Document Type: EIS-Administrative Record
Index Field: Final Environmental Document
Project Name: Single Nuclear Unit at the Bellefonte Site
Project Number: 2009-22

VOLUME 1

FINAL SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT

SINGLE NUCLEAR UNIT AT THE BELLEFONTE PLANT SITE

Jackson County, Alabama

PREPARED BY:
TENNESSEE VALLEY AUTHORITY

MAY 2010

Page intentionally blank

Final Supplemental Environmental Impact Statement **May 2010**

Proposed project:	Single Nuclear Unit at the Bellefonte Plant Site Jackson County, Alabama
Lead agency:	Tennessee Valley Authority
For further information on the supplemental environmental impact statement, contact:	Ruth M. Horton Senior NEPA Specialist Tennessee Valley Authority 400 W. Summit Hill Drive Knoxville, Tennessee 37902 Phone: 865-632-3719 Fax: 865-632-3451 E-mail: blnp@tva.gov
For general information on the project, contact:	Andrea L. Sterdis Senior Manager, NGD Project Development & Environmental Tennessee Valley Authority 1101 Market Street, LP 5A Chattanooga, Tennessee 37402 Phone: 423-751-7119 E-mail: alsterdis@tva.gov
Comments Must Be Submitted by:	June 21, 2010

Abstract: Tennessee Valley Authority (TVA) proposes to complete or construct and operate a single 1,100 to 1,260 megawatt nuclear generating unit at the Bellefonte Nuclear Plant (BLN) site located in Jackson County, Alabama. TVA may choose to complete and operate one of the partially constructed Babcock and Wilcox pressurized light water reactors (B&W) or construct and operate a new Westinghouse AP1000 advanced passive pressurized light water reactor (AP1000). Construction activities would incorporate existing facilities and structures and use previously disturbed ground within the 1,600-acre BLN site where possible. TVA has determined that the existing transmission system would need to be upgraded to prevent overloading while transmitting electricity generated at BLN. TVA would use licensing processes that are already underway for the B&W and AP1000 technologies. TVA has prepared this document to inform decision makers and the public about the potential for environmental impacts that would result from a decision to complete or construct and operate a single nuclear generating unit at the BLN site. This document supplements the original 1974 *Final Environmental Statement, Bellefonte Nuclear Plant Units 1 and 2* (TVA 1974a) for the BLN project and updates other related environmental documents, including the TVA 2008 environmental report entitled *Bellefonte Nuclear Plant Units 3&4 COL Application, Part 3* (TVA 2008a) for the construction and operation of AP1000 units at the BLN site. TVA will use this information and input provided by reviewing agencies and the public to make an informed decision about locating a single nuclear generating unit at the BLN site.

Page intentionally blank

SUMMARY

PURPOSE OF AND NEED FOR ACTION

Demand for electricity in the Tennessee Valley Authority (TVA) power service area has grown at the average rate of 2.3 percent per year from 1990 to 2008. Although the 2008-2009 economic recession has slowed load growth in the short term and adds uncertainty to the forecast of power needs, economic recovery is expected and future power needs are projected to grow at a rate that requires additional generating capacity. TVA's medium-load forecast of future demands for electricity from its power system has identified the need for approximately 7,500 megawatts (MW) of additional capacity in the 2018-2020 time frame. At the same time, TVA is striving to reduce fossil-fuel emissions and lower its delivered cost of power.

TVA proposes to complete or construct and operate a single 1,100- to 1,260-MW nuclear generating unit at its Bellefonte Nuclear Plant (BLN) site located in Jackson County, Alabama. As part of its proposal, TVA is seeking to assure future power supplies, maximize the use of existing assets and avoid larger capital outlays by using those assets, and to avoid the environmental impacts of siting and constructing new power generating facilities elsewhere. Completing or constructing a single nuclear unit at the BLN site would meet a substantial portion of TVA's future generating needs and provide a low carbon-emitting power source at a significantly lower cost per installed kilowatt than other generation options.

Currently, there are two partially constructed Babcock and Wilcox pressurized light water reactors (B&W) with an expected rated capacity of 1,260 MW each at the BLN site. TVA may choose to complete and operate either one of these partially constructed units (Alternative B) or construct and operate a new Westinghouse AP1000 advanced passive pressurized light water reactor (AP1000) using some of the existing infrastructure (Alternative C). TVA will also consider taking no action at the Bellefonte site (Alternative A). Under either of the Action Alternatives, TVA would use licensing processes that are already underway. TVA currently holds a construction permit for the two B&W units and has applied for a combined (construction and operating) license for two AP1000 units. TVA's current proposal is to complete only one of these units. The considerable work that has been accomplished toward licensing the B&W and AP1000 technologies would reduce the time and cost of bringing a single nuclear generating unit at BLN on line.

The purpose of this final supplemental environmental impact statement (FSEIS) is to inform decision makers, agencies, and the public about the potential for environmental impacts that would result from a decision to complete or construct and operate a single nuclear generating unit at the BLN site. The draft supplemental environmental impact statement (DSEIS) was published on November 4, 2009.

This document supplements the original TVA 1974 *Final Environmental Statement Bellefonte Nuclear Plant Units 1 and 2* (1974 FES) for the BLN project and updates other related environmental documents including the TVA 2008 environmental report entitled *Bellefonte Nuclear Plant Units 3&4 COL Application, Part 3* (TVA 2008a) for the construction and operation of AP1000 units at the BLN site. It also updates the need for power analysis. This SEIS tiers from TVA's *Energy Vision 2020 Integrated Resource Plan* (TVA 1995), a comprehensive environmental review of alternative means of meeting demand for power on the TVA system. In June 2009, TVA announced the preparation of a new Integrated Resource Plan (IRP) to replace *Energy Vision 2020.* The new IRP is

scheduled to be completed in early 2011. Given the long lead time for bringing a nuclear plant on line, completing the SEIS for BLN while simultaneously developing the new IRP will help ensure that a new generating unit could be built in time to meet the projected demand for base load energy.

PUBLIC REVIEW OF THE DRAFT SEIS

The draft supplemental environmental impact statement (DSEIS) was published on November 4, 2009. Notice of Availability of the DSEIS was posted in the Federal Register November 13, 2009 (74 Federal Register 58626). Public comments were solicited until December 28, 2009. During the 45-day DSEIS public review period, TVA received comments from 39 individuals or entities. A public meeting was held on December 8, 2009. In addition to responding to these comments in Appendix C, appropriate revisions were made to the FSEIS in support of the responses.

NEED FOR POWER

Since the release of the DSEIS, changes in planning assumptions have been made as part of the normal business planning cycle. These changes are reflected in an updated load forecast. Additionally plans now include long-term lay-up of 1,000 to 2,000 MW fossil-fueled plants by 2015. The revised high, medium, and low load forecasts all still show the need for additional capacity by 2018-2020. The completion or construction and operation of a single nuclear unit at the BLN site would provide TVA's customers with reduced risk from volatile fuel prices; a supply of reliable, low-cost power from a proven high-energy producing resource; and afford increased operating flexibility in the face of increasing environmental constraints.

TVA has updated the base case in the need for power analysis in this FSEIS to include an Energy Efficiency and Demand Response (EEDR) program that reduces required energy needs by about 5,200 gigawatt-hours by 2019. An Enhanced EEDR program, which about doubles the reduction in energy use of the base case EEDR program in the 2018-2020 time period, also has been studied. With either set of modified assumptions, TVA must still add new generation in the 2018-2020 time frame to balance resources with the projected load requirements.

ALTERNATIVES

TVA considered a number of alternatives to constructing and operating BLN 1&2 in its 1974 FES, including various sources of base load generation and alternative plant locations. Alternative sites and energy options were also included in the 2008 environmental report (TVA 2008a) as part of the combined license application process for locating AP1000 units (BLN 3&4) at the BLN site. In this FSEIS, TVA evaluates three generation alternatives and two transmission alternatives. The generation alternatives are Alternative A – No Action, Alternative B – Completion and Operation of a B&W Pressurized Light Water Reactor, and Alternative C – Construction and Operation of an AP1000 Advanced Passive Pressurized Light Water Reactor. The transmission alternatives include No Action and an Action Alternative. All of these alternatives are within the bounds of alternatives considered in previous environmental reviews, which are incorporated herein by reference. Previous reviews also considered alternatives to nuclear generation, including energy sources not requiring new generating capacity, alternatives requiring new generating capacity, and combinations of alternatives. Alternative sites for additional nuclear generation were also considered. The FSEIS supplements the discussion of energy alternatives in response to comments received on the DSEIS, including additional discussion of renewable energy sources such as biomass, wind, and solar power.

TVA conducted a study of the delivery of power produced from a single nuclear unit at the BLN site and determined that transmission network upgrades would be required to prevent overloading while transmitting electricity generated at BLN. These network upgrades represent the Action Alternative for the transmission system and consist of modifications to 222 miles of existing transmission lines and two existing switchyards. No new transmission lines would be needed under any alternative, and therefore no additional right-of-way (ROW) would be required. The decision whether to approve and fund a single nuclear generating unit would be made first. If either Alternative B (B&W) or Alternative C (AP1000) were selected and implemented, the Action Alternative for the transmission system would be selected. The scope of work for the transmission Action Alternative is the same under Alternatives B and C.

Several evaluations in the form of environmental reviews, studies, and white papers have been prepared for actions related to the construction and operation of a nuclear plant or alternative power generation source at the BLN site. As provided in the *National Environmental Policy Act* (NEPA) implementing regulations (40 Code of Federal Regulations [CFR] Part 1502), this FSEIS updates, tiers from, and incorporates by reference information contained in these documents about the BLN site and about completing or constructing and operating a single nuclear generating unit at the BLN site.

CHANGES IN THE AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

Under the No Action Alternative for nuclear generation, TVA would continue to maintain the construction permits for BLN 1&2 in deferred status. In deferred status, any construction activities would be related to maintaining the existing plant infrastructure, including intake and discharge structures, cooling tower, and wastewater system. Under Alternatives B and C, construction activities would incorporate existing facilities and structures and use previously disturbed ground where possible. Both the B&W and AP1000 unit would use the existing intake channel and pumping station, cooling towers, blowdown discharge diffuser, switchyard, and transmission system. Under Alternative B, a partially constructed B&W unit would be completed on previously cleared ground, and minimal new site clearing or grading would occur. The majority of the construction activities on plant systems and components would involve replacement or refurbishment of equipment contained within the current structures. Under Alternative C, the AP1000 unit would be constructed on a new nuclear island located on vacant ground within the BLN project area. Construction of an AP1000 unit and associated structures is expected to require clearing of about 50 acres of forested land, and reclearing and grading of previously disturbed ground.

The FSEIS updates information about the affected environment of the BLN site and the affected transmission lines. Potential environmental impacts of the no action and two nuclear generation alternatives are described in Chapter 3 and summarized in Table S-1 below. Potential environmental impacts of the two alternatives for transmission system upgrades and line reenergizing that would be needed to support the generation Action Alternatives are described in Chapter 4 and summarized in Table S-2 below. TVA would implement various mitigation measures to reduce or avoid environmental impacts under any of the Action Alternatives.

MITIGATION

TVA has identified measures to mitigate the potential environmental impacts associated with completion or construction and operation of a nuclear unit at the BLN site. The following measures supplement those of earlier reviews that either were met during past construction or will be addressed by required permits and authorizations:

- Avoid disturbance of archaeological site 1JA111.
- Take appropriate steps to mitigate potential housing, traffic, and school impacts during plant construction in Jackson County as needed.
- In accordance with the take permit issued by U.S. Fish and Wildlife Service on April 15 2010, provide $30,000 for research and recovery of pink mucket mussels.
- For Alternative C, purchase wetland mitigation credits at an approved mitigation bank in compliance with a Clean Water Act Section 404/401 permit.
- For Alternative C, mitigate noise impacts through use of noise dampening measures and limit blasting to daylight hours.

Should TVA select Alternative B or C, the following mitigation measures would be implemented to respond to the potential impacts of the proposed transmission system improvements. Prior to implementing any ground-disturbing work, TVA would:

- Survey areas to be disturbed where listed plant species have been previously reported to verify if the rare species are still present in the ROW. The location of any federally and state-listed species resources would be identified on construction plans and avoided during construction activities.
- Survey wetlands in the areas that may be disturbed as a result of upgrading/reenergizing activities. Mitigation measures that avoid, minimize or compensate for impacts to wetlands would be implemented to ensure no significant impacts or loss of wetland function occurs.
- In consultation with the State Historic Preservation Officer (for which the property is located) and other consulting parties, develop and evaluate alternatives or modifications that would avoid, minimize, or mitigate any adverse effects to historic properties.

PREFERRED ALTERNATIVE

TVA's integrated assessment of the two alternatives (completing a B&W unit or constructing an AP1000) has resulted in identifying a preferred project alternative for completing Unit 1 (one of the partially completed B&W units). The assessments conclude that from financial, schedule, and risk-minimization perspectives, this is the preferred generation option. In support of the preferred alternative, TVA also prefers upgrading the transmission systems.

NEXT STEPS

TVA will make a decision on the proposed action no sooner than 30 days after the notice of availability of the FSEIS is published in the *Federal Register*. This decision will be based on the project purpose and need and anticipated environmental impacts, as documented in the FSEIS, along with cost, schedule, technological, and other considerations. To document the decision, TVA will issue a record of decision.

Table S-1. Summary of the Environmental Impacts of the Three Alternatives Under Consideration

Resource	Attribute/Potential Effects	Alternative		
		A - No Action	B – One B&W Unit	C – One AP1000 Unit
Surface Water	Chemical or thermal degradation of surface water quality; changes to hydrology and consumptive use of surface water.	No impacts or changes anticipated.	Temporary and minor impacts from construction. No impacts are anticipated to water supply from plant water use. Near-field and far-field effects (e.g., cumulative) to water quality associated with cooling water discharge are not expected to be significant. Minor impacts from chemical discharges.	Temporary and minor effects from construction. No impacts are anticipated to water supply from plant water use. Insignificant effects on water quality similar to Alternative B, but slightly less due to smaller amount of water withdrawal and blowdown discharge. Minor impacts from chemical discharges.
Groundwater	Chemical impacts to groundwater quality; changes in use of groundwater.	No impacts expected.	No impacts expected to groundwater hydrology or groundwater use on site or locally. Insignificant impacts to groundwater quality. No cumulative effects expected.	As with Alternative B, no impacts expected to groundwater hydrology or groundwater use on site or locally. Insignificant impacts to groundwater quality. No cumulative effects expected.
Floodplain and Flood Risk	Construction or modification to the floodplain. Flooding of the plant site from the river, Town Creek, or Probable Maximum Precipitation (PMP).	No anticipated adverse impacts to the floodplain. All safety-related structures are located above the Probable Maximum Flood (PMF) and PMP drainage levels or are flood-proofed to the resulting levels.	Minor impacts from construction and dredging. All safety-related structures are located above the PMF and PMP drainage levels or are flood-proofed to the resulting levels. No cumulative effects to flood risk.	Minor impacts from construction and dredging. All safety-related structures are located above the PMF and PMP drainage levels or are flood-proofed to the resulting levels. The new administrative building would be located above the 100-year and Flood Risk Profile elevations. No cumulative effects to flood risk.

Resource	Attribute/Potential Effects	Alternative		
		A - No Action	B – One B&W Unit	C – One AP1000 Unit
Wetlands	Destruction of wetlands or degradation of wetland functions.	No impacts.	No impacts.	Impacts to 12.2 acres of wetlands with no net loss of wetland function due to in-kind mitigation within the watershed, No indirect or cumulative impacts expected.
Aquatic Ecology	Destruction of aquatic organisms; degradation or destruction of aquatic habitat.	No impacts.	Minor impacts to benthos from dredging intake channel, to aquatic communities from thermal discharge, impingement, and entrainment. No cumulative effects	Effects similar to Alternative B but slightly less dredging. Impacts from thermal discharge and impingement and entrainment minor and less than Alternative B due to smaller intake water volumes. No cumulative effects.
Terrestrial Ecology	Removal or degradation of terrestrial vegetation, wildlife habitat, and/or wildlife.	No impacts.	Insignificant impacts from minor vegetation clearing. No indirect or cumulative effects expected.	Similar to Alternative B. Minor direct impacts from removal of about 50 acres of forest and native grass. No indirect or cumulative effects expected.
Endangered and Threatened Species	Mortality, harm, or harassment of federally listed or state-listed species including impacts to their critical habitat.	No impacts.	No impacts from site construction or runoff. Adverse direct, indirect, and cumulative impacts to the pink mucket mussel from dredging and towing barges. Minor indirect effects from stress of potential mussel host fish from thermal effluent; negligible effect of impingement/entrainment of potential host fish.	No impacts from site construction or runoff. Little or no impact to Indiana bats from removal of low-quality potential roost habitat with some moderate-quality potential roost trees. Adverse direct, indirect, and cumulative impacts to the pink mucket from dredging and towing barges. Fewer individuals affected than under Alternative B.

Resource	Attribute/Potential Effects	Alternative		
		A - No Action	B – One B&W Unit	C – One AP1000 Unit
				Operational impacts to pink mucket and other aquatic species same as Alternative B.
Natural Areas	Degradation of the values or qualities of natural areas.	No impacts.	No direct or indirect impacts. Minor cumulative effects.	No direct or indirect impacts. Minor cumulative effects.
Recreation	Degradation or elimination of recreation facilities or opportunities.	No impacts.	Minor impacts from construction and operation, noise, and withdrawal of water. No cumulative effects.	Minor impacts from construction and operation, noise, and withdrawal of water. No cumulative effects.
Archaeology and Historic Structures	Damage to archaeological sites or historic structures.	No impacts.	No impacts. Mark and avoid site 1JA111.	No impacts. Mark and avoid site 1JA111.
Visual	Effects on scenic quality, degradation of visual resources.	No additional impact.	Minor, temporary impacts during construction. Minor impact of vapor plume. Little or no additional impacts to scenic quality. Minor cumulative impacts to regional visual setting.	Construction of new buildings offset by removal of existing buildings; construction impacts minor. Minor impact of vapor plume. Little or no additional impacts to scenic quality. Minor cumulative impacts to regional visual setting.
Noise	Generation of noise at levels causing a nuisance to the community.	No impact.	Small to moderate impacts from temporary noise during hydrodemolition and other construction. Minor impacts during operation.	Small to moderate impacts from temporary noise during blasting and other construction. Minor impacts during operation.
Socioeconomics and Environmental Justice	Changes in population, employment, income, and tax revenues. Disproportionate effects on low income and/or minority populations.	No impact. No impact.	No substantial change in population; no significant adverse effects; minor beneficial impacts. No disproportionate impact.	No substantial change in population; no significant adverse effects; minor beneficial impacts. No disproportionate impact.

Resource	Attribute/Potential Effects	Alternative		
		A - No Action	B – One B&W Unit	C – One AP1000 Unit
	Changes in availability of housing.	No impact.	Minor to potential significant adverse impacts during construction; minor impacts during operation. Potentially apply measures to mitigate demand for housing.	Minor to potential significant adverse impacts during construction; minor impacts during operation. Potentially apply measures to mitigate demand for housing.
	Effects on water supply, wastewater, schools, police, fire and medical services.	No impact.	Minor and insignificant with the exception of significant increase in demand for schools during construction; moderate increase in demand for schools during operation.	Minor and insignificant with the exception of significant increase in demand for schools during construction; moderate increase in demand for schools during operation.
	Changes in land use, land acquisition, land conversion or road locations.	No impact.	No change in designated land use. Minor indirect impact from increased residential use.	No change in designated land use. Minor indirect impact from increased residential use.
	Elevated levels of traffic from construction workforce and deliveries.	No impact.	Impacts on transportation corridors from construction workforce and deliveries would be minor on all roads except for County Road 33 where temporary minor to moderate impacts are expected. Operational effects expected to be minor.	Impacts on transportation corridors from construction workforce and deliveries would be minor on all roads except for County Road 33 where temporary minor to moderate impacts are expected. Operational effects would be minor; impacts would be minor.
	Cumulative effects	No impact.	Minor impact, minor cumulative effects.	Minor impacts, minor cumulative effects.

Resource	Attribute/Potential Effects	Alternative		
		A - No Action	B – One B&W Unit	C – One AP1000 Unit
Solid and Hazardous Waste	Generation and disposal of solid and hazardous waste.	No impact related to construction; Minor indirect impact of off-site disposal in permitted facilities.	No direct or cumulative impacts; minor indirect impacts during construction and operation from off-site disposal in permitted facilities.	Quantity of construction waste greater than under Alternative B. No direct or cumulative impacts; minor indirect impacts during construction and operation from off-site disposal in permitted facilities.
Seismology	Seismic adequacy.	No change.	No adverse seismic effects anticipated.	No adverse seismic effects anticipated.
Air Quality	Radiological emissions resulting in increases of air pollutants.	No impacts expected.	Small radiological doses to workers and members of the public from routine radioactive emissions during normal plant operation. Releases would be well below the regulatory limits; impacts are expected to be insignificant. Calculated impacts from design-basis accident releases would be well below the regulatory limit and therefore insignificant.	Impacts would be similar to Alternative B.
	Gasoline and diesel emissions from vehicles and equipment.	No impacts expected.	Minor impacts from vehicular and equipment emissions, controlled to meet applicable regulatory requirements.	Minor impacts from vehicular and equipment emissions, controlled to meet applicable regulatory requirements.
Radiological Effects	Effects to humans and nonhuman biota from normal radiological releases.	No impacts expected.	Annual doses to the public well within regulatory limits; no observable health impacts. Doses to nonhuman biota well below regulatory limits; no noticeable acute effects.	Annual doses to the public well within regulatory limits; no observable health impacts. Doses to nonhuman biota well below regulatory limits; no noticeable acute effects.

Table S-2. Summary of the Environmental Impacts of the Two Transmission Alternatives

Resource	Attribute/Potential Effects	Alternative	
		No Action	**Action**
Surface Water	Chemical or thermal degradation of surface water quality; changes to hydrology and surface water use.	No impacts.	Minor, temporary impacts during upgrade activities. Minor impacts during routine maintenance. No cumulative impacts.
Groundwater	Chemical impacts to groundwater quality; changes in use of groundwater.	Minor impacts to groundwater quality from ROW maintenance.	Minor impacts to groundwater quality from ROW maintenance.
Aquatic Ecology	Degradation of water quality; destruction of aquatic organisms.	Minor direct and indirect impacts from ROW maintenance. No cumulative impacts.	No impacts from ROW clearing; no additional impacts of ROW maintenance as compared to No Action.
Terrestrial Ecology	Removal or degradation of terrestrial vegetation, associated wildlife habitat, and wildlife.	No local or regional impacts.	Impacts to plants and wildlife on the affected ROWs would be temporary, minor and insignificant.
Endangered and Threatened Species	Mortality, harm, or harassment of federally listed or state-listed species.	No impacts.	Not likely to adversely affect any federally listed species or adversely modify critical habitat.
Wetlands	Destruction of wetlands or degradation of wetland functions.	No impacts.	With avoidance, minimization, and mitigation, no significant impacts are expected.
Floodplains	Construction or modification to a floodplain.	No floodplains affected.	With adherence to Executive Order (EO) 11988, no impacts.
Natural Areas	Degradation of the values or qualities of natural areas.	No impacts.	Minor direct impact to natural areas on ROWs, no impact to natural areas nearby.
Recreation	Degradation or elimination of recreation facilities or opportunities.	No impacts.	Minor impact from refurbishing lines and routine maintenance.
Land Use	Changes in land use and effects to uses of adjacent land.	No changes to current land use.	Minor disruption during upgrade activities.
Visual	Effects on scenic quality, degradation of visual resources.	No impacts.	Minor short-term impacts during construction and minor long-term impacts from taller structures.

Resource	Attribute/Potential Effects	Alternative	
		No Action	Action
Archaeology and Historic Structures	Damage to archaeological sites or historic structures.	No impacts.	Potential for adverse impact to archaeological sites and/or historic structures. Effects would be avoided or mitigated in accordance with the memorandums of agreement (MOAs) developed in consultation with Tennessee, Alabama and Georgia State Historic Preservation Officer(s).
Socioeconomics	Changes, at local and regional scales, in the human population; employment, income, and tax revenues; and demand for public services and housing.	No impacts.	Minor impacts during construction.
Environmental Justice	Disproportionate effects on low income and/or minority populations.	No disproportionate effects.	No disproportionate effects.
Operational Impacts	Potential effects of electromagnetic fields (EMF), lightning strike hazard, electric shock hazard, and generation of noises and odors.	No impacts.	No significant impacts from EMF; no alteration of line grounding, minor noise, no odors.

TABLE OF CONTENTS – VOLUME 1

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES – VOLUME 2

ACRONYMS, ABBREVIATIONS, AND SYMBOLS

1974 FES	*Final Environmental Statement Bellefonte Nuclear Plant Units 1 and 2*
7Q10	Lowest flow over 7 consecutive days that occurs once every 10 years
@	At Symbol, Abbreviation for the Word At
°C	Degree Celsius
°F	Degree Fahrenheit
±	Plus or Minus
§	Section
$\mu g/m^3$	Micrograms per Cubic Meter
AADT	Average Annual Daily Traffic
AC	Alternating Current
ACSS	Aluminum Conductor, Steel Supported
ADCNR	Alabama Department of Conservation and Natural Resources
ADEM	Alabama Department of Environmental Management
AEA	*Atomic Energy Act*
AEC	U.S. Atomic Energy Commission
AIA	Authorized Inspection Agency
Ala.	Alabama
ALARA	As Low as Reasonably Achievable
ALDOT	Alabama Department of Transportation
AMA	American Medical Association
ANSS	Advanced National Seismic System
ANO	Arkansas Nuclear One
ANSI	American National Standards Institute
AP1000 Units	Bellefonte Units 3 and 4 or BLN 3&4 (Westinghouse Advanced Passive Pressurized Light Water Reactors)
APE	Area of Potential Effects
APHIS	Animal and Plant Health Information Service
AREOR	Annual Radiological Environmental Operating Report
AREVA	AREVA NP Inc.
ARPA	*Archaeological Resources Protection Act*
ASME	American Society of Mechanical Engineers
B&W	Babcock and Wilcox
B&W Units	Bellefonte Units 1 and 2 or BLN 1&2 (Babcock and Wilcox Pressurized Light Water Reactors)
BA	Biological Assessment
BEA	U.S. Department of Commerce, Bureau of Economic Analysis
BFN	Browns Ferry Nuclear Plant
BLN	Bellefonte Nuclear Plant
BO	Biological Opinion
BMPs	Best Management Practices
BP	Containment Bypass

BREDL	Blue Ridge Environmental Defense League
BTU	British Thermal Units
CAES	Compressed Air Energy Storage
CCP	Coal Combustion Products
CEQ	Council on Environmental Quality
CE-QUAL-W2	A two-dimensional, laterally averaged, hydrodynamic and water quality model for reservoirs
CESQG	Conditionally Exempt Small Quantity Generator
CFE	Early Containment Rupture Before Core Relocation
CFEL	Early Containment Failure by Leakage
CFER	Early Containment Failure by Rupture
CFI	Early Containment Rupture After Core Relocation
CFL	Late Containment Failure
CFR	Code of Federal Regulation
cfs	Cubic Feet per Second
CI	Containment Isolation Systems Failure
CLWR	Commercial Light Water Reactor
CLWR FEIS	*Final Environmental Impact Statement for the Production of Tritium in a Commercial Light Water Reactor*
CO_2	Carbon Dioxide
COGEMA	Compagnie Générale des Matières Nucléaires
COL	Combined License
COLA	Combined License Application
COLA ER	*Combined License Application Environmental Report*
COLA FSAR	*Combined License Application Final Safety Analysis Report*
CORMIX	Cornell Mixing Zone Expert System
CRP	Conservation Reserve Program
CSP	Concentrating Solar Power
CTBD	Cooling Tower Blowdown
CWA	*Clean Water Act*
DAW	Dry Active Waste
dB	Decibel
dBA	A-weighted Decibel
DBA(s)	Design-Basis Accident(s)
DCD	Design Control Document
DCOP	Delivered Cost of Power
DEIS	Draft Environmental Impact Statement
DO	Dissolved Oxygen
DOE	U.S. Department of Energy
DOI	U.S. Department of Interior
DOT	Department of Transportation
DR	Demand Response
DR/DSM	Demand Response/Demand Side Management

DSEIS	Draft Supplemental Environmental Impact Statement
DSEP	Detailed Scoping, Estimating, and Planning
DSM	Demand-Side Management
DSN	Discharge Serial Number
EAB	Exclusion Area Boundary
ECM&D	Engineering, Construction, Monitoring, and Documentation
EE	Energy Efficiency
EEDR	Energy Efficiency/Demand Response
EF	Enhanced Fujita Scale (used to estimate tornado wind speeds)
e.g.	Latin term, *exempli gratia,* meaning "for example"
EIS	Environmental Impact Statement
EMF	Electromagnetic Field
Energy Vision 2020 FEIS	*Energy Vision 2020 - Integrated Resource Management Plan and Final Programmatic Environmental Impact Statement* (TVA 1995)
EO	Executive Order
EPA	U.S. Environmental Protection Agency
EPRI	Electric Power Research Institute
EPT	Index for measuring health of benthic macroinvertebrate community (measures Ephemoptera, Plecoptera, Trichoptera taxa families)
ER	Environmental Report
ERCW	Essential Raw Cooling Water
ESA	*Endangered Species Act*
ESRP	Environmental Standard Review Plan
ESS	Ecologically Significant Sites
et al.	Latin term, *et alii* (masculine), *et aliae* (feminine), or *et alia* (neutral), meaning "and others"
etc.	Latin term *et cetera*, meaning "and other things" "and so forth"
et seq.	Latin term *et sequential,* meaning "and the following one"
FAA	Federal Aviation Administration
FES	Final Environmental Statement
FEIS	Final Environmental Impact Statement or Final EIS
FERC	Federal Energy Regulatory Commission
FRP	Flood Risk Profile
FSA	Farm Service Agency
FSAR	Final Safety Analysis Report
FSEIS	Final Supplemental Environmental Impact Statement
ft^2	Square Feet
Ga.	Georgia
gal	Gallon(s)
GCC	Global Climate Change
GHG	Greenhouse Gases
GIS	Geographic Information System
gm/sec	Grams per Second
gpm	Gallons per Minute

GWh	Gigawatt-Hours
HIC(s)	High Integrity Container(s)
HPA	Habitat Protection Area
HUD	U.S. Department of Housing and Urban Development
HVAC	Heating, Ventilation, and Air Conditioning
HVN	Hartsville Nuclear Plant
HWSF	Hazardous Waste Storage Facility
IAEA	International Atomic Energy Agency
IC	Intact Containment
ICRP	International Commission on Radiological Protection
i.e.	Latin term, *id est,* meaning “that is”
IGCC	Integrated Gasification Combined Cycle
IPCC	Intergovernmental Panel on Climate Change
IPEEE	Individual Plant Examination for External Events
IRP	Integrated Resource Plan
ISFSI	Independent Spent Fuel Storage Installation
kg	Kilogram
km	Kilometer
km^2	Square Kilometer
kV	Kilovolt
kW	Kilowatt
kWe	Kilowatt Electric
kWh	Kilowatt-Hour
lb	Pound(s)
lb/hr	Pounds per Hour
Ldn	Day-Night Noise Level
LLRW	Low-Level Radioactive Waste
LLRWPAA	*Low-Level Radioactive Waste Policy Amendments Act*
LOCA	Loss-of-Coolant Accident
LPZ	Low Population Zone
m^2	Square Meter
M	Magnitude
MA	Managed Area
MACCS2	MELCOR Accident Consequence Code System
Man-rem	Unit of Radiation Dose to an Individual
Max	Maximum
mbLg	Lg Wave Magnitude
MEI	Maximally Exposed Individual
mG	Milligauss
MGD	Millions of Gallons per Day
MH	Murphy Hill
Min	Minimum

MMI	Modified Mercalli Intensity
MOA(s)	Memorandum(s) of Agreement
MPC	Multipurpose Canister
mph	Miles per Hour
mrad	Millirad
mrem	Millirem
msl	Mean Sea Level
MTU	Metric Ton Uranium
MVA	Megavolts-Ampere
MW	Megawatt
MWa	Megawatt Annual Generation/Annual Hours
MWD	Megawatt-Days
MWe	Megawatt Electric
MWt	Megawatt Thermal
MWh/year	Megawatt Hours per Year
N/A	Not Applicable
NAAQS	National Ambient Air Quality Standards
NCDC	National Climatic Data Center
NEI	Nuclear Energy Institute
NEPA	*National Environmental Policy Act*
NH_4Cl	Ammonium Chloride
NHPA	*National Historic Preservation Act*
NIEHS	National Institute of Environmental Health Sciences
No(s).	Number(s)
NOA	Notice of Availability
NOI	Notice of Intent
NO_x	Nitrogen Oxide
NPDES	National Pollutant Discharge Elimination System
NPS	National Park Service
NQAP	Nuclear Quality Assurance Plan
NRC	U.S. Nuclear Regulatory Commission
NRHP	National Register of Historic Places
NRI	Nationwide Rivers Inventory
NSRC	Norfolk Southern Railway Company
NUREG	U.S. Nuclear Regulatory Commission Regulatory Guidance Document
NWI	National Wetlands Inventory
NWP	Nationwide Permit
OSHA	Occupational Safety and Health Administration
Pa	Annual Average Power (MW)
PBN	Phipps Bend Nuclear Plant
PCBs	Polychlorinated Biphenyls
PCP	Process Control Program

Person-rem	Unit of Collective Radiation Dose to a Given Population
PM	Particulate Matter
$PM_{2.5}$	Particulate matter having a diameter of less than 2.5 microns
PMF	Probable Maximum Flood
PMP	Probable Maximum Precipitation
PNNL	Pacific Northwest National Laboratory
ppm	Parts per Million
PPA	Power Purchase Agreement
PPS	Protection Planning Site
PRA	Probabilistic Risk Assessment
PSA	Probabilistic Safety Assessment
psig	Pound-Force per Square Inch Gauge
PSAR	Preliminary Safety Analysis Report
PRA	Probabilistic Risk Assessment
PV	Photovoltaic
PWR(s)	Pressurized Light Water Reactor(s)
QA	Quality Assurance
Radwaste	Radioactive Waste
RBI	Reservoir Benthic Index
RCRA	*Resource Conservation and Recovery Act*
REMP	Radiological Environmental Monitoring Program
RFAI	Reservoir Fish Assemblage Index
RIMS II	Regional Input-Output Modeling System Economic Model
ROD	Record of Decision
ROI	Region of Interest
ROS	Reservoir Operations Study
ROS FEIS	*Reservoir Operations Study Final Programmatic Environmental Impact Statement* (TVA 2004)
ROW(s)	Right(s)-of-Way
rpm	Revolutions per Minute
RV	Recreational Vehicle
SACE	Southern Alliance for Clean Energy
SALP	NRC Systematic Assessment of Licensee Performance
SAR	Sensitive Area Review
SCCW	Supplemental Condenser Cooling Water
SEIS	Supplemental Environmental Impact Statement
SEPA	Southeastern Power Administration
SERC	SERC Reliability Corporation
SFP	Spent Fuel Pool
SGB	Steam Generator Blowdown
SHPO	State Historic Preservation Officer
SNA	State Natural Area
SMZ	Streamside Management Zone

SO_2	Sulfur Dioxide
SOW	Scope of Work
SPCC	Spill Prevention Control and Countermeasure
SQG	Small Quantity Generator
SQN	Sequoyah Nuclear Plant
SRM	Sequatchie River Mile
SRP	Standard Review Plan
SSCs	Structures, Systems, and Components
STO	Saltillo
SWPPP	Storm Water Pollution Prevention Plan
SWA	Small Wild Area
TBD	To Be Determined
TDEC	Tennessee Department of Environment and Conservation
TEDE	Total Effective Dose Equivalent
Tenn.	Tennessee
TCRs	Tree Growth Regulators
TNC	The Nature Conservancy
TPS-TOM	TVA Transmission Operations and Maintenance
TRM	Tennessee River Mile
TVA	Tennessee Valley Authority
TVAPSA	TVA Power Service Area
TWRA	Tennessee Wildlife Resources Agency
U	Uranium
UFC	Uranium Fuel Cycle
UO_2	Uranium Dioxide
U.S.	United States
USACE	U.S. Army Corps of Engineers
U.S.C.	U.S. Code
USGS	U.S. Geological Survey
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
VS	Vital Signs
vs.	Versus
WAW	Wet Active Waste
WBN	Watts Bar Nuclear Plant
WCF	Widows Creek Fossil Plant
WEC	Westinghouse Electric Company
WHO	World Health Organization
WMA	Wildlife Management Area
WOA	Wildlife Obervation Area
χ/Q	Atmospheric Dispersion Factors
YCN	Yellow Creek Nuclear Plant

CHAPTER 1

1.0 PURPOSE OF AND NEED FOR ACTION

The Tennessee Valley Authority (TVA) operates the largest public power system in the country. From 1990 to 2008, demand for electricity in the TVA power service area grew at an average rate of 2.3 percent. The 2008-2009 economic recession has slowed load growth in the short term and adds uncertainty to the forecast of power needs; however, economic recovery is expected and future power needs are expected to grow at a rate that requires additional generating capacity. TVA's medium forecast analysis of future demands for electricity from its power system has identified the need for at approximately 7,500 megawatts (MW) of additional capacity in the 2018-2020 time frame (see Section 1.4).

TVA proposes to complete or construct and operate a single 1,100- to 1,260-MW nuclear generating unit at the Bellefonte Nuclear Plant (BLN) site located in Jackson County, Alabama. As part of its proposal, TVA is seeking to assure future power supplies; maximize the use of existing assets and avoid larger capital outlays by using those existing assets; and to avoid the environmental impacts of siting and constructing new power generating facilities elsewhere. Completing or constructing a single nuclear unit at the BLN site would meet a substantial portion of TVA's future generating needs and provide a low carbon-emitting power source at a significantly lower cost per installed kilowatt than other generation options.

Currently, there are two partially constructed Babcock and Wilcox pressurized light water reactors (B&W) with an expected rated capacity of 1,260 MW each at the BLN site. TVA may choose to complete and operate either one of these partially constructed units (Alternative B) or construct and operate a new Westinghouse AP1000 advanced passive pressurized light water reactor (AP1000) using some of the existing infrastructure (Alternative C). TVA will also consider taking no action at the Bellefonte site (Alternative A). Under any of the proposed construction alternatives, TVA would use licensing processes that are already underway. TVA currently holds construction permits for the two B&W units (BLN 1&2) and has applied for combined (construction and operating) licenses for two AP1000 units (BLN 3&4). TVA's current proposal is to complete only one nuclear generating unit. The considerable work that has been accomplished toward licensing the B&W and AP1000 technology will reduce the time and cost of bringing a single nuclear generating unit at BLN on line.

The purpose of this final supplemental environmental impact statement (FSEIS) is to inform decision makers, agencies, and the public about the potential for environmental impacts that would result from a decision to complete or construct and operate a single nuclear generating unit at the BLN site. This document supplements the original *Final Environmental Statement, Bellefonte Nuclear Plant Units 1 and 2* (1974 final environmental statement [FES]; TVA 1974a) for the BLN project and updates pertinent information discussed and evaluated in related environmental documents identified in Section 1.7, including the 2008 environmental report (ER) for the construction and operation of two AP1000 units at the BLN site (TVA 2008a). In doing so, TVA has updated the power needs analysis and information on environmental, cultural, recreation, and socioeconomic resources. TVA will use this information, along with input from reviewing agencies and the public, to make an informed decision about locating a single nuclear generating unit at the BLN site. This supplemental environmental impact statement (SEIS) tiers from TVA's *Energy Vision 2020 Integrated Resource Plan* (TVA 1995), a comprehensive environmental

review of alternative means of meeting demand for power in the TVA system. Energy Vision 2020 is described further in Section 1.7. In June 2009, TVA announced the preparation of a new Integrated Resource Plan (IRP) to replace *Energy Vision 2020.* The new IRP is scheduled to be completed in early 2011. Given the long lead time for bringing a nuclear plant on line, completing the SEIS for BLN while simultaneously developing the new IRP will help ensure that a new generating unit could be built in time to meet the projected demand for base load energy.

Chapter 1 includes a historic overview of TVA's activities related to the BLN site; a brief description of the TVA power system; a need for power analysis, a description of the *National Environmental Policy Act* (NEPA) process and public involvement; a listing of past documents related to the BLN site; and a list of permits, licenses and approvals.

In response to comments on the draft supplemental environmental impact statement (DSEIS), information was added to Chapter 1 to describe the evaluation processes that will inform TVA's decision makers regarding addition of a single nuclear unit at the BLN site and some information was updated including the Need for Power section.

1.1. Decision to be Made

TVA will decide whether to approve and fund the completion or construction and operation of a single nuclear unit at the BLN site and upgrade its transmission system to support electric generation load from the BLN site.

Over the past few years, TVA has conducted various activities that have led to the development of two potential nuclear generation options for the Bellefonte site. These activities have included licensing interactions with the U.S. Nuclear Regulatory Commission (NRC), financial assessments, engineering evaluations, need for power analyses, and risk evaluations. All of these evaluations will be used in the decision-making process.

1.2. Background

1.2.1. The Bellefonte Site

The BLN site is located on a 1,600-acre peninsula on the western shore of Guntersville Reservoir at Tennessee River Mile (TRM) 392, near the town of Hollywood and the city of Scottsboro in Jackson County in northeast Alabama (Figure 1-1). Scottsboro, Alabama, located 7 miles southwest of the site is the largest city within a 10-mile radius of the site. The three largest population centers (defined as having more than 25,000 residents) in the region are Huntsville, Alabama; Chattanooga, Tennessee; and Gadsden, Alabama. The BLN site is located 38 miles east of downtown Huntsville, Alabama; 44 miles southwest of downtown Chattanooga, Tennessee; and 48 miles north of downtown Gadsden, Alabama. Guntersville Reservoir is an impoundment of the Tennessee River and is operated by TVA as part of its integrated management of the Tennessee River system.

1.2.2. Historical Overview of Bellefonte Nuclear Plant Units 1 and 2

TVA submitted an application to construct and operate two B&W reactors at its BLN site on May 14, 1973. The design of the BLN 1&2 reactors is an evolution of the earlier B&W 177 model, with seven units currently operating in the United States. The 205 fuel assembly model at BLN is larger and includes many other safety and operational improvements over the earlier designs. Although larger, the basic design, operation, and maintenance

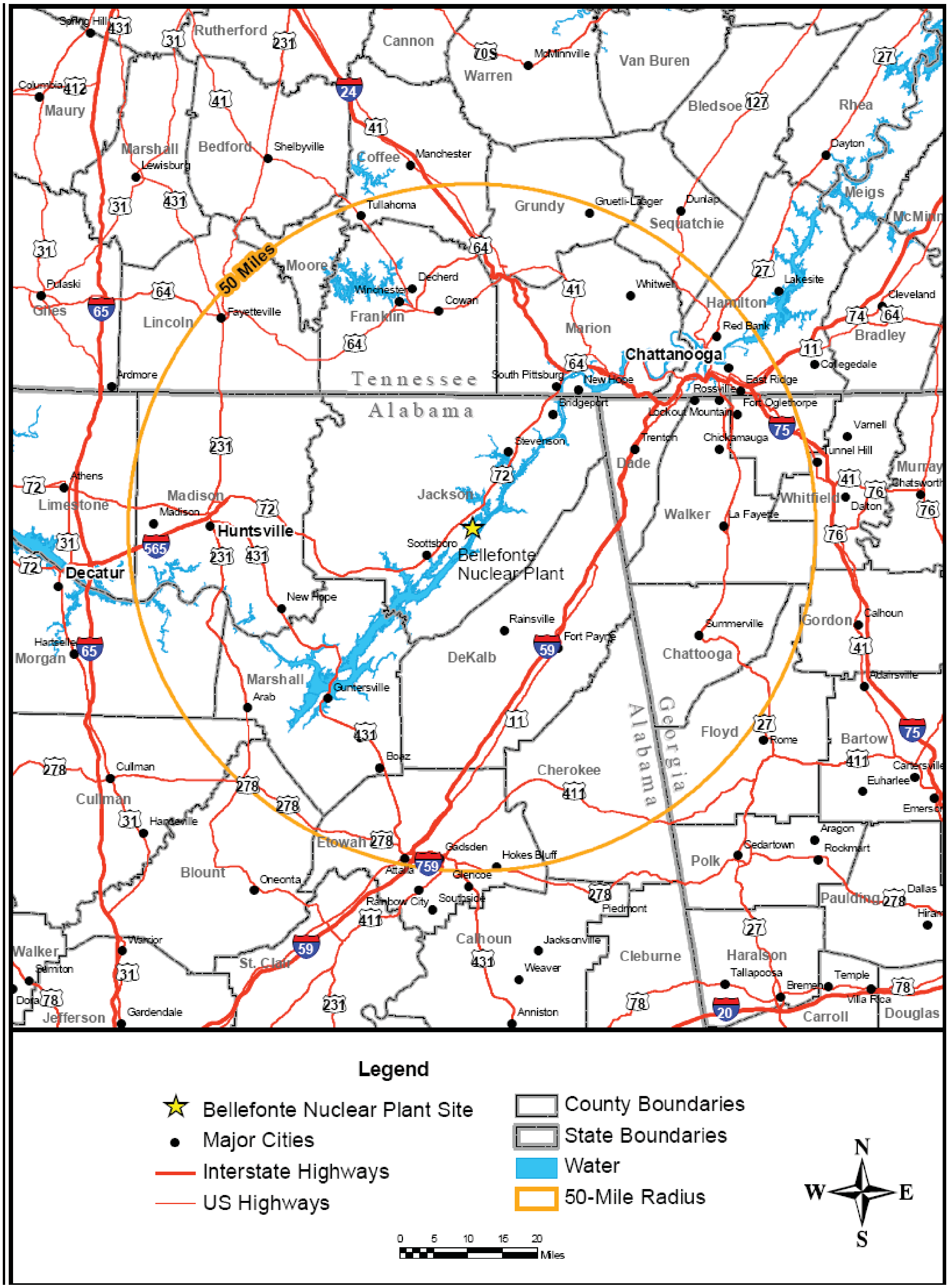


Figure 1-1. Bellefonte Locator Map

philosophy is the same as the current fleet of pressurized light water reactors (PWRs) operating in the United States. TVA issued an FES addressing the construction and operation of BLN 1&2 in May 1974 (TVA 1974a), and the U.S. Atomic Energy Commission (AEC) (now called the U.S. Nuclear Regulatory Commission or NRC) issued its FES in June 1974 (AEC 1974). NRC issued construction permits for both units on December 24, 1974.

On February 1, 1978, TVA filed an application for operating licenses for BLN 1&2, which included an *Operating License Final Safety Analysis Report* (FSAR) (TVA 1978a) and an *Operating License ER (TVA 1976)*. NRC docketed TVA's Operating License Application on June 6, 1978, and published a Notice of Hearing Opportunity on TVA's Operating License Application on July 17, 1978 (43 *Federal Register* 30628). There were no requests for a hearing or petitions to intervene filed in response. Construction of BLN 1&2 continued until the mid-1980s when forecasted load growth began to decrease and TVA halted work on the two units in 1988. When TVA requested deferred status for the two units in 1988, Unit 1 was approximately 90 percent complete, and Unit 2 was approximately 58 percent complete.

In 1993, when TVA considered resuming construction on the B&W units, a white paper was prepared to review the 1974 FES and to update information on existing environmental conditions (TVA 1993a). TVA determined that neither the plant design nor environmental conditions had changed in a manner that materially altered the environmental impacts described in the FES. At the same time, TVA stated it would continue to monitor the situation and if changes occurred that materially affected impact projections in the FES, a supplement would be prepared.

The 1997 final EIS for the Bellefonte Conversion Project (TVA 1997) considered construction and operation of five optional types of fossil fuel generation, four of which involved plants with total electricity production capacity equivalent to BLN 1&2 (approximately 2,400 MW). The Conversion EIS substantially updated the description of the affected environment at BLN and the potential for environmental impacts from new construction. The proposed combustion turbine plant was not constructed.

TVA maintained the plant in deferred status and, in 2003, NRC extended the construction permits for BLN 1&2 to the year 2011 and 2014, respectively. Subsequently, TVA's Board of Directors approved the cancellation of BLN 1&2 in November 2005 in order to facilitate consideration of the BLN site for other possible uses. By letter dated April 6, 2006, TVA submitted a site redress plan (TVA 2006) to the NRC along with a request for withdrawal of the construction permits. Subsequently, NRC withdrew the BLN 1&2 construction permits on September 14, 2006. Under the redress plan, TVA maintained environmental permits and equipment associated with ongoing activities at BLN, including a training center and an electrical substation. Some equipment or structures not identified as necessary for these ongoing activities were sold for reuse or abandoned in place as part of an investment recovery program. The construction activities that will be necessary to complete the units are largely refurbishment, replacement, analysis, and testing activities. The existing structural plant footprint is not expected to change.

In August 2008, in response to changes in power generation economics since 2005 and the possible effects of constraints on the availability of the worldwide supply of components needed for new generation development, TVA requested reinstatement of the construction permits for BLN 1&2. Reinstatement would allow TVA to resume preservation and maintenance activities. The NRC reinstated TVA's construction permits for BLN 1&2 in

terminated plant status in March 2009 pending reestablishment of the quality assurance (QA) programs, physical conditions, and records quality necessary to move the license back to deferred status.

Following reinstatement, TVA (1) revised its Nuclear Quality Assurance Plan (NQAP) to acknowledge the new plant status; (2) established the necessary programs, policies, and procedures to warrant BLN 1&2 being placed in deferred status; and (3) resumed preservation and maintenance activities aimed at protecting selected plant assets, including building repairs to eliminate leaks, and preservation of site documents. TVA has also instituted asset preservation activities to maintain the intake and discharge facilities, cooling towers, wastewater system, and transmission switchyards. In accordance with the NQAP, the lapse in QA oversight that occurred in the period from withdrawal of the construction permits through March 2009 was entered into the Corrective Action Program. In addition, TVA implemented work process controls to prevent construction-related activities from being conducted until NRC approval is given to reactivate construction.

By letter dated August 10, 2009, TVA requested that the NRC authorize placement of BLN 1&2 in deferred plant status in accordance with NRC's order reinstating the construction permits (see Appendix A). NRC conducted a BLN site inspection for deferred status the week of October 19, 2009. NRC issued Inspection Reports 05000438/2009601 and 05000439/2009601 on December 2, 2009. The NRC concluded that TVA has established the necessary programs to support transition to deferred status, consistent with the Commission Policy Statement for Deferred Plants. The inspection reports are included as Appendix B.

By letter dated January 14, 2010, the NRC authorized placement of BLN Units 1 and 2, into "deferred plant" status (see Appendix A). With this authorization, TVA has placed the plant into "deferred plant" status.

1.2.3. Combined License Application for Bellefonte Nuclear Plant Units 3 and 4

In 2006, TVA formally joined NuStart Energy Development LLC, a consortium consisting of nine member utility companies and two reactor vendors. The purpose of this consortium is to demonstrate the new 10 Code of Federal Regulations (CFR) Part 52 licensing process for completing a combined license application (COLA) and to complete the design engineering for two selected reactor technologies, one of which is the AP1000 reactor. In choosing the BLN site as the AP1000 COLA site, TVA and NuStart recognized that a substantial portion of the existing BLN 1&2 equipment and ancillary structures (e.g., cooling towers, intake structure, transmission switchyards) could be used to support a new facility and that their use could reduce the cost of new construction. A COLA was submitted to the NRC in October 2007 with TVA as the applicant of record. The COLA described the siting of two AP1000 reactors, BLN 3&4, with an estimated reactor power level of 3,400 megawatts thermal (MWt) and an expected net output each of 1,100 megawatts electric (MWe) at the BLN site. The BLN COLA included an FSAR and an ER. In October 2008, TVA submitted Revision 1 of the COLA ER (TVA 2008a), and in January 2009, Revision 1 of the COLA FSAR (TVA 2009a). Although TVA was the applicant of record for the demonstration, TVA had not proposed to construct these advanced reactors at the BLN site or elsewhere.

In April 2009, NuStart transferred the initial licensing efforts and reference plant designation for the AP1000 from BLN 3&4 to Southern Company's Plant Vogtle. The transfer of the reference designation will help the NRC complete the reference plant licensing process

sooner and help move the industry closer to new plant construction and commercial operation of the AP1000 technology. Notwithstanding the transfer of the reference plant designation to Plant Vogtle, TVA is continuing to pursue a combined license (COL) for BLN 3&4 to preserve future base load generation options. Since July 2009, as part of their review process, NRC has issued Safety Evaluation Reports with Open Items on all FSAR chapters except Chapter 6 and Sections 2.4, 3.7, and 3.8.

Reinstatement of the construction permits for BLN 1&2 and efforts to return the units to deferred plant status do not affect TVA's current plans to pursue a COL for BLN 3&4, and the license information submitted to the NRC for the purpose of supporting the COLA remains valid. Should TVA decide to restart construction on a B&W unit, TVA would address the resulting impacts on the BLN COLA. Likewise, should TVA choose to construct an AP1000 unit, TVA would address the resulting impacts on its construction permits for BLN 1&2.

1.3. TVA Power System

TVA is an agency and instrumentality of the United States, established by an act of Congress in 1933, to foster the social and economic welfare of the people of the Tennessee Valley region and to promote the proper use and conservation of the region's natural resources. One component of this mission is the generation, transmission, and sale of reliable and affordable electric energy.

TVA operates the nation's largest public power system, producing 4 percent of all electricity in the nation. The agency serves an 80,000-square-mile region encompassing most of Tennessee and parts of Virginia, North Carolina, Georgia, Alabama, Mississippi, and Kentucky. The major load centers are the cities of Memphis, Nashville, Chattanooga, and Knoxville, Tennessee; and Huntsville, Alabama. The population of the service territory in 2008 was estimated to be 9 million people. TVA delivers electricity to 155 local power distributors and 58 directly served large industries and federal facilities. The total number of businesses and residential customers served in 2008 was 4,571,600. TVA supplies almost all electricity needs in Tennessee, 31 percent in Mississippi, 24 percent in Alabama, and 26 percent in Kentucky. Its contribution to the electricity needs in Virginia, North Carolina, and Georgia is 3 percent or less. The *TVA Act* requires that the TVA power system be self-supporting and operated on a nonprofit basis, and the *TVA Act* directs TVA to sell power at rates as low as are feasible.

Dependable capacity on the TVA power system is about 37,000 MW. TVA generates most of this power with three nuclear plants, 11 coal-fired plants, nine combustion-turbine plants, a combined-cycle plant, 29 hydroelectric dams, a pumped-storage facility, a wind farm, a methane-gas cofiring facility, and several small renewable generating facilities. A portion of delivered power is obtained through long-term power purchase and lease agreements. About 60 percent of TVA's annual generation is from fossil fuels, predominantly coal; 30 percent is from nuclear; and the remainder is from hydroelectric and other renewable energy resources. TVA transmits electricity from these facilities over almost 16,000 miles of transmission lines. Like other utility systems, TVA has power interchange agreements with utilities surrounding the Tennessee Valley region and purchases and sells power on an economic basis almost daily.

1.4. Need for Power

Electricity is a just-in-time commodity. The resources needed to produce the amount of electricity demanded from a system must be available when the demand is made. If the

demand cannot be met or reduced through managed demand response programs, forced reductions and curtailments in service (i.e., brownouts or blackouts) result. One of TVA's most important responsibilities is ensuring that it is able to meet the demand for electricity placed on its power system. Thousands of businesses, industries and public facilities, and millions of people depend on TVA every day to supply their power needs reliably.

To meet this responsibility, TVA forecasts the future demand and the need for additional generating resources in the region it serves. A need for additional power exists when future demand exceeds the capabilities of currently available and future planned generating resources. Because planning, permitting, and construction of new generating capacity and transmission requires a long lead time, TVA must make decisions to build new generating capacity well in advance of the actual need.

This section updates the need for power analysis in the original BLN 1974 FES and subsequent pertinent publications (see Section 1.7). It shows the circumstances when demand exceeds supply, given the current forecasts and assumptions. TVA's method of forecasting demand and its analysis of a large number of supply- and demand-side management resources (options) that could meet forecasted demand are addressed in *Energy Vision 2020* (TVA 1995).

Terms used in this section have the following meanings:

1. Demand, also called load, is used to describe the amount of energy required in a specific time period and is typically measured in MW.

2. Peak demand is the maximum load during a specific time period, which could be annually, seasonal, or monthly.

3. Capacity is used to describe the output rating of a generator and is measured in MW.

4. Generation is used to describe how much energy or electricity is produced over a specified time frame, and it is typically measured in gigawatt-hours (GWh).

1.4.1. Power Demand

The primary factor affecting the demand for power is economic growth. A large portion of the economic growth in the TVA region is dependent on the manufacturing sector, and the region benefits from its favorable location at the center of the southern U.S. automotive industry. Even as job growth in the manufacturing sector is declining, job opportunities still exist, and continued migration into the TVA region supports strong population growth. While some of this population growth stems from jobs in retail businesses serving the existing population, a growing part is "export" services that are sold to areas outside the TVA region. Notable examples include corporate headquarters such as Nissan in Nashville and Service Master in Memphis as well as industries in the still-growing music business centered in Nashville. In addition, the TVA region has become attractive to retirees looking for a moderate climate in an affordable area, which has led to additional population growth to support service industries.

Nevertheless, future growth is expected to be lower than historical averages as a result of a number of factors including the impacts of the 2008-2009 recession and subsequent recovery, the trend of declining U.S. manufacturing, and the projected loss of some TVA customer load. Increased financial market regulation, tighter credit conditions, as well as large federal budget deficits may all work toward restraining growth to a level lower than

what was previously predicted. Although the TVA region is expected to retain its comparative advantage in the automotive industry, as exemplified by the new Volkswagen auto plant under construction in Chattanooga, Tennessee, reduced long-term prospects for the U.S. automotive industry will also have an impact on the regional industry. These changes in the economic outlook could persist in the long term with overall gross domestic product growth for both the TVA region and the nation being slightly below previous expectations.

No matter what the economic environment holds, TVA is committed to providing reliable, low-cost power to meet the needs of all residential, directly served industrial customers and distributor-served commercial and industrial customers (local utilities delivering power to other customers). In order to fulfill this mission, TVA strives to predict future demand for electricity accurately by using historical sales and announced plans of large industrial customers to use electric power, combined with state-of-the-art load-forecasting techniques, such as advanced econometric models, that calculate the demand for electricity based on (1) the level of economic activity, (2) the price of electricity, (3) the prices of available alternative fuels, and (4) increased efficiencies from new conservation and technology. To address the uncertainty inherent in single-point forecasts, inputs such as inflation rates, electricity prices, and the price of fuel are evaluated across probable ranges to develop high, medium, and low future scenarios. TVA also utilizes advanced analytical techniques such as Monte Carlo simulation of select key random variables like load, fuel prices, and weather to help it assess the overall robustness of its long-term plans.

Figure 1-2 shows TVA's actual and forecast net system requirements, which consists of sales to all distributor-served and directly served customers, plus distribution and transmission losses. The three load forecast scenarios are based on economic drivers and other assumptions updated in August 2009 and are described in detail below.

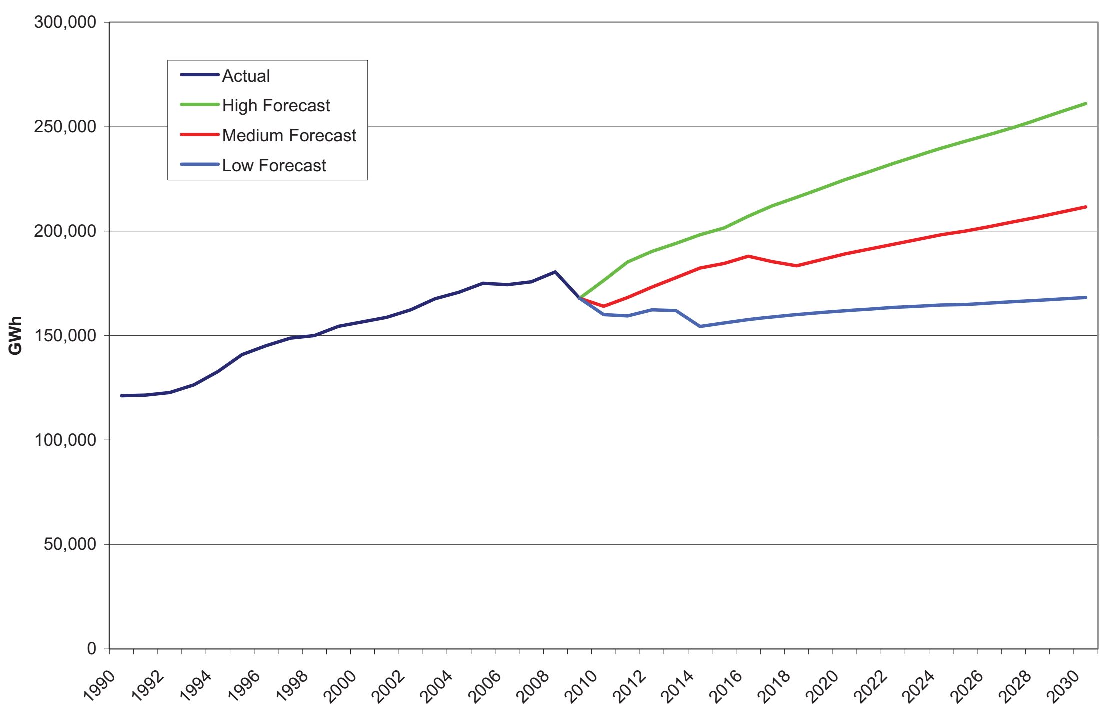


Figure 1-2. Actual and Forecast Net System Requirements by Fiscal Year

Historically, net system requirements grew at an average rate of 2.3 percent (1990-2008) before the recent economic downturn. The medium-load forecast, which shows a reduction in demand through 2010 and 1.3 percent average annual growth from 2010 through 2030, is used to provide a projection of future power needs with the high and low forecasts being used to help make more informed power supply decisions by considering the uncertainty associated with a future outside of normal expectations. Further details on the three alternative scenarios are as follows:

- **Medium.** The medium-load forecast reflects TVA's "expected" inputs and outcomes and assumes demand and energy grow at a rate similar to that expected for overall economic growth. Distributor and direct-served customers who have not already given notice of departing[1] (i.e., receiving their electrical power from a non-TVA source) are assumed to renew their power supply contracts continually through the planning period. In addition, TVA considers changes in demand based on input from its direct-served customers and distributors. TVA sales outside its service territory continue to be guided by the "fence" provisions of the *TVA Act*.[2]

- **High.** The high forecast assumes higher demand and energy usage are driven by a combination of favorable economic conditions and retail electricity and gas price assumptions. It also assumes additional industrial growth in the directly served sector. Net system requirements are projected to grow at a rate of 2.0 percent for the 2010-2030 time period in the high load forecast. It would be highly unlikely that the actual load would exceed the high forecast given the range of possible outcomes used in the forecast.

- **Low.** The low forecast assumes lower demand and energy usage are driven by a combination of unfavorable conditions, including assumptions for economic growth and retail electricity and gas prices. There is an assumed industrial load reduction in the directly served sector. Net system requirements are projected to grow at a rate of 0.3 percent for the 2010-2030 time period in the low load forecast. It would be highly unlikely that the actual load would fall below the low forecast given the range of possible outcomes used in the forecast.

1.4.2. Power Supply

TVA is a dual-peaking system with high demand occurring in both the summer and winter months. For example, the annual peak demand in 2008 occurred in August, while in 2009, the annual peak occurred in January. Winter peaks are expected to continue for the next couple of years; thereafter, the forecasted peak load or the highest demand placed on the TVA system is projected to be in the summer months. To ensure that enough capacity is available to meet peak demand in most circumstances, including unforeseen contingency, additional generating capacity beyond that which is needed just to meet peak demand, is necessary. This additional generating capacity, known as "reserve capacity" or "total reserves", must be large enough to cover the loss of the largest single operating unit (contingency reserves), be able to respond to moment by moment changes in system load (regulating reserves) and replace contingency resources should they fail (replacement

[1] Distributors who have recently departed are Paducah (December 2009) and Princeton (January 2010). No further notices of departure have been filed.

[2] TVA is limited in the sale and delivery of power outside the area for which it was the primary source of power supply on July 1, 1957.

reserves). Total reserves must also be sufficient to cover unplanned unit outages, load forecasting error including abnormal weather, and undelivered purchased capacity, among other uncertainties. As typical for the utility industry, TVA plans for total reserves of between 12 and 20 percent of total system load, depending on the age of current resources, as required by North American Electric Reliability Corporation reliability standards. TVA optimizes its mix of generating assets and purchases to meet these standards.

TVA's generating supply consists of a combination of existing TVA-owned resources, budgeted and approved projects (such as new plant additions and uprates to existing assets), and power purchase agreements. This supply includes a diverse portfolio of coal, nuclear, hydroelectric, natural gas and oil, market purchases, and renewable resources designed to provide reliable, low-cost power while reducing the risk of disproportionate reliance on any one type of resource. Each type of generation can be categorized, based on its degree of utilization, into base load, intermediate, or peaking generation.

Base load generators[3] are primarily used to meet continuous energy needs, because they have lower operating costs and are expected to be available and operate continuously throughout the day. However, they typically have higher capital costs. This type of generation typically comes from larger coal plants and nuclear plants that can provide continuous, reliable power over a period of uniform demand. Some energy providers may consider combined-cycle plants for incremental base load generation needs; however, historically, natural gas prices, when compared to coal and nuclear fuel prices, make combined cycle an expensive option for larger continuous generation needs.

Intermediate resources are primarily used to fill the gap in generation between base load and peaking needs. These units are required to cycle with more or less output as the energy demand increases and decreases over time (usually during the course of a day). Intermediate units are more costly to operate than base load units, but cheaper than peaking units. This type of generation typically comes from natural gas-fired combined-cycle plants and smaller coal plants. Renewable resources (such as wind and solar), which are intermittent in nature and have capacity factors typically well below 50 percent, are increasingly being used as a source of intermediate generation. Energy storage technologies can be integrated into a solar or wind project to increase the availability of the generated energy, as discussed in Section 2.4.

Peaking units, conversely, are only expected to operate during shorter duration high-demand periods and are essential for maintaining system reliability requirements, as they can ramp up quickly to meet sudden capacity changes. Typical peaking resources include natural gas-fired combustion turbines and hydroelectric generation (which is also used to help regulate the system, but could be limited due to water supply) and renewable resources.

Once a load forecast has been developed, TVA determines if the combination of existing and planned resources is sufficient to meet the projected demand. If a capacity need is identified, TVA conducts expansion-planning studies to select the combination of resources

[3] Base load capacity consists of all resources with expected capacity factors greater than or equal to 85 percent. Base load demand is that portion of forecasted net system requirements occurring at loads equal to or less than average load (U.S. Nuclear Regulatory Commission, Environmental Standard Review Plan, NUREG 1555, October 1999).

that provides the lowest-cost combinations of options while not subjecting customers to excessive levels of risk. The options considered range from resources that do not require the construction of new generation, such as power purchases, repowering existing units, and energy conservation, as well as installation of new generating capacity. Section 2.4 discusses the range of options considered. Section 1.4.3 presents the mix of resources currently projected to meet future demand.

1.4.3. Resource Plan

TVA employs a variety of analytical tools and models to develop its long-term resource plans, including production cost models that consider many variables including fuel costs, variable operating and maintenance expenses, and the type of generating unit in order to simulate future demands for each unit in the TVA portfolio. To ensure that future demand needs are accurately identified, the most current approved assumptions and forecasts available are used as inputs to the modeling.

Since the publication of the DSEIS, a number of changes in planning assumptions have been made as part of the normal business planning cycle. These include adjustments in reserve requirements, forecasted hydropower production (due to the end of the 2005-2009 Southeast U.S. drought), fuel and emissions allowance prices, and an updated load forecast, as presented in Subsection 1.4.1. In addition, TVA entered into certain long-term power purchase agreements (PPAs) in late 2009 and early 2010 for wind energy as a result of its December 2008 Request for Proposals for Renewable Energy and/or Clean Energy Sources. These PPAs are now part of the long-term resource plan.

TVA also further refined its plans for reducing emissions from its coal-fired power plants beyond current levels. As part of its response to changing regulatory environment, TVA is increasingly utilizing emission-control equipment, such as scrubbers and selective catalytic reduction systems, and moving away from reliance on cap-and-trade programs for nitrogen oxide (NO_x), sulfur dioxide (SO_2), and mercury. For example, changes in National Ambient Air Quality Standards (NAAQS) for ozone and fine particles and technology requirements for controlling mercury emissions influence the approach toward emission control. The response to these anticipated emissions-reduction requirements have also resulted in plans to place certain fossil assets in long-term lay-up and/or expedite existing plans for placing fossil assets in long-term lay-up. These changes have been incorporated into the long-term resource plan used as the base case for the need for power analysis, resulting in a foreseeable capacity reduction of 1,000 to 2,000 MW by 2015.

The base case for this SEIS includes an Energy Efficiency and Demand Response (EEDR) program that is predicted to reduce energy needs by about 5,200 GWhs in the 2018-2020 time period. An Enhanced EEDR program, which almost doubles the reduction in energy use of the base case EEDR program in the long run, has also been developed. Section 2.4.1 provides a more detailed discussion of both programs. This need for power analysis includes a sensitivity study to show the impact of the Enhanced EEDR program on the long-term resource plan with the proposed nuclear unit.

The analysis performed for this SEIS and discussed in Subsection 1.4.4 below shows that additional capacity and energy is needed by the 2018-2020 time frame. Overall needs increase approximately 7,500 MW in capacity and 22,000 GWh of energy from 2010 to 2019 in the medium-load case. For the high-load case, an additional 12,700 MW in capacity is needed over the same period. Furthermore, the low-load case shows the need for 1,800 MW of additional capacity.

Capacity
TVA's existing capacity in 2010 and projected capacity in 2019 in its current business plan consists of a mix of coal, nuclear, natural gas, and renewable resources, market purchases, and EEDR programs, as shown in Figures 1-3 and 1-4, respectively. Market purchases are almost always derived from gas-fired resources and therefore are classified as "Gas and Oil" in Figures 1-3 and 1-4. The required capacity to meet the annual peak load increases from 35,876 MW in 2010 to 43,092 MW in 2019.

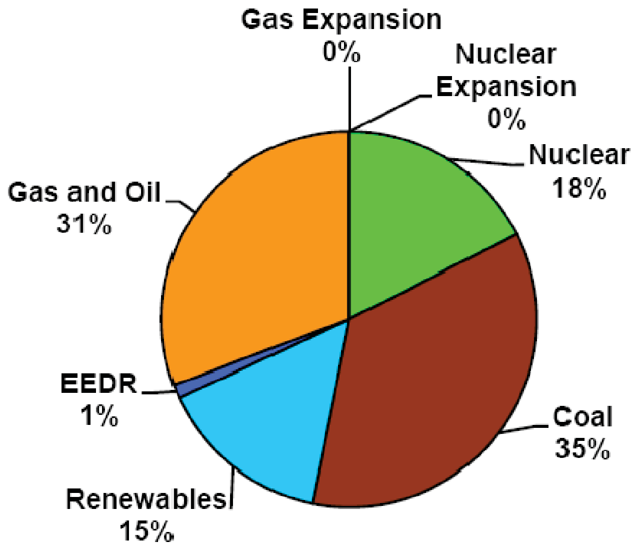


Figure 1-3. 2010 Estimated Capacity by Fuel Type, Based on 35,900 MW

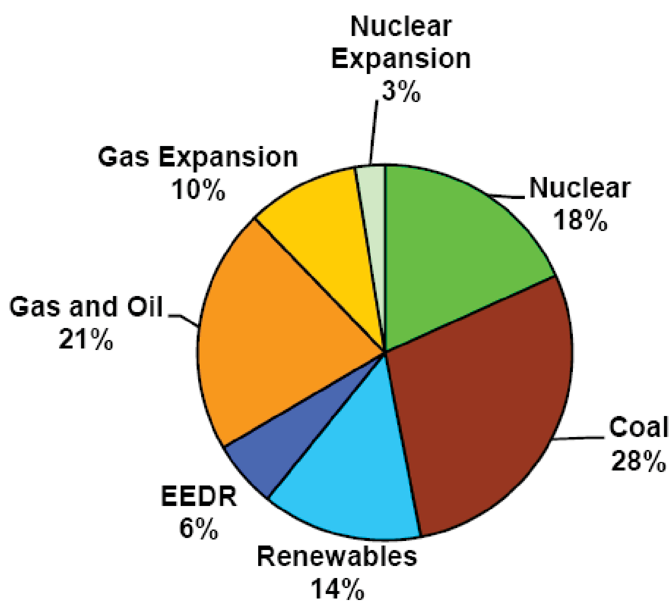


Figure 1-4. 2019 Estimated Capacity by Fuel Type Based on 43,100 MW

Currently, renewable resources consist primarily of generation from TVA hydro plants and power purchases from the Southeastern Power Administration (SEPA) for generation from

U.S. Army Corps of Engineers (USACE) hydro plants. The amount of renewable resources in the TVA portfolio is projected to increase in 2019 relative to 2010 due to the addition of long-term contracts for the purchase of renewable wind energy from outside the TVA region, as announced late 2009 and early 2010. The renewable resources as a percentage of TVA's total capacity decreases slightly (from 15 percent in 2010 to 14 percent in 2019) because the forecasted peak load also grows. TVA anticipates acquiring additional renewable resources beyond these recent announcements.

The EEDR portion of the base case capacity mix increases from 1 percent in 2010 to 6 percent in 2019. While the specific programs and mix of EEDR continue to evolve, they are currently designed in the base case to achieve approximately 1,400 MW summer peak demand reduction by 2012, reaching 2,700 MW by 2019. This corresponds to energy reductions of approximately 1,800 GWh by 2012 and 5,200 GWh by 2019.

The projected decrease in coal capacity from 35 percent in 2010 to 28 percent in 2019 is the result of lower capacity on units where air pollution control equipment has been installed[4] and the long-term lay-up of 1,000 to 2,000 MW of existing coal units, as discussed previously.

The increase in nuclear capacity from 18 percent in 2010 to 21 percent in 2019, comprised of both existing and planned nuclear capacity expansion, includes already approved additions such as the startup of TVA's Watts Bar Nuclear Unit 2 and the uprate of Browns Ferry Nuclear Unit 1. The proposed completion of one nuclear unit at the BLN site is included in the nuclear expansion portion of the 2019 capacity mix.

The portion of the capacity mix using gas and oil is 31 percent in both 2010 and 2019. This includes an increase from the natural gas combined-cycle plant that is proposed to be located at John Sevier Fossil Plant. Gas-fired capacity expansion and market purchases based on natural gas are included by 2019 to assure that TVA has adequate reserves to meet growing peak load requirements.

Generation

The generation profile differs from the capacity profile because the actual output from the installed capacity (how much is generated from a unit) depends on a number of different variables including fuel costs, variable operating and maintenance expenses, and the type of demand being met (e.g., base load, intermediate, or peaking). Capacity factor is the total energy a plant produces during a period of time divided by the energy the plant would have produced at full capacity during that same period of time. TVA's nuclear capacity factor is 90 percent or higher, which reflects a higher contribution of nuclear generation than a coal plant with a 70 to 80 percent capacity factor, or a combined-cycle capacity factor of 20 to 70 percent, or a simple-cycle combustion turbine at 5 percent or less.

TVA's current and future expected energy mix in the base case consists of coal, nuclear, natural gas, renewable resources, market purchases (which are mostly natural gas-fired), and EEDR programs, as shown in Figure 1-5 for the period from 2010 to 2028. Existing resources consist of generating units currently owned by TVA, approved capacity addition projects, and power purchase agreements. Planned resources are those selected in expansion planning studies as the combination of resources that provides the lowest-cost long-term resource plan and mitigates fuel, technology, or other supply-side risk.

[4] The operation of air pollution control equipment on coal-fired plants reduces the generating capability of the units.

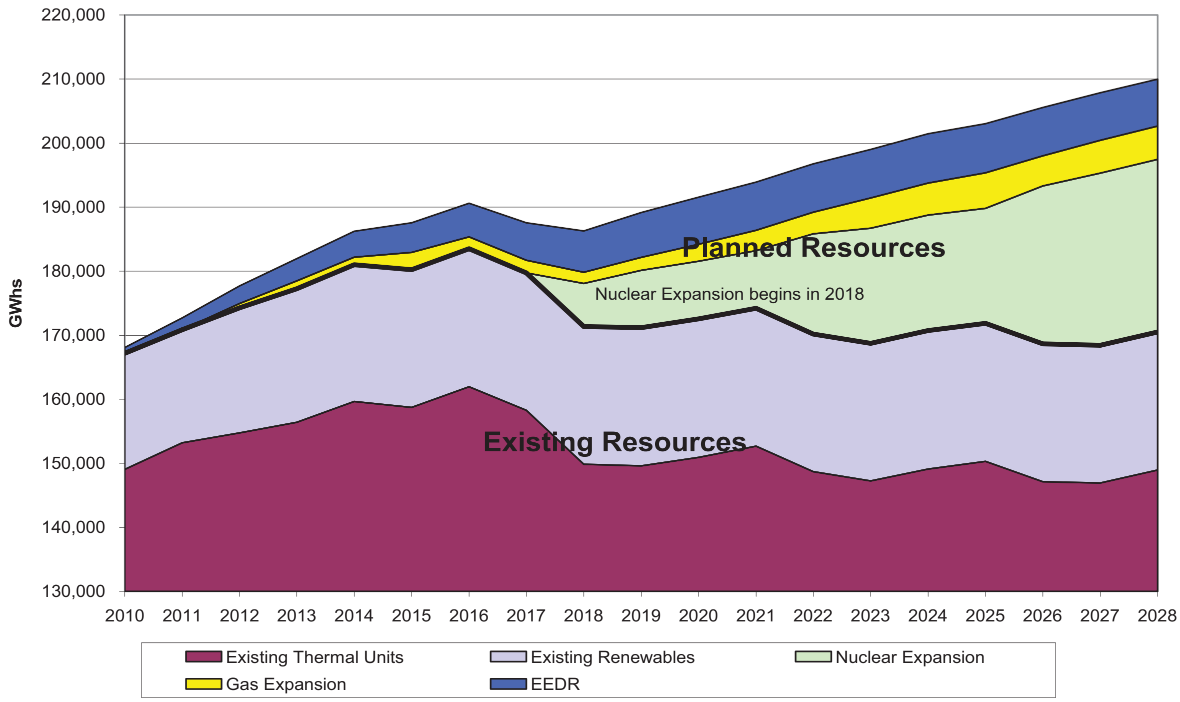


Figure 1-5. 2010 Base Case – Generation (GWh)

As shown in Figure 1-5, the majority of TVA's generation from existing resources comes from thermal (coal, gas, and nuclear) units and PPAs, with the remainder from renewable resources. The generation from existing thermal units declines after 2016 due to reductions in coal unit capacity and planned long-term lay-up of units. Renewable resources increase from 2010 to 2014 due to the recently purchased wind generation.

The projected resources consist of EEDR and natural gas-fired generation through 2017 supplemented by nuclear expansion beginning in 2018. The nuclear expansion consists of the completion of nuclear units at the Bellefonte site although that has yet to be proposed and would depend on a number of factors including future events. TVA anticipates acquiring additional renewable resources to meet future capacity needs through PPAs, but planning has not progressed to the point where they can be included in the base case.

By relying less on carbon-emitting sources, there are significant reductions in emissions from TVA's coal- and gas-fired generation. The projected changes in emissions from the TVA system in the long-term resource plan between 2010 and 2019 are shown in Table 1-1. Emissions of SO_2, NO_x, and mercury are cut by over half from 2010 levels. Carbon dioxide (CO_2) emissions are reduced by 1.3 percent.

Table 1-1. Changes in TVA Emissions From 2010 to 2019 by Pollutant Type

Change in Emissions (percent)			
Sulfur Dioxide	Nitrogen Oxide	Carbon Dioxide	Mercury
-68	-52	-1.3	-60

1.4.4. Effect of Alternatives on Long-Term Resource Plan

Three generation alternatives to the base case long-term resource plan have been evaluated:

- Alternative A – No Action
- Alternative B – Completion and Operation of a B&W Pressurized Light Water Reactor at Bellefonte
- Alternative C – Construction and Operation of an AP1000 Advanced Passive Pressurized Light Water Reactor at Bellefonte

The expected energy mix for the No Action Alternative (Alternative A) is shown in Figure 1-6 for the period from 2010 to 2028. The long-term supply needs of the TVA region are met only by EEDR resources and natural gas expansion in the No Action Alternative. There are no nuclear expansions beginning in 2018, as there is in the base case. There is more generation from TVA's existing coal and gas resources because the incremental cost of running the existing units is less expensive than adding new gas units. Consequently, the No Action Alternative results in higher emissions in 2019 than the base case. Therefore, there is less reduction in SO_2, NO_x, and mercury emissions from 2010 levels in the No Action Alternative—1 percent less for SO_2 and 2 percent less for NO_x and mercury. CO_2 emissions in 2019 increase by 5.6 percent from 2010 levels in the No Action Alternative instead of decreasing by 1.3 percent as in the base case.

The expected energy mix for Alternative B is shown in Figure 1-7 for the period from 2010 to 2028. Alternative B has a very similar energy mix to base case. The portion of the generation from nuclear expansion attributable to the Bellefonte B&W alternative is shown as the darker green. Emissions reductions for Alternative B are virtually the same as Table 1-1.

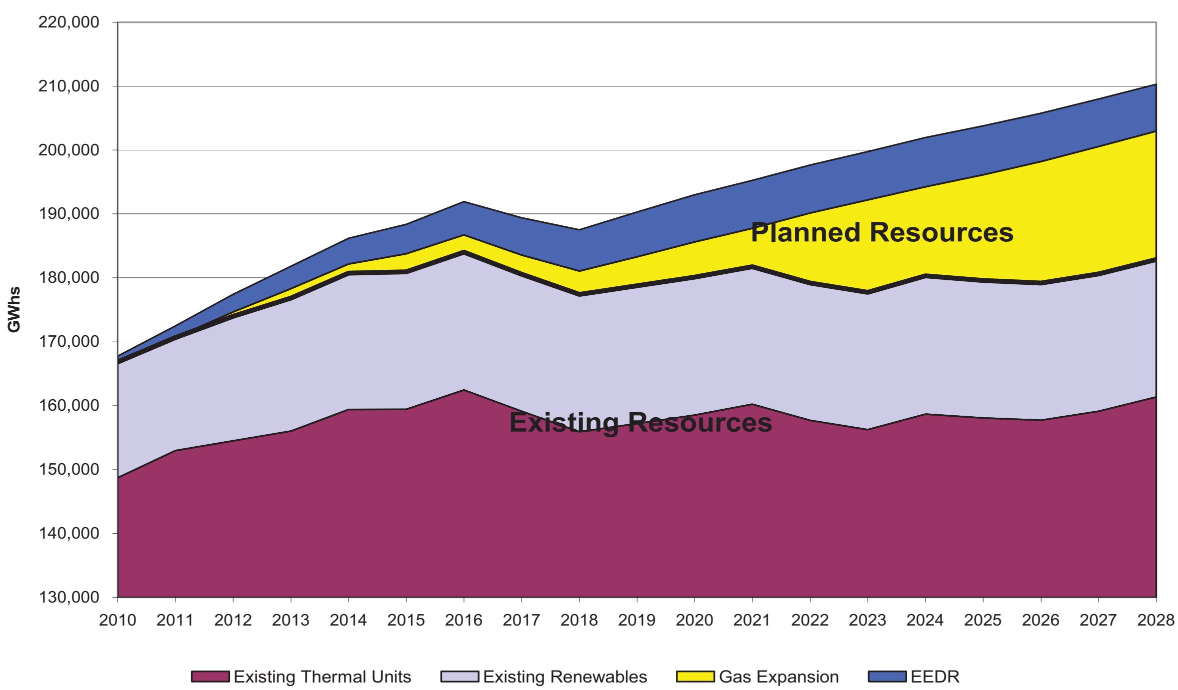


Figure 1-6. Alternative A – No Action With No Nuclear Expansion

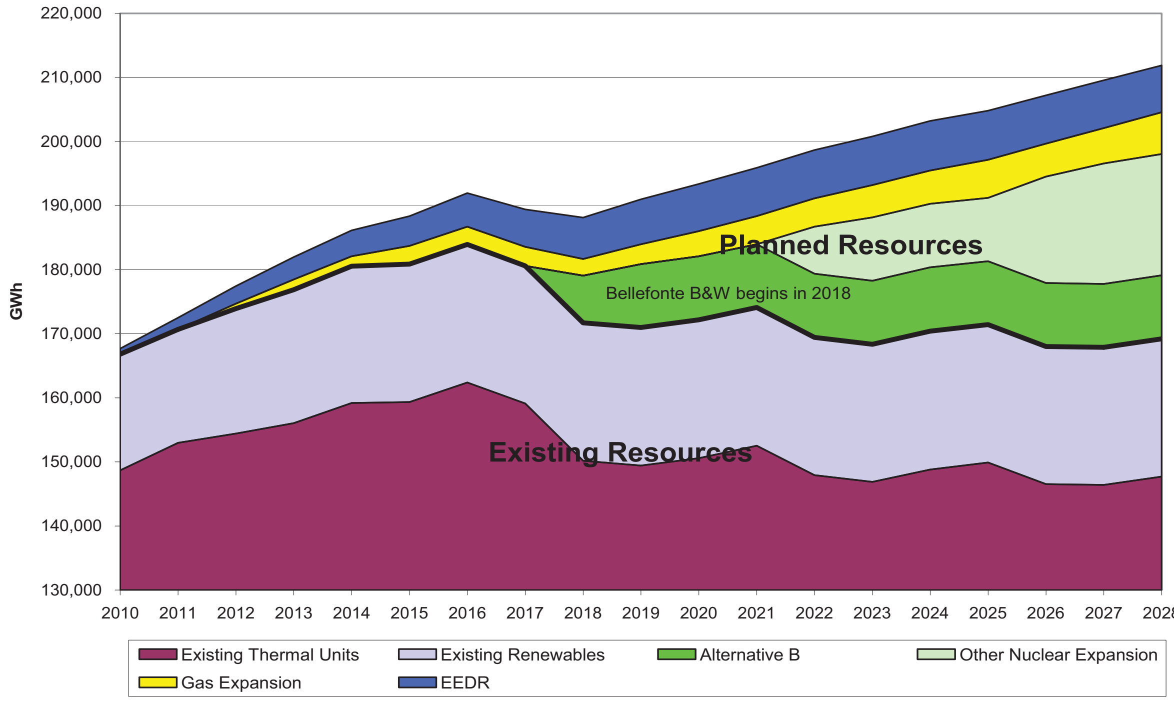


Figure 1-7. Alternative B – Bellefonte B&W

The expected energy mix for Alternative C has very similar impacts to the generation profile as Alternative B and is therefore not represented graphically. Emissions reductions for Alternative C are virtually the same at Table 1-1.

TVA conducted a sensitivity study to analyze the effect of the Enhanced EEDR program discussed in Subsection 2.4.1 on the expected energy mix for Alternative B and is shown in Figure 1.8. The Enhanced EEDR program leads to reductions in 3,500 MW of capacity and approximately 10,500 GWh in electric generation by 2019. Figure 1-8 shows that increasing EEDR resources results in less gas expansion and market purchases based on gas and less generation by existing TVA coal and gas resources. Existing and planned nuclear generation is unaffected, meaning nuclear generation is the same with an Enhanced EEDR program as in the base case. Adding more EEDR resources results in an additional 0.5-1.0 percent reduction in 2019 SO_2, NO_x, and Mercury emissions relative to 2010, as compared to the base case (Table 1-1). CO_2 emissions are reduced by 3.4 percent instead of 1.3 percent.

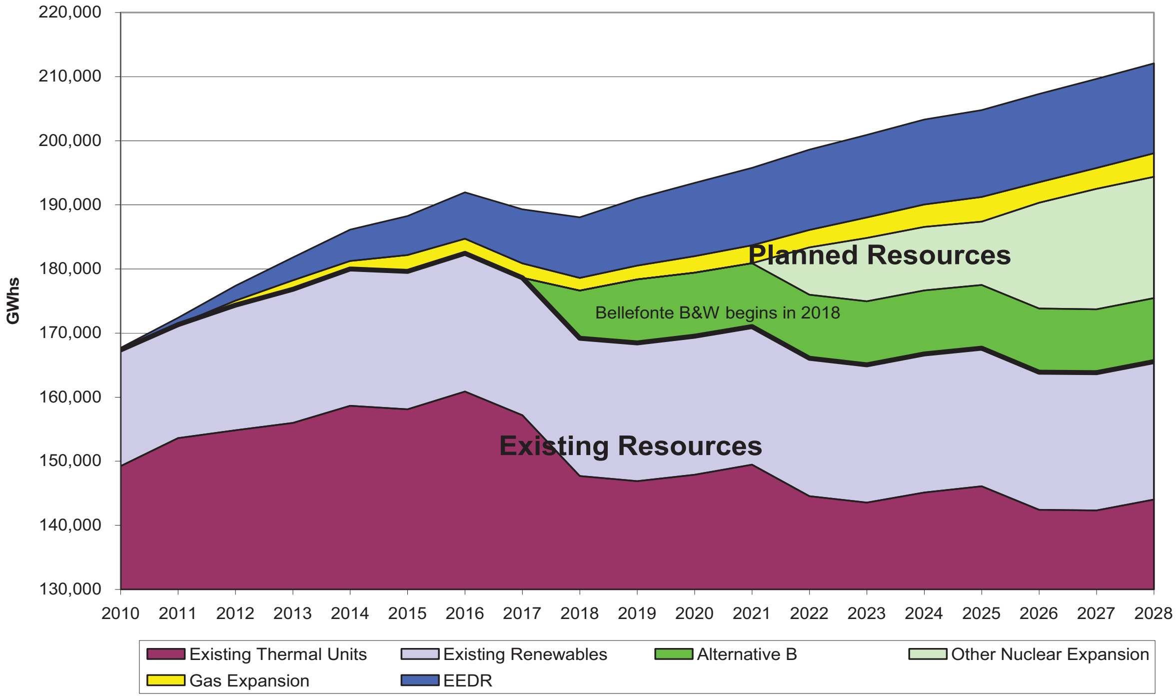


Figure 1-8. Estimated Generation by Fuel Type With Modified Assumptions

Future development and improvement of the EEDR portfolio will be influenced by many things including program measurement and verification results, the economic performance of current programs, and technology advancement and penetration in the marketplace. If EEDR programs are proven successful, TVA could further reduce reliance on its carbon-emitting generation sources.

1.4.5. Average Cost of Power

The annual cost of power in 2018-2024 for the base case and all alternatives is shown in Table 1-2. The annual cost of power does not include the payments in lieu of taxes, fuel cost adjustment, and other minor costs, but is otherwise consistent with the delivered cost of power shown in the DSEIS. Differences between alternatives and the base case using the annual cost of power have the same trends as differences using the delivered cost of power indicator.

Table 1-2. Effect of One BLN Nuclear Unit on TVA's Annual Cost of Power

Scenario	cents/kWh						
	2018	2019	2020	2021	2022	2023	2024
Base Case	6.7	6.9	7.2	7.5	7.8	8.1	8.3
Alternative A - No Action with No Nuclear Expansion	6.5	6.8	7.1	7.4	7.8	8.2	8.4
Alternative B - Bellefonte B&W	6.6	6.8	7	7.3	7.6	7.9	8.1
Alternative C - Bellefonte AP1000	6.6	6.8	7.1	7.4	7.8	8.1	8.3
Change from Revised Base Case							
Alternative A - No Action with No Nuclear Expansion	(0.18)	(0.13)	(0.08)	(0.07)	(0.08)	0.04	0.05
Alternative B - Bellefonte B&W	(0.11)	(0.13)	(0.11)	(0.11)	(0.21)	(0.23)	(0.22)
Alternative C - Bellefonte AP1000	(0.02)	(0.04)	(0.03)	(0.03)	(0.03)	(0.00)	(0.01)

The annual cost of power for all three alternatives is lower than the cost of power in the base case. The cost of power for the No Action Alternative loses its cost advantage compared to the base case over time and becomes more costly than the base case by 2023 because it relies only on natural gas expansion and EEDR to provide for future energy needs. A B&W unit would be less costly than the base case and would increase its cost advantage over time relative to the base case because of the lower operating cost and lower capital cost of the B&W unit. The annual cost of an AP1000 unit would not be significantly less expensive than the base case. Operation of a B&W unit would be the least costly alternative for providing additional generation by 2020 and overall the most cost-effective alternative for providing base load energy.

1.4.6. Summary

The Need for Power analysis shows that the demand for capacity and energy in the TVA region exceeds what TVA's existing resources can provide. Required reductions in emissions from TVA coal-fired units have resulted in plans to add emissions controls and long-term lay-up of existing coal units. Consequently, the generation from existing TVA resources is projected to decrease in the future.

TVA anticipates using a mix of resources, including EEDR programs, renewable resources, natural gas-fired generation, and nuclear generation to provide the additional future needs. Given the magnitude of the capacity and energy need, and to avoid the risk of relying on only one fuel or technology, no single resource can meet all of the future energy and capacity requirements.

The decision anticipated in this SEIS is the choice of the next capacity addition to the TVA portfolio. Given the future capacity and generation needs and analyzing a number of different resource mixes, TVA has determined that adding a nuclear unit at the BLN site is the most cost-effective alternative to meet a portion of these future needs. A nuclear unit at the BLN site would (1) supply reliable, low-cost power from a proven high-energy-producing resource; (2) afford increased operating flexibility in the face of increasing environmental constraints; and (3) provide TVA's customers with additional fuel cost stability to reduce risk from volatile fuel prices.

1.5. National Environmental Policy Act (NEPA) Process

The NEPA process, 42 U.S.C. §§ 4321 et seq., requires federal agencies to consider the impact of their proposed actions on the environment before making decisions. If an action is expected to have a significant impact on the environment, the agency proposing the action must develop a study for public and agency review. This study, called an EIS, is an analysis of the potential impacts to the natural and human environment from the proposed action, as well as from a range of reasonable alternatives. The Council on Environmental Quality (CEQ) regulations (40 CFR §1505.1) require federal agencies to make environmental review documents, comments, and responses a part of each agency's administrative record. When an agency proposes substantial changes to a previously reviewed action and/or significant new circumstances or information are present, agencies are directed to prepare supplements to previously prepared EISs (40 CFR §1502.9). TVA is preparing this SEIS to update information in the BLN 1974 FES and other pertinent reviews relative to its proposed action to complete or construct and operate a single nuclear unit at the BLN site.

In compliance with 40 CFR §1501.7, TVA prepared and issued a notice of intent (NOI) to prepare this SEIS. The NOI was published on August 10, 2009 (74 *Federal Register*

40000). This NOI briefly described the proposed action, reasonable alternatives, and probable environmental issues to be addressed in the SEIS. Because of the number of environmental reviews, including public involvement, that have been developed related to the BLN project over the last 35 years, TVA did not solicit public scoping comments as part of the NOI consistent with 40 CFR §1502.9(c)(4).

At the close of the DSEIS public comment period, TVA responded to the comments received and incorporated any required changes into the FSEIS. TVA has completed consultation with the U.S. Fish and Wildlife Service (USFWS) and the appropriate State Historic Preservation Officers (SHPOs). The completed FSEIS will be sent to those who received the DSEIS or submitted comments on the DSEIS. It will also be transmitted to the U.S. Environmental Protection Agency (EPA) who will publish a notice of its availability in the *Federal Register*.

TVA will make a decision on the proposed action no sooner than 30 days after the notice of availability (NOA) of the FSEIS has been published in the *Federal Register*. This decision will be based on the project purpose and need, anticipated environmental impacts as documented in the FSEIS, along with cost, schedule, technological, and other considerations. To document the decision, TVA will issue a record of decision (ROD). The ROD normally includes (1) what the decision was; (2) the rationale for the decision; (3) what alternatives were considered; (4) which alternative was considered environmentally preferable; and (5) any associated mitigation measures and monitoring, and enforcement requirements.

1.6. Public Review Process

1.6.1. Scoping

NEPA regulations require an early and open process, known as the scope of the evaluation, for deciding what should be discussed in an environmental review. However, additional public scoping is not required for an SEIS per 40 CFR §1502.9(c)(4).

As described below, the BLN site and the B&W and AP1000 technologies have received extensive environmental review, including public comments, over the last 35 years. Extensive internal scoping, including compilation and review of the documents listed in Table 1-3 and review of the COLA ER (TVA 2008a) and NRC public scoping related to the COLA, was conducted by a TVA interdisciplinary team. In addition, TVA has considered records related to public review of the SEIS for *Completion and Operation of Watts Bar Nuclear Plant Unit 2* (TVA 2007a) completed in connection with the Watts Bar Unit 2 operating license application.

Based on these reviews and an assessment of the proposed action, TVA has determined that the scope of the FSEIS should include the following topics:

- Surface Water and Groundwater Resources
- Floodplains and Flood Risk
- Wetlands
- Aquatic and Terrestrial Ecology
- Endangered and Threatened Species
- Natural Areas
- Recreation
- Archaeological Resources and Historic Structures

- Visual Resources
- Noise
- Socioeconomics, including environmental justice
- Solid and Hazardous Waste
- Seismology (i.e., earthquakes)
- Climatology and Meteorology, Air Quality, and Global Climate Change
- Radiological Effects of Normal Operations
- Uranium Fuel Use Effects (radioactive waste, spent fuel, and transportation)
- Nuclear Plant Safety and Security
- Decommissioning
- Transmission System Improvements

1.6.2. Draft Review and Preparation of FSEIS

The DSEIS for the Single Nuclear Unit at the Bellefonte Plant Site was posted on TVA's Web site on November 4, 2009. Copies of the draft were mailed to state, local, and federal agencies and organizations listed in Section 7.1. EPA published an NOA on November 13, 2009 (74 *Federal Register* 58626). A press release describing opportunities for commenting on the DSEIS, including an information open house, was issued on November 10, 2009 (see Section 7.2). Paid advertisements for the open house (see Section 7.3) were published in seven regional newspapers between December 2 and December 7, 2009 (listed in Section 7.3).

An information open house was held on December 8, 2009, at the Goose Pond Civic Center in Scottsboro, Alabama, from 4:00 to 8:00 p.m. Central Standard Time. Forty-nine people registered. During the open house, comments on the draft could be made orally to a court reporter, on the Internet by computer, or by written comment form. A copy of the open house handout is included in Section 7.4.

TVA accepted comments on the DSEIS from November 13 until December 28, 2009. Comments were received from 35 individuals and four federal and state agencies. Many of the commenters supported nuclear power, while others voiced general concerns about the use of nuclear power. Many comments focused on the age of existing structures, water quality, reactor design, the safety of nuclear power, air quality, spent fuel, radwaste, alternative sources of energy and conservation, and socioeconomic impacts. Some comments raised concerns about the need and cost of power. A listing of all comments received and TVA's responses to these comments are included in Appendix C.

This FSEIS reflects revisions in support of the responses to comments on the DSEIS including an updated need for power analysis, more analysis of transportation effects in Subsection 3.13.10 and an expanded treatment of global climate change in Subsection 3.16.3.

1.7. Other Pertinent Environmental Reviews and Documentation

Past Documents Related to the BLN Site

Several evaluations in the form of environmental reviews, studies, and white papers have been prepared for actions related to the construction and operation of a nuclear plant or alternative power generation source at the BLN site. The following paragraphs describe some of the most pertinent documents. These documents are available on TVA's Web page at http://www.tva.gov/environment/reports/index.htm. As provided in the regulations

(40 CFR §1502) for implementing NEPA, this SEIS updates, tiers from, and incorporates by reference information contained in these documents about the BLN site and about nuclear plant construction and operation.

The environmental consequences of constructing and operating BLN 1&2 were addressed comprehensively in TVA's 1974 FES (TVA 1974a). The FES concluded that the principal ways the plant will interact with the environment are (1) releases of small quantities of radioactivity to the air and water, (2) releases of minor quantities of heat and nonradioactive wastewaters to Guntersville Reservoir and major quantities of heat and water vapor from the plant's cooling towers into the atmosphere, and (3) a change in land use from farming to industrial.

By 1993, when TVA drafted a white paper in support of TVA's 120-day notice to NRC for resumption of plant construction, most of the construction effects had already occurred. The white paper reviewed 10 aspects of TVA's proposal in its 1974 FES that had changed or were likely to change. It concluded that most of the changes involved design modifications or changes in expected operational practices that would improve safety or lessen potential environmental impacts. Because none of the changes were determined to materially affect impact projections in TVA's 1974 FES, TVA concluded that the FES would not have to be supplemented. However, TVA subsequently chose not to resume construction.

Environmental conditions at the BLN site have been comprehensively reviewed three more times since 1993. The 1997 Final EIS for the Bellefonte Conversion Project (TVA 1997) considered construction and operation of five optional types of fossil fuel generation, four of which involved plants with total electricity production capacity equivalent to BLN 1&2 (approximately 2,400 MW). The Conversion EIS substantially updated the description of the affected environment at BLN, and the potential for environmental impacts from new construction. The proposed combustion turbine plant was not constructed.

In the late 1990s, TVA participated as a cooperating agency with the U.S. Department of Energy (DOE) on an environmental review evaluating the production of tritium at one or more commercial light water reactors (CLWR) to ensure safe and reliable tritium supply for U.S. defense needs. The final environmental impact statement (FEIS) for the *Production of Tritium in a Commercial Light Water Reactor* (DOE 1999) addressed the completion and operation of BLN 1&2 and updated the environmental analysis of their operation. TVA adopted this DOE FEIS in May 2000. TVA's current proposal to complete additional generating capacity at the BLN site does not involve the production of tritium. The CLWR FEIS includes pertinent information on spent nuclear fuel management, health and safety, decommissioning, and other topics.

Most recently in 2007, as a part of a COLA process, TVA, as a member of the NuStart Consortium, prepared and submitted to NRC a comprehensive ER for the construction and operation of two AP1000 nuclear units at the BLN site (see Subsection 1.2.3). In addition to updating the description of environmental conditions at the BLN site and some operational aspects of the cooling water system, the COLA ER fully describes the environmental effects of constructing and operating two AP1000 units. The ER also contains a discussion of alternative sites and energy resource options. The ER was revised in response to NRC requests for additional information, and COLA ER Revision 1 (hereafter referred to as the COLA ER) was issued in October 2008 (TVA 2008a).

Other Related Documents

In addition to documents directly related to the BLN site, two other TVA documents are relevant to this SEIS. In December 1995, TVA completed a comprehensive environmental review of alternative means of meeting demand for power on the TVA system through the year 2020, published as *Energy Vision 2020 – Integrated Resource Management Plan and Final Programmatic Environmental Impact Statement* (TVA 1995; hereafter referred to as *Energy Vision 2020*). Deferral and/or completion of BLN 1&2, individually or together, were among the resource options evaluated in that FEIS, but not as the preferred alternative. The alternative adopted by the TVA Board following completion of the *Energy Vision 2020* was a portfolio of various supply- and demand-side energy resources. Completion of BLN Units 1 and/or 2 was not part of this portfolio.

In *Energy Vision 2020*, TVA made conservative assumptions about the expected capacity factor (performance—roughly how much a unit would be able to run) of its nuclear units. This capacity factor was used in conducting the economic analyses of nuclear resource options. TVA nuclear units, consistent with nuclear industry performance in the United States, now routinely exceed this earlier assumed capacity factor, which changes the earlier analyses for BLN 1&2, and the increased capacity factor is used in the current consideration of completing the unit (see Section 1.4, Need for Power).

On June 15, 2009, TVA announced its intent to conduct a new comprehensive study and EIS entitled *Integrated Resource Plan: TVA's Environmental and Energy Future.* This new plan will replace *Energy Vision 2020* and is scheduled to be completed by 2011. In order to meet the anticipated demand for base load power, TVA must make a decision on a single nuclear unit at BLN before the new IRP is completed. The proposal set out in the BLN FSEIS supports TVA's efforts to reduce its carbon footprint and the need to make beneficial use of the existing infrastructure at the BLN site.

In February 2004, TVA issued its *Reservoir Operations Study Final Programmatic Environmental Impact Statement* (ROS FEIS) evaluating the potential environmental impacts of alternative ways of operating the agency's reservoir system to produce overall greater public value for the people of the Tennessee Valley (TVA 2004). The ROS FEIS evaluated, among other things, the adequacy of the water supply necessary for reliable, efficient operation of TVA generating facilities within the operating limits of their National Pollutant Discharge Elimination System (NPDES) permits and other permits. A ROD for the ROS FEIS was subsequently issued in May 2004. Although operation of a single nuclear unit was not included in the ROS FEIS analysis, the reservoir operations described therein are adequately robust and flexible to encompass the operation of a nuclear plant with a closed-cycle cooling system, which uses only a minor amount of the river flow passing the BLN site (see Section 3.1). Furthermore, BLN's location on a mainstream reservoir ensures TVA control of flows. The assumptions for reservoir operations resulting from the ROS FEIS review and the cumulative effects analysis as it pertains to the operation of BLN are incorporated by reference in the present evaluation and used in the hydrothermal analysis (see Subsection 3.1.3).

In addition to the documents mentioned above, Table 1-3 provides a more complete listing of relevant environmental documents pertaining to the construction and operation of a nuclear plant or alternative power generation source at the BLN site.

Table 1-3. Environmental Reviews and Documents Pertinent to the Bellefonte Nuclear Plant Site

Document Type	Title	Date
FES	*Final Environmental Statement, Bellefonte Nuclear Plant Units 1 and 2* (TVA 1974a)	May 24, 1974
FES	*Final Environmental Statement Related to Construction of Bellefonte Nuclear Plant Units 1 and 2*, Tennessee Valley Authority, Docket Nos. 50-438 and 50-439 (AEC 1974)	June 4, 1974
FER [1]	*Bellefonte Nuclear Plant Units 1 and 2 Environmental Report, Operating License Stage*, Volumes 1-4 (TVA 1976)	January 1, 1976
FSAR	*Bellefonte Nuclear Plant Units 1 & 2, Final Safety Analysis Report, Amendment 30* (TVA 1991)	Original as updated through 1991
White Paper	*Environmental Impact Statement Review, Bellefonte Nuclear Plant White Paper* (TVA 1993a)	March 1993
FEIS/ROD	*Energy Vision 2020 - Integrated Resource Plan and Final Programmatic Environmental Impact Statement*, and *Record of Decision* (TVA 1995)	December 1995
FEIS	*Final Environmental Impact Statement for the Bellefonte Conversion Project* (TVA 1997)	October 1997
FEIS	*Final Environmental Impact Statement for the Production of Tritium in a Commercial Light Water Reactor* (DOE 1999)	March 1999
ROD/ Adoption	*Record of Decision and Adoption of the Department of Energy Final Environmental Impact Statement for the Production of Tritium in a Commercial Light Water Reactor* (TVA 2000)	May 19, 2000
FEIS	*Guntersville Reservoir Land Management Plan, Jackson and Marshall Counties, Alabama, and Marion County, Tennessee* (TVA 2001)	August 2, 2001
FEIS	*Reservoir Operations Study Final Programmatic Environmental Impact Statement and Record of Decision* (TVA 2004)	May 19, 2004
FEA [2]	*Final Environmental Assessment Bellefonte Nuclear Plant Redress, Jackson County, Alabama* (TVA 2006)	January 2006
ER	*Bellefonte Nuclear Plant Units 3&4, COL Application, Part 3, Environmental Report, Revision 1* (TVA 2008a)	October 2008
FSAR	*Bellefonte Nuclear Plant Units 3&4, COL Application, Part 2, Final Safety Analysis Report, Revision 1* (TVA 2009a)	January 2009
FEA [2]	*Activities at Bellefonte Nuclear Plant Related to Future Site Use, Jackson County Alabama* (TVA 2008b)	July 2008

[1] Final Environmental Report
[2] Final Environmental Assessment

1.8. Permits, Licenses, and Consultation Requirements

Federal and state environmental laws establish standards for radiation exposure in the general environment (areas outside of the NRC-regulated area) and for sources of air pollution, water pollution, and hazardous waste. TVA will obtain applicable permits by submitting construction and operation plans and specifications for review by the appropriate government agencies. Environmental permits contain specific conditions governing construction and operation of a new or modified emission source, describe pollution abatement and prevention methods to reduce pollutants, and contain emission limits for the pollutants that will be emitted from the facility.

TVA has maintained the BLN site in regulatory compliance following the cancellation of the construction permits by NRC in September 2006. Table 1-4 lists permits that have been cancelled since 2006 and those that are still active.

Table 1-5 lists federal, state, and local authorities evaluated for potential applicability to the proposed project.

Table 1-4. Permits Held or Canceled Since Year 2006

Type of Permit/Authorization	Expiration Date	Additional Information
NPDES Permit AL0024635	11/30/2014	Still active
NRC Construction Permit for Unit 1 - CPPR-122	10/01/2011	Cancelled September 2006; Reinstated March 9, 2009, to a “terminated plant” status
NRC Construction Permit for Unit 2 - CPPR-123	10/01/2014	Cancelled September 2006; Reinstated March 9, 2009, to a “terminated plant” status
Air Permit for Synthetic Minor Source Operation Permit #705-0021-X002 (two 115.2 million British thermal units/hour auxiliary boilers (No. 2 diesel oil fuel)	None	Cancelled June 2007; auxiliary boiler building sold and dismantled
Air Permit for Synthetic Minor Source Operating Permit #705-0021-X004 (two 7,000-kilowatt [kW] diesel generators)	None	Still active
Resource Conservation and Recovery Act (RCRA) EPA Identification No. AL5640090002	None	Still active

Table 1-5. Federal, State, and Local Environmental Authorizations

Statute/Agency	Authority	Activity Covered
U.S. Nuclear Regulatory Commission (NRC)	10 CFR Part 50; 10 CFR Part 52	Construction and Operation for Commercial Nuclear Plant.
Endangered Species Act (ESA) USFWS	16 United States Code (U.S.C.) §1531 et seq.	Consultation with USFWS for potential impacts to federally listed threatened or endangered species.
Native American Graves Protection and Repatriation Act	25 U.S.C. §3001 et seq.	Provides for the repatriation of Native American human remains or cultural items that are excavated from or inadvertently discovered on federal lands.
American Indian Religious Freedom Act	42 U.S.C. §1996	Protection and preservation of traditional religions of Native Americans.

Statute/Agency	Authority	Activity Covered
National Historic Preservation Act of 1966 Alabama, Tennessee, and Georgia Historical Commissions; SHPO; Federal Advisory Council on Historic Conservation	16 U.S.C. §§470 et seq.	Consultation with SHPO for potential impacts to historic properties listed in the National Register of Historic Places.
Object Affecting Navigable Space; Federal Aviation Administration (FAA)	Title 49, Subtitle VII; 14 CFR Part 77	Preconstruction letter of notification to FAA results in a written acknowledgment certifying that no hazards would result from constructing and operating the BLN Units 1 and 2. Similar acknowledgment may need to be obtained for the proposed project.
U.S. Coast Guard	14 U.S.C. §§81, 83, 85, 633; 49 U.S.C. §1655(b)	Navigation markers authorization to protect river navigation from hazards connected with construction activities in a river. TVA complies voluntarily.
U.S. Army Corps of Engineers (USACE)	33 U.S.C. §1344; 33 U.S.C. §1341	*Clean Water Act* (CWA) Section 404 permit for the discharge of dredge or fill material into the waters of the United States. Concerned with placement of structures, working in or altering waters, and aquatic resources including wetlands. Alteration of jurisdictional wetlands requires compensatory mitigation if such impacts cannot be avoided. A state Section 401 certification that the action does not violate state water quality standards must be obtained prior to application for a USACE Section 404 permit.
EPA/Alabama Department of Environmental Management (ADEM)	42 U.S.C. §§7661-7661f; Title 22, Alabama Code, Chapter 28	Construction permit and operating permit for emission of air pollutants from the proposed project.
EPA/ADEM	33 U.S.C. §1342; Title 22, Alabama Code, Chapter 22	Existing permit identifies outfalls through which wastewater may be discharged. Permit may need to be modified for the proposed project.
EPA/ADEM	33 U.S.C. §1342; Title 22 Alabama Code, Chapter 22	Storm water runoff control for construction and individual sites
RCRA; *Alabama Hazardous Waste Management and Minimization Act*	42 U.S.C. §6901 et seq.; Title 22, Alabama Code, Chapter 30	Permit for construction of a disposal facility.
RCRA; *Alabama Hazardous Waste Management and Minimization Act*	42 U.S.C. §6901 et seq.; Title 22, Alabama Code, Chapter 30	Permit for disposal of nonhazardous waste.
RCRA; Alabama Hazardous Waste Management and Minimization Act	42 U.S.C. §6901 et seq.; Title 22 Alabama Code, Chapter 30	Transport, treatment, storage, and disposal of hazardous waste.
Executive Order (EO) 11514 (Protection of Enhancement of Environmental Quality)	40 CFR §§1500-1508	Requires federal agencies to protect and enhance the quality of the environment; develop procedures to ensure the fullest practicable provision of timely public information and understanding of federal plans and programs that may have potential environmental impacts so that the views of interested parties can be obtained.
EO 11988 (Floodplain Management)	10 CFR §1022; 18 CFR Part 725	Requires federal agencies to avoid floodplain impacts to the extent practicable.

Statute/Agency	Authority	Activity Covered
EO 11990 (Protection of Wetlands)	10 CFR §1022; 18 CFR Part 725	Requires federal agencies to avoid any short- and long-term adverse impacts on wetlands wherever there is a practicable alternative.

CHAPTER 2

2.0 ALTERNATIVES INCLUDING THE PROPOSED ACTION

TVA considered a number of alternatives to constructing and operating BLN 1&2 in its 1974 FES, including various sources of base load generation and eight alternative plant locations. In subsequent environmental reviews, as part of the COLA process, TVA evaluated the construction and operation of AP1000 units (BLN 3&4) at the BLN site, which also included alternative sites and energy resource options. In this FSEIS, TVA discusses in detail three generation alternatives and two transmission alternatives. The nuclear generation alternatives include: Alternative A – No Action, Alternative B – Completion and Operation of a B&W Pressurized Light Water Reactor, and Alternative C – Construction and Operation of an AP1000 Advanced Passive Pressurized Light Water Reactor. These alternatives are described below in Sections 2.1, 2.2, and 2.3, respectively. The transmission alternatives, described in Section 2.6, include an Action and a No Action Alterative. All of these alternatives were considered in previous environmental reviews or reports (see Section 1.7), which are incorporated herein by reference. The project area for the nuclear generation alternatives, shown in Figures 2-1 and 2-12, is defined as the area within the BLN site where all construction activity would occur for either Alternative B or C. The project area includes the south security checkpoint on Bellefonte Road shown in the map inset of Figure 2-1.

These previous reviews also addressed alternatives to nuclear generation, including energy sources not requiring new generating capacity (i.e., power purchases; repowering, reactivating, uprating, or extending service life of existing plants; and DSM). Alternatives requiring new generating capacity (e.g., coal, natural gas, hydroelectric, and renewable sources) were also assessed, as were combinations of alternatives. A discussion of alternative energy sources considered is provided in Section 2.4. Section 2.5 describes the site screening process, identification of candidate sites, and the selection of the BLN site as the preferred site for additional nuclear generation.

Section 2.7 compares the alternatives for a single nuclear generating unit at the BLN site and summarizes the anticipated environmental impacts of the three generation alternatives and two transmission system alternatives. Mitigation measures designed to avoid or minimize impacts to resources are described in Section 2.8, and TVA staff's preferred alternative is addressed in Section 2.9.

In response to public and agency comments on the DSEIS, information was added to Chapter 2 to clarify the comparison of the two reactor technologies, explain the Detailed Scoping, Estimating, and Planning (DSEP) process, and enhance the discussion of energy alternatives.

2.1. Alternative A – No Action

Under the No Action Alternative, TVA would continue to maintain the construction permits for BLN 1&2 in deferred status. In deferred status, no construction would occur, and no power would be generated on site. TVA would continue to maintain selected plant systems and the physical plant to prevent deterioration, including major components such as the intake and discharge structures, cooling towers, and wastewater system. The switchyards and the transformer yard on site would continue to be maintained in an active state. TVA would continue to use the simulator building. TVA has refurbished the construction administration building to provide office space for personnel assigned to study the feasibility

of completing BLN 1&2, and TVA would continue to maintain facilities to house personnel. The on-site staff would total approximately 50 persons.

The existing containment, turbine, and auxiliary buildings would not be demolished. Other structures not identified as necessary would continue to be sold, dismantled, and removed from the site, or demolished. Such structures, most of which are metal and wood warehouses, are located in the western portion of the site. Any demolition wastes generated would be disposed of in appropriately permitted solid waste or other disposal facilities. Equipment identified as unnecessary would have the power disconnected and would either be reused at other TVA facilities, sold for reuse elsewhere, or abandoned in place. TVA has both agency and site processes and procedures in place to safely handle the demolition and removal of the identified equipment, structures, and fuels or lubricants in an environmentally sound manner. TVA would continue to conduct periodic site inspections to ensure that none of the equipment or materials would cause environmental, health, or safety problems. In deferred status, TVA would also perform basic maintenance of key equipment and structures.

TVA would continue regulatory compliance activities that include monitoring and maintenance of equipment used to assure compliance with NPDES and Spill Prevention Control and Countermeasures (SPCC) programs. In addition, monitoring reports, demolition permits (10-day notifications), and permits applicable to the entire site would be maintained. These measures would continue as long as TVA has ownership of the BLN site. The NPDES permit, an Air Permit for Synthetic Minor Source Operation related to diesel generators, and a RCRA permit remain active. Maintaining and complying with these existing permits and regulations would ensure the stability of the site until such time that TVA may decide if, or how, the site would be utilized. Such a future decision would be subjected to the appropriate environmental review at that time. Under the No Action Alternative, TVA would continue to pursue the BLN 3&4 licensing activities leading to the issuance of a COL in order to preserve future generation options.

2.2. Alternative B – Completion and Operation of a Single B&W Pressurized Light Water Reactor

Under Alternative B, TVA would complete and operate one B&W pressurized light water reactor, either BLN Unit 1 or Unit 2, as described in TVA's 1974 FES (TVA 1974a) and Bellefonte FSAR (TVA 1978a). The B&W facility descriptions provided in Subsection 2.2.1 are based on the contents of these documents.

2.2.1. Facility Description for Single Unit Operation

Each of the two B&W pressurized light water reactors is rated at 3,600 MWt (core thermal) with a stretch capability of 3,760 MWt, and an expected electrical output of 1,260 MW. The station operating life is expected to be at least 40 years.

The plant structures (see Figure 2-1) presently consist of two reactor containment buildings, a control building, a turbine building, an auxiliary building, a service building, a condenser circulating water pumping station, two diesel generator buildings, a river intake pumping station, two natural draft cooling towers, a transformer yard, a 500-kilovolt (kV) switchyard and a 161-kV switchyard, two spent nuclear fuel storage pools, and sewage treatment facilities. Additionally, there are office buildings to house engineering and other personnel. Entrance roads, parking lots, railroad spurs, and a helicopter landing pad are in place and are capable of supporting a construction project.

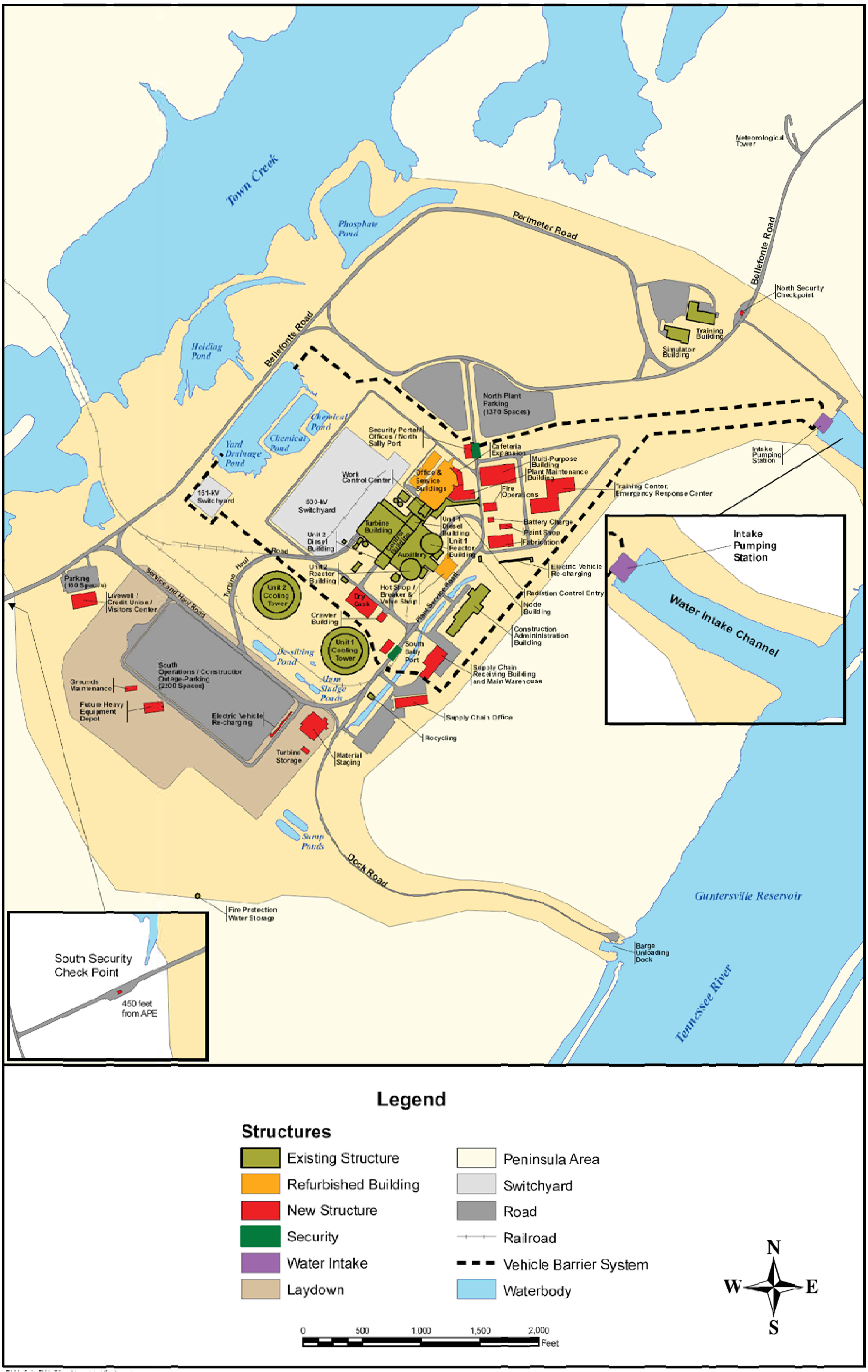
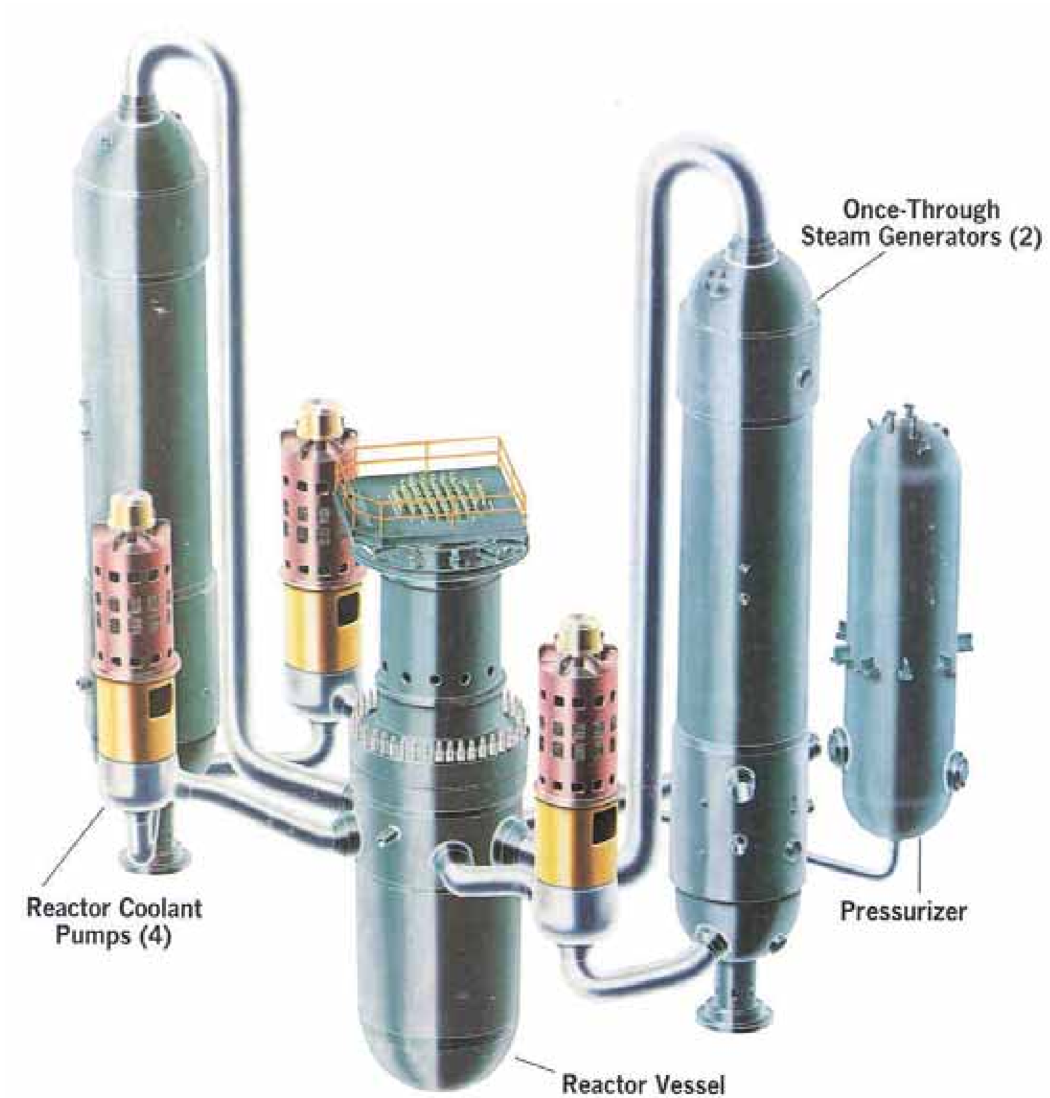


Figure 2-1. B&W Site Plan

Reactor Power Conversion System and Reactor Coolant System
The nuclear steam supply system design for each unit comprises a pressurized light water reactor, the reactor coolant system, and associated auxiliary fluid systems. The reactor coolant system (see Figure 2-2) is arranged in two, closed coolant loops connected in parallel to the reactor vessel. Each loop contains two reactor coolant pumps and a once-through steam generator. An electrically heated pressurizer is connected to one of the loops.



Source: AREVA 2009a

Figure 2-2. B&W Reactor Coolant System

The reactor core consists of 205 fuel assemblies, 72 control rod assemblies, and eight axial power shaping rod assemblies. Each 12-foot fuel assembly provides for 264 fuel rods, 24 rod guide tubes, and one instrumentation tube positioned in a 17 by 17 array. The core is designed to operate approximately 18 months between refueling (DOE 1999).

The reactor and reactor coolant system have three primary safety functions. First, the system is designed to provide conditions for the reactor coolant temperature, pressure, flow, and core power that allow adequate heat removal from the fuel. This safety function maintains the integrity of the fuel cladding, which is the primary barrier to the release of radioactive fission products. Second, the reactor coolant system is designed to maintain its integrity under all operating conditions, which functions as a second barrier to the release of fission products that may escape the fuel cladding. Third, the system is able to place the reactor core in a safe shutdown condition, assuming failure of a supporting system or failure of the reactor coolant system itself. Several supporting systems aid in performing these safety functions.

The reactor building for each unit consists of a post-tensioned concrete primary containment structure and a free-standing reinforced concrete secondary containment structure. The primary containment, which houses the reactor power conversion and coolant systems, has a leak-tight 0.25-inch-thick steel liner. This primary containment is surrounded by a free-standing secondary containment composed of a reinforced concrete shell designed to maintain a slight vacuum in the annulus between the primary containment and the secondary containment to assure in-leakage into the annulus. The primary containment has a design pressure of 50 pound-force per square inch gauge (psig) and is designed to withstand the internal pressure associated with any design-basis loss-of-coolant accident. The secondary containment is designed to resist various combinations of seismic activity, wind, tornado forces, external missiles, snow loads, and external water pressure for normal and accident conditions.

The turbine generator system is designed to change the thermal energy of the steam flowing through the turbine into rotational mechanical work, which rotates a generator to provide electrical power. Each turbo-generator is a tandem compound, four-flow, two-stage reheat, 1,800 revolutions per minute (rpm) machine, manufactured by the Brown Boveri Corporation. The expected net generator electrical output is 1,260 MW at rated (licensed) power levels.

Cooling Water Systems

The component cooling water system provides cooling water for various system components and heat exchangers during both normal and accident conditions. The component cooling water system is a closed cooling system consisting of two separate cooling loops per unit and acts as an intermediate heat sink. This heat is then rejected to the essential raw cooling water. The essential raw cooling water system is designed to remove heat loads from safety-related equipment and systems. It consists of a total of eight main essential raw water cooling water pumps for both units, located in the intake pumping station to supply water from the river to the components to be cooled, and to discharge the water into the cooling tower basins. The intake pumping station is also equipped with four traveling water screens, and four screen wash pumps prevent the screens from becoming clogged with debris.

The intake channel directly connects to the main river channel at all reservoir levels, including loss of the downstream Guntersville Dam. The ultimate heat sink for the B&W units is the water source and associated routing structures, exclusive of the intake pumping station, which is used to remove waste heat from the plant under all conditions. The water source (also called the ultimate heat sink) is the Tennessee River, including the complex of TVA-controlled dams upstream of the plant intake, Guntersville Dam, and the plant intake channel. The ultimate heat sink is designed to perform the principal safety function,

throughout the plant's life, of dissipating essential equipment heat loads after an accident and during normal conditions including startup, power generation, shutdown, and refueling.

Engineered Safety Features
Engineered safety features are used to reduce the potential radiation dose to the general public from the result of a maximum hypothetical accident to below the guideline values of 10 CFR Part 100. The potential dose is reduced by immediate and automatic isolation of all reactor building fluid penetrations that are not required for limiting the consequences of the accident. This action eliminates these penetrations from becoming potential leakage paths. Long-term potential releases following the accident are minimized by reducing the reactor buildings' pressure to nearly atmospheric pressure within 24 hours, thereby reducing the driving potential for fission product escape.

In addition, the engineered safety features would cool the core, maintaining it in a coolable geometry should the worst postulated loss-of-coolant accident occur. This is accomplished by the emergency core cooling system, which includes the core flooding, high-pressure injection, and low-pressure injection systems. The core flooding system consists of two accumulator tanks directly connected to the reactor vessel via check valves. The tanks contain borated water with a nitrogen overpressure that provides automatic injection of the contained water through the check valves into the reactor vessel whenever the reactor coolant system pressure falls below the nitrogen pressure in the tank. The high-pressure injection system uses the high-pressure reactor makeup pumps to pump water from a borated water source into the cold leg reactor coolant piping near the reactor vessel inlet nozzles. The low-pressure injection system uses the decay heat removal pumps to take suction from a borated water source and pump this water through the decay heat removal heat exchangers directly into the reactor vessel through the core flood nozzles. After injection is complete, the coolant is recirculated by the low- and high-pressure injection pumps from an emergency sump below the reactor coolant system through the decay heat removal heat exchanger and back to the reactor vessel.

Each of the two nuclear units in the plant is provided with an independent electric power system to supply plant auxiliaries and provide instrumentation and control power. Each nuclear unit is provided with two diesel generators as standby power supplies in the event of a loss of all off-site power. Each diesel generator supplies power to one of the two redundant and independent Class IE power trains in each nuclear power unit. The capacity of the diesel generators would allow either one of the two generators per unit to supply safe shutdown or accident loads for its unit.

2.2.2. Use of Other Existing Structures and Systems

Natural Draft Cooling Tower
The existing cooling towers are closed-cycle, natural draft hyperbolic cooling towers. Each concrete tower is 474 feet high and has a basin with a diameter of 412 feet. This type of condenser cooling water system enables the plant to operate with a minimum thermal effect on the Tennessee River, because the system cycles cool water from the cooling towers through the condensers and discharges the warmed water back to the cooling towers in a closed system rather than discharging it to the river. As a result, closed-cycle cooling systems use substantially less water because the cooling water is continually recirculated through the main condenser and only makeup water for normal system losses is required.

Intake Channel and Pumping Station
The intake pumping station is located at the end of the intake channel extending 1,200 feet from the Guntersville Reservoir shoreline. The intake channel is centered in a natural draw on the west side of the reservoir. When constructed, the channel was excavated to rock to create a 200-foot-wide man-made channel from the reservoir to the intake pumping station. In addition, a 25-foot-wide trench was excavated into the rock along the centerline of the channel bottom and extends an additional 760 feet beyond the shoreline to the main river channel. This trench is angled to slope downward toward the intake pumping station from elevation 566.5 feet at the main river channel to elevation 565.5 feet near the intake pumping station. An intrusion barrier would be installed across the intake channel to provide security for the intake channel and pumping station. Approximately 11,100 cubic feet of dredged material would be removed from a total of 1,960 feet of intake channel (pumping station to main river channel). This proposed plant activity is described in greater detail in Subsection 2.2.4.

Blowdown Discharge Structure
The blowdown discharge system, which is designed to disperse water from the cooling tower, is discussed in greater detail in Subsection 3.1.3

Transmission Lines and Switchyards
Existing transmission lines and switchyards would be used. The transmission system is discussed in Section 2.6 and Chapter 4 of this SEIS.

Barge Unloading Dock
A barge unloading dock is located just north of the blowdown vault on the west bank of Guntersville Reservoir approximately 4,600 feet south of the intake channel. This facility was constructed with steel pilings to permit use of the facility throughout the operating life of the plant. Upgrades to the barge unloading dock are discussed in Subsection 2.2.4.

Railroad Spur
Norfolk Southern Railway Company (NSRC) owns and operates a railroad line, which runs through Scottsboro and Hollywood. TVA owns and controls a railroad spur that connects the BLN site to the NSRC mainline about 3 miles northwest of the BLN site. The rail spur would be refurbished and used to support delivery of components and equipment small enough to ship by rail.

Meteorological Tower
The existing meteorological tower was built in 2006. For a B&W unit, a taller tower may be needed to describe atmospheric transport and diffusion characteristics for operation of Unit 1 or 2. If necessary, either the height of the existing 55-meter tower would be increased or a new tower would be built that provides sufficