] ($)
		CDF	Population Dose		
G06 Improve ability to cool the RHR heat exchangers.	The failure fraction for top events SW2A, SW2C, SW2B, and SW2D was set to zero.	<1 / 5	0 / 3	26,000	4,500,000
G07 Provide a redundant train of ventilation.	The redundant train of ventilation has an availability of 1.0 and is independent of any support system such as electric power.	2 / 9	2 / 2	71,000	26,400,000
G08 Improve diagnosis of loss of switchgear room heating, ventilation, and air conditioning (HVAC) a) install high temperature alarm b) install redundant louver and thermostat.	Top events related to diesel support recovery were set to guaranteed success.	<1 / <1	0 / 0	300	a) 587,000/bldg b) 8,800,000/bldg
G09 Install a containment vent large enough to remove ATWS decay heat.	The relevant logic macro (AHEAT) was modified to reflect the vent as a potential success path.	3 / 2	2 / 3	97,000	8,700,000
G10 Use fire protection system as a back-up source for the drywell spray system.	The top event representing the containment spray function was set to success.	<1 / <1	<1 / 3	14,000	2,200,000
G11 Install a passive containment spray system.	The top event representing the containment spray function was set to success.	<1 / <1	<1 / 3	14,000	26,400,000
G12a Provide additional DC battery capacity.	Any sequence involving successful scram, no stuck open SRVs, and successful operation and control of either HPCI or RCIC was considered to be successfully mitigated.	18 / 29	10 / 21	564,000 [61,000][4]	4,500,000
G12b Use fuel cells instead of lead acid batteries.		18 / 29	10 / 21	564,000 [61,000][4]	26,400,000

Table G-4. (contd)

Phase 2 SAMA	Assumptions	% Risk Reduction (Unit 2) / (Unit 3)		Total Baseline Benefit ($)[1]	Estimated Cost[2] ($)
		CDF	Population Dose		
G12c Add redundant DC control power for SW pumps.		18 / 29	10 / 21	564,000 [61,000][4]	1,500,000
G13a Incorporate an alternate battery charging capability.	Improve the unavailability of each of the three station batteries by a factor of 10.	2 / 1	1 / 1	52,000	4,500,000
G13b Replace existing batteries with more reliable ones.		2 / 1	1 / 1	52,000	26,400,000
G14 Develop procedures to repair or replace failed 4-kV breakers.	The transfer of power at the unit board level was assumed to occur without fault.	<1 / <1	0 / 0	0	146,000[3]
G15 Use fire protection system (FPS) as a back-up source for diesel cooling.	The FPS has sufficient capacity to service all 8 diesel generators. The FPS is aligned for diesel cooling in a timely manner. The FPS unavailability is set to zero.	8 / 9	4 / 6	217,000	1,500,000
G16 Improve inspection of rubber expansion joints on main condenser.	The initiating event flooding frequencies were reduced from the base case by 25 percent. The new flooding frequencies for small and large turbine building floods became 1.15×10^{-2} and 1.76×10^{-3}, respectively.	<1 / <1	<1 / <1	21,000	440,000
G17 Develop procedure to instruct operators to trip unneeded RHR/core spray pumps on loss of room ventilation.	All requirements for area cooling were removed for the top events representing RHR and core spray pumps by reducing each corresponding split fraction by 20 percent.	2 / 2	2 / 2	71,000	146,000[3] [476,000][4]

Table G-4. (contd)

Phase 2 SAMA	Assumptions	% Risk Reduction (Unit 2) / (Unit 3)		Total Baseline Benefit ($)[1]	Estimated Cost[2] ($)
		CDF	Population Dose		
G18 Increase the SRV reseat reliability.	Any valves that lift will successfully reseat.	<1 / 1	<1 / 2	30,000	3,100,000
G19 Reduce DC dependency between high pressure injection system and automatic depressurization system.	DC dependency for HPCI was completely removed.	<1 / 1	0 / <1	10,000	1,870,000
G20 Use CRD for alternate boron injection.	Actions by the operator are necessary to initiate boron injection. Any additional operator actions associated with initiating the CRD are represented by a top event. Any additional failure modes of the CRD system over that analyzed in the base case were not significant contributors to CRD system unavailability in its postulated function of delivering boron solution to the reactor.	<1 / <1	5 / 5	105,000	8,700,000

(1) Values are based on TVA averted cost estimates (using seven-percent discount rate) reported in the ER. The values include multipliers to the estimated benefits for Units 2 and 3 to account for multiple-unit operation. The values also include a multiplier of two to account for additional risk reduction benefits in external events.
(2) Estimated costs are given in calendar year 2016 dollars, and are stated for site-wide implementation unless otherwise noted.
(3) Costs for a procedure and training were estimated to be $73,000/unit (year 2016). However, due to similarities between units and shared systems, this cost was doubled to obtain a site-wide implementation cost.
(4) The information within brackets indicates revised values were provided by the licensee in response to an RAI (TVA 2004b).
(5) This SAMA would provide little benefit because the CRD system is a backup for high pressure injection, and it does not rely on SW.

G.5 Cost Impacts of Candidate Plant Improvements

TVA estimated the costs of implementing the 43 Phase 2 candidate SAMAs through the application of engineering judgment and review of prior BFN-completed capital projects for similar improvements. The cost estimates provided in the ER accounted for inflation (3 percent per year) to arrive at year 2016 estimated costs (TVA 2003).

The staff reviewed the bases for TVA's cost estimates. For certain improvements, the staff also compared the cost estimates to estimates developed elsewhere for similar improvements, including estimates developed as part of other licensees' analyses of SAMAs for operating reactors and advanced light-water reactors. The staff reviewed the costs and found them to be consistent with estimates provided in support of other plants' analyses.

The staff concludes that the cost estimates provided by TVA are sufficient and appropriate for use in the SAMA evaluation.

G.6 Cost-Benefit Comparison

TVA's cost-benefit analysis and the staff's review are described in the following sections.

G.6.1 TVA Evaluation

The methodology used by TVA was based primarily on NRC's guidance for performing cost-benefit analysis in NUREG/BR-0184, *Regulatory Analysis Technical Evaluation Handbook* (NRC 1997c). The guidance involves determining the net value for each SAMA according to the following formula:

$$\text{Net Value} = (APE + AOC + AOE + AOSC) - COE$$

where,

APE = present value of averted public exposure ($)
AOC = present value of averted offsite property damage costs ($)
AOE = present value of averted occupational exposure costs ($)
AOSC = present value of averted onsite costs ($)
COE = cost of enhancement ($).

If the net value of a SAMA is negative, the cost of implementing the SAMA is larger than the benefit associated with the SAMA and it is not considered cost-beneficial. TVA's derivation of each of the associated costs is summarized below. For the purposes of the SAMA analysis, TVA considered the "present" to be the year 2016; therefore, all values were recalculated to the year 2016 using a 3 percent per year inflation rate.

TVA presented the results for both a 3-percent and 7-percent real discount rate. For the purposes of the staff's evaluation, the staff relied on the values given by TVA for the 7-percent real discount rate, but also considered the impact on the results of a 3-percent discount rate.

Averted Public Exposure (APE) Costs

The APE costs were calculated using the following formula:

APE = Annual reduction in public exposure (Δperson-rem/yr)
x monetary equivalent of unit dose ($3097 per person-rem, based on $2000 per person-rem inflated at 3 percent to year 2016 values)
x present value conversion factor (10.76 based on a 20-year period with a 7-percent discount rate).

As stated in NUREG/BR-0184 (NRC 1997c), 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 resulting from a single accident. Rather, it is the present value of a stream of potential losses extending over the remaining lifetime (in this case, the license renewal term) of the facility. Thus, it reflects the expected annual loss resulting from a single accident, the possibility that such an accident could occur at any time over the license renewal term, and the effect of discounting these potential future losses to present value. For the purposes of initial screening, TVA calculated an APE of approximately $54,700 (Unit 2) and $64,900 (Unit 3) for the 20-year license renewal term, which assumes elimination of all severe accidents.

Averted Offsite Property Damage Costs (AOC)

The AOCs were calculated using the following formula:

AOC = Annual CDF reduction
x offsite economic costs associated with a severe accident (on a per-event basis)
x present value conversion factor.

For the purposes of initial screening, which assumes all severe accidents are eliminated, TVA calculated an annual offsite economic risk of about $2000 (Unit 2) and $2100 (Unit 3) based on the Level 3 risk analysis. This results in a discounted value of approximately $21,200 (Unit 2) and $23,000 (Unit 3) for the 20-year license renewal term.

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.

TVA derived the values for averted occupational exposure from information provided in Section 5.7.3 of the regulatory analysis handbook (NRC 1997c). 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 $3097 per person-rem, based on $2000 per person-rem inflated at 3 percent to year 2016 values, a real discount rate of 7-percent, and a time period of 20 years to represent the license renewal term. For the purposes of initial screening, which assumes all severe accidents are eliminated, TVA calculated an AOE of approximately $1500 (Unit 2) and $2000 (Unit 3) for the 20-year license renewal term.

Averted Onsite Costs (AOSC)

AOSC include averted cleanup and decontamination costs and averted power replacement costs. Repair and refurbishment costs are considered for recoverable accidents only and not for severe accidents. TVA derived the values for AOSC based on information provided in Section 5.7.6 of the regulatory analysis handbook (NRC 1997c).

TVA divided this cost element into two parts: (1) the Onsite Cleanup and Decontamination Cost, also commonly referred to as averted cleanup and decontamination costs, and (2) the replacement power cost.

Averted cleanup and decontamination costs (ACC) were calculated using the following formula:

ACC = Annual CDF reduction
x present value of cleanup costs per core damage event
x present value conversion factor.

The total cost of cleanup and decontamination subsequent to a severe accident is estimated in the regulatory analysis handbook to be $\$1.7 \times 10^9$, based on $\$1.1 \times 10^9$ inflated at 3 percent to year 2016 values. This value was converted to present costs over a 10-year cleanup period and integrated over the term of the proposed license extension. For the purposes of initial screening, which assumes all severe accidents are eliminated, TVA calculated an ACC of approximately $48,400 (Unit 2) and $62,000 (Unit 3) for the 20-year license renewal term.

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

TVA based its calculations on the value of 1190 MW(e), which is the current electrical output for Units 2 and 3. Therefore, TVA applied a power scaling factor of 1190 MW(e)/910 MW(e) to determine the replacement power costs. For the purposes of initial screening, which assumes all severe accidents are eliminated, TVA calculated an RPC of approximately $42,200 (Unit 2) and $54,000 (Unit 3) for the 20-year license renewal term.

In response to an RAI regarding the expected output under EPU conditions, TVA stated that using a scaling factor of 1250 MW(e)/910 MW(e) would result in a 5-percent increase in the replacement power costs, and a 1.6 percent (Unit 2) and 1.7 percent (Unit 3) increase in the total avoidance costs.

Using the above equations, the total "present" (i.e., year 2016) dollar value equivalent associated with completely eliminating severe accidents from internal events at Browns Ferry to be about $168,000 (Unit 2) and $206,000 (Unit 3). Considering the effect of multiple-unit operation and uncertainties, TVA conservatively established a value of $6 million for the initial screening of SAMAs that are not economically feasible.

TVA's Results

The total benefit associated with each of the 43 Phase 2 SAMAs was evaluated by TVA. These values were determined based on the equations described above for the various averted costs together with the estimated annual reductions in CDF and person-rem dose.

The CDF and population dose risk for BFN Units 2 and 3, which are used to calculate the averted costs, are based on the assumption that Unit 1 is in extended lay-up and not operating. The license renewal application presumes that Unit 1 will be returned to operation. The operation of Unit 1 will increase the CDF values calculated in the Unit 2 and Unit 3 PSAs because of the impact of shared equipment including diesel generators, the residual heat removal service water system (RHRSW), and the emergency cooling water system. This impact is estimated from the results of the Multiple-Unit PSA performed in 1995 (TVA 1995b). This study indicated that the mean CDF for Unit 2 with all three units operating (2.8×10^{-5}/yr) is a factor of four greater than in the earlier PSA (Unit 2 IPE Rev. 1A [TVA 1995c]) with only Unit 2 operating (7.6×10^{-6}/yr). For the TVA SAMA evaluation, it is assumed that with all three units operational, the baseline CDFs and risks for Units 1 and 2 are equal and will be four times greater than the CDF from the Unit 2 EPU PSA. Because Unit 1 is more closely tied to Unit 2 than to Unit 3, it is expected that the impact of Unit 1 operation on the Unit 3 CDF and risk would be smaller than the above impact on Unit 2. Based on this reasoning, the operation of Unit 1 is assumed to result in a factor of two increase in Unit 3 CDF and risk from that indicated by the Unit 3 EPU PSA. Therefore, TVA applied a multiplier of four to the Unit 2 averted cost estimates (benefits), assumed these same benefits for Unit 1, and applied a multiplier of two to the Unit 3 averted cost estimates. As a result, all SAMAs that were evaluated were eliminated because the cost was expected to exceed the estimated benefit, as adjusted to account for multiple-unit operation.

As described below, the staff based its evaluation on TVA's estimated benefits for a 7-percent discount rate, applied the same multipliers as TVA to account for multiple-unit operation, and applied an additional multiplier of two to the averted cost estimates for each SAMA to account for the potential impact of external events. As a result, none of the SAMAs appeared to be potentially cost-beneficial. However, four SAMAs appeared to be within a factor of three of being cost-beneficial (i.e., SAMAs B11, G04, G12, and G17). TVA performed a more detailed assessment of each of these SAMAs to more realistically estimate the risk reduction and/or implementation costs for each SAMA. The revised values are denoted by brackets within Table G-4. Based on this re-assessment, none of the SAMAs is within a factor of three of being cost-beneficial.

G.6.2 Review of TVA's Cost-Benefit Evaluation

The cost-benefit analysis performed by TVA was based primarily on NUREG/BR-0184 (NRC 1997c) and was executed consistent with this guidance. However, TVA considered the "present" to be the year 2016, and therefore, inflated dollar values to the year 2016 using a 3 percent per year inflation rate. This approach was taken for both implementation costs and SAMA benefits.

The TVA BFN license renewal application is made assuming that Unit 1 is returned to service. As described above, the impact of all units operating is accounted for in the SAMA analysis by increasing the Unit 2 risk from the EPU PSA by a factor of four and the Unit 3 risk by a factor of two. The factor of four is obtained from the ratio of Unit 2 CDF in the Multiple-Unit PSA with all units considered operating (Multiple-Unit PSA = 2.8×10^{-5}/yr) to the CDF from the revised Unit 2 IPE, which considered only Unit 2 operating (Unit 2 IPE Rev. 1A [TVA 1995c] = 7.6×10^{-6}/yr). The factor of two used to adjust the Unit 3 risk was based on the judgment that the impact of all units operating would be less for Unit 3 than for Unit 2 because Units 1 and 2 share more equipment than Unit 3 shares with Units 1 and 2. The CDF for Unit 1 was assumed to be equal to the adjusted CDF for Unit 2.

The staff notes that the adjustment factors for multiple-unit operation are based on the total CDF. However, the impact of all units operating will vary from sequence to sequence depending on the failures involved in the sequences. For sequences that involve shared systems (e.g., loss of offsite power), the increase could be larger than the average factors of four (Units 1 and 2) and two (Unit 3), while for other sequences that do not involve significant shared systems, the increase could be smaller.

In response to an RAI (TVA 2004a), TVA assessed the impact of multiple-unit operation on an initiator-specific basis. The impact of multiple-unit operation was found to be greater than the multiplier of four used (for Units 1 and 2) for four initiating events. In three cases, the modeling in the Multiple-Unit PSA was found to be conservative so that the correct impact of multiple-unit operation would be expected to be less than that used (four for Unit 2 and two for Unit 3). In the fourth case, the frequency of the CDF for the initiator is so small that, even if the multiplier of four is used, the benefit of any SAMA that eliminates this initiator would not be cost effective. The impact of three-unit operation could also reduce the availability of the EECW system and the RHRSW system, which are shared between Units 1 and 2. This was also addressed by TVA in response to an RAI (TVA 2004b). While the impact of this on CDF may be larger than the multiplier of four used, the importance of these systems is small enough that the impact on CDF is expected to be so small that it would not lead to cost-effective SAMAs.

There is considerable uncertainty in the validity of the above "correction factors," or multipliers. However, based on a review of the modeling changes made for the Multiple-Unit PSA, other results such as the change in CDF when Unit 3 operation is accounted for (Unit 2 PSA with Unit 3 operating versus Unit 2 IPE Rev. 1A [TVA 1995c]), and the relatively large "effective" CDF after applying these factors compared to the CDF for other similar BWRs, the staff finds that these factors are acceptable for estimating the impact of multiple-unit operation. It is noted that during the course of the review, TVA completed a PSA for Unit 1, based on the expected configuration at the time of restart, including EPU conditions (TVA 2004b). The Unit 1 CDF is 1.86×10^{-6}/yr, which is less than the EPU PSA CDF for Unit 2 used in the SAMA analysis. As such, the use of the Unit 2 CDF with a multiplier of four to represent the Unit 1 CDF appears to be bounding and conservative for the purposes of the SAMA analysis.

In the IPEEE SER, the staff estimated a fire CDF of 1.24×10^{-5}/yr for Unit 2, and 7.5×10^{-6}/yr for Unit 3 (NRC 2000). In response to an RAI, TVA provided the control room fire CDF based on the latest fire analysis. The control room fire CDF for BFN is approximately 1×10^{-5}/yr for Unit 2, which is about a factor of four greater than the internal events CDF of 2.6×10^{-6}/yr for Unit 2 used in the SAMA analysis. TVA stated that the fire CDF values should be considered as upper bound values only, and that the mean CDF resulting from fire-related initiating events in each of the fire areas is judged to be considerably lower than these values (TVA 2004a).

The staff agrees that the BFN fire analysis contains numerous conservatisms and that a more realistic assessment could result in a substantially lower fire CDF. However, the staff believes that the information provided by TVA is not sufficient to ignore the risk contribution from external events. Based on evaluations of past ERs submitted in support of license renewal applications, the staff believes that a more realistic fire CDF is likely a factor of two to three less than the screening values used in the FIVE methodology. If a factor of three reduction is applied to the BFN fire CDF, the external events (fire) CDF and internal events CDF are comparable. As such, this would justify use of a multiplier of two to the averted cost estimates (for internal events) to represent the additional SAMA benefits in external events. Therefore, the staff applied a multiplier of two to the averted cost estimates (for internal events) to obtain a baseline estimate of the benefits for each SAMA. This implicitly assumes that each SAMA would offer the same percentage reduction in external event CDF and population dose as it offers in internal event CDF and population dose. The adjusted benefit values are shown in Table G-4 for the 43 SAMAs. No SAMAs were found to be cost-beneficial, even after applying a multiplier of two to account for external events.

The staff notes that TVA evaluated a SAMA for a control room fire, which is one of the zones that are large contributors to the fire CDF. The averted cost was estimated to be about $479,000 (Unit 2) and $239,000 (Unit 3). After accounting for multiple-unit operation, the maximum averted cost was estimated to be $4,300,000 for the site (TVA 2004b). The estimated cost to install redundant remote shutdown panels is $5 million per unit. Therefore, this SAMA would not be cost-beneficial.

The staff also considered the impact that further increases in the contribution from analysis uncertainties would have on the estimated costs and benefits. TVA estimated that the ratio of the 95th percentile to the mean CDF is 3.2 and 2.8 for Units 2 and 3, respectively (TVA 2003). The staff considered the impact if the cost and benefits were altered by a factor of three to account for uncertainties. Four SAMAs had estimated benefits within a factor of three of the estimated implementation costs and were further evaluated.

In response to an RAI, TVA re-examined each of these SAMAs. This included re-examining the modeling assumptions that could lead to overestimation of the averted costs and refining the implementations costs to better represent the actual costs that would be incurred. The results of this reassessment are provided in the RAI response (TVA 2004b), and summarized below. The revised values are also reported in Table G-4.

- SAMA B11 involves improving/enhancing procedures for load shedding, which would improve direct current (DC) reliability. The staff estimated the benefit of this SAMA to be $54,000 for the site based on TVA's risk reduction estimate reported in the ER and a multiplier of two to account for external events. Implementation costs were estimated by TVA to be $73,000/unit. However, this is a procedural modification and, therefore, the staff estimates that such a modification would not be three times the estimated cost for three units. Because of similarities between units and shared systems, the staff doubled TVA's implementation cost from $73,000 to $146,000 to obtain a site-wide implementation cost. Thus, this SAMA was within a factor of three of being cost-beneficial. TVA's initial risk reduction estimate was bounding in that it set the unavailability of the three battery boards to zero. TVA reassessed the potential enhancement and determined that, more realistically, only a 20 percent improvement would be achieved (TVA 2004b). Therefore, the revised benefit, or averted cost, would be 20 percent of the initial value, or approximately $10,800. Additionally, TVA stated that an engineering analysis would be necessary to determine the improvement in unavailability, if any. When compared to the implementation cost of $146,000 for the site, this SAMA is not cost-beneficial, nor would it be when considering uncertainties.

- SAMA G04 involves both procedural improvements and hardware changes for use of cross-tied component cooling or SW pumps, which would reduce the frequency of a loss of component cooling water or SW. The staff estimated the benefit of this SAMA to be $74,000 for the site based on TVA's risk reduction estimate reported in the ER and a multiplier of two to account for external events. Implementation costs were initially estimated by TVA to be $73,000/unit. However, this is a procedural modification, and therefore, the staff estimates that such a modification would not be three times the estimated cost for three units. Due to similarities between units and shared systems, the staff doubled TVA's implementation cost from $73,000 to $146,000 to obtain a site-wide implementation cost. Thus, this SAMA was within a factor of three of being cost-beneficial. According to TVA, this SAMA would require a hardware modification as well as the procedural modification (TVA 2004b). The cost of the hardware modification was not included in the initial implementation cost, and would increase the implementation cost by $77,000/unit to $150,000/unit. Because procedural modification is estimated by the staff to cost $146,000 for the site, the addition of the hardware modification ($77,000/unit or $231,000 for the site) would bring the implementation costs to $377,000 for the site. TVA also noted that the potential benefits are clearly overstated because the frequency of the loss of RBCCW initiator is assumed to be zero, and that the action to align the swing pumps is assumed to occur without error. The staff agrees with the revised implementation costs because of the need to develop new procedure(s), to perform engineering analysis to support procedure development, and to install the required hardware. The staff also agrees that the benefits would be much less if more realistic assumptions are used. The staff concludes that this SAMA has a negative net value. Accordingly, the staff agrees that this SAMA would not be cost-beneficial at BFN even when considering uncertainties.

- SAMA G12c involves the addition of redundant DC control power for the SW pumps, which would increase the reliability of the SW system and decrease the CDF because of a loss of SW. The staff estimated the benefit of this SAMA to be $564,000 for the site based on TVA's risk reduction estimate reported in the ER and a multiplier of two to account for external events. Implementation costs were estimated by TVA to be $1.5 million for the site. Thus, this SAMA was within a factor of three of being cost-beneficial. TVA's initial risk reduction estimate was bounding in that it assumed that charging capability is always available to extend the life of the batteries. The assessment also assumed that if HPCI or RCIC remain constant for 6 hours, then the scenario is successfully terminated. TVA reassessed the potential enhancement using a more realistic, but still bounding, model that assumed that the reliability of every battery would be increased as a result of the addition of redundant dc control power; however, the unavailability of each battery was assumed to decrease by a factor of two (TVA 2004b). This resulted in a total site benefit of $61,000 (including the multiplier of two to account for external events). The staff finds the implementation cost to be reasonable and comparable to costs provided by other applicants for similar modifications. Additionally, the staff agrees that the original assessment overestimated the benefit, and that the revised assessment is more realistic. Therefore, the staff agrees that this SAMA would not be cost-beneficial even when considering uncertainties.

- SAMA G17 involves the development of procedure(s) to instruct operators to trip unneeded RHR core spray pumps on loss of room ventilation. The staff estimated the benefit of this SAMA to be $71,000 based on TVA's risk reduction estimate reported in the ER and a multiplier of two to account for external events. Implementation costs were estimated to be $73,000/unit. However, this is a procedural modification, and therefore, the staff estimates that such a modification would not be three times the estimated cost for three units. Because of similarities between units and shared systems, the staff doubled TVA's implementation cost from $73,000 to $146,000 to obtain a site-wide implementation cost. Thus, this SAMA is within a factor of three of being cost-beneficial. TVA's initial analysis assumed that the unavailability of the RHR and core spray pumps would be decreased by 20 percent if dependence of room ventilation could be removed. This value was derived from a review of the system analyses; ventilation failures contribute approximately 20 percent to the unavailability of the RHR and core spray (CS) pumps. However, engineering analyses to support the assumption that environmental conditions would remain within pump operability limits if the unneeded pumps were tripped would be required. Additionally, local area temperature time histories would have to be conducted for all three units. TVA stated that the cost of these analyses (engineering and temperature histories) were not included in the original implementation costs (TVA 2004b). The cost for these analyses is estimated to be $110,000/unit; therefore, the total implementation cost would be $476,000 for the site. The staff agrees with the revised implementation costs because of the need to develop new procedure(s) and to perform engineering analyses and other analyses. The staff concludes that this SAMA has a negative net value. Accordingly, the staff agrees that this SAMA would not be cost-beneficial at BFN even when considering uncertainties.

The staff reviewed the SAMAs analyzed by TVA to determine if lower cost alternatives had been evaluated, including the use of portable battery chargers. TVA did evaluate the use of portable battery chargers (SAMA G13) (TVA 2003). The estimated benefit associated with this SAMA is around $52,000 per site. The implementation cost provided by TVA was over $2 million per site. This implementation cost is questionable; however, the staff expects that the realistic implementation costs would be greater than the estimated benefits. In SAMA G10, TVA assessed the use of the fire protection system as a backup source to the drywell spray system. The estimated benefit associated with this SAMA is around $14,000, which is less than the cost that would be incurred for such a modification. Although the implementation costs provided by TVA appear to be over-estimated, the expected costs would be significantly greater than the estimated benefits. The staff considers the evaluation and estimation of these lower cost alternatives reasonable and acceptable for purposes of the SAMA evaluation.

TVA estimated all costs based on 3-percent and 7-percent real discount rates. When determining if a SAMA was cost-beneficial, TVA used the values based on the 3-percent real discount rate. The use of a 3-percent real discount rate (rather than 7 percent used in the baseline) results in an increase in the maximum attainable benefit of approximately 54 percent. The results of using the 3-percent discount rate are bounded by the staff's averted cost estimates, which applied a multiplier of two to the internal events benefits to obtain a baseline estimate for each SAMA.

The staff concludes that the costs of all of the SAMAs assessed would be higher than the associated benefits. Improvements realized as a result of the IPE and IPEEE processes and resolution of seismic outliers would minimize the likelihood of identifying further cost-beneficial enhancements.

G.7 Conclusions

TVA compiled a list of 135 SAMA candidates based on the major contributors to CDF and LERF at BFN, generic SAMAs based on analyses submitted in support of licensing activities for other nuclear power plants, NRC and industry documents discussing potential plant improvements, and insights from current PSA. A qualitative screening removed SAMA candidates that (1) were not applicable at BFN because of design differences, (2) were related to reactor coolant pumps (RCP) seal leakage, (3) had already been implemented at BFN, (4) were similar in nature to and could be combined with another SAMA, or (5) cost more than $6 million to implement. A total of 92 SAMA candidates were eliminated based on the above criteria, leaving 43 SAMA candidates for further evaluation.

Using guidance in NUREG/BR-0184 (NRC 1997c), the current PSA model, and a Level 3 analysis developed specifically for SAMA evaluation, a more detailed assessment of the costs and benefits was developed for the 43 remaining SAMA candidates. TVA concluded in the ER that none of the candidate SAMAs evaluated would be cost-beneficial for BFN because their implementation costs exceeded their estimated benefits.

The staff reviewed the TVA analysis and concluded that the methods used and the implementation of those methods were sound. The unavailability of a seismic and fire PSA model precluded a detailed quantitative evaluation of SAMAs specifically aimed at reducing risk of these initiators. In view of the relative contribution to risk from fire events indicated from the BFN fire analysis, the staff applied a multiplier of two to the averted cost estimates for each SAMA to account for the potential impact of external events. Even then, however, none of the SAMAs were cost-beneficial.

The staff considered the impact if the cost and benefits were increased by a factor of three to account for uncertainties and determined that four SAMAs could be potentially cost-beneficial. TVA re-examined each of these SAMAs and provided a more realistic estimate of their benefits and/or implementation costs. As a result of this reassessment, the cost-benefit analyses showed that none of the candidate SAMAs was cost-beneficial.

Based on its review of the TVA SAMA analysis, the staff concurs that none of the candidate SAMAs is cost-beneficial. This is based on conservative treatment of costs and benefits. This conclusion is consistent with the low residual level of risk indicated in the BFN PSA and the fact that BFN has already implemented the plant improvements identified from the IPE and IPEEE processes, with the exception of the removal of the transformers, which is scheduled to occur in the future.

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10. SUPPLEMENTARY NOTES

Docket Numbers 50-259, 50-260, 50-296

11. ABSTRACT *(200 words or less)*

This final supplemental environmental impact statement (SEIS) has been prepared in response to an application submitted to the NRC by Tennessee Valley Authority (TVA) to renew the operating licenses for Browns Ferry Nuclear Plant, Units 1, 2, and 3 (BFN) for an additional 20 years under 10 CFR Part 54. The final 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 determine that the adverse environmental impacts of license renewal for BFN are not so great that preserving the option of license renewal for energy-planning decisionmakers would be unreasonable. This recommendation is based on (1) the analysis and findings in the GEIS; (2) the Environmental Report submitted by TVA; (3) consultation with Federal, State, and local agencies; (4) the staff's own independent review; and (5) the staff's consideration of public comments.

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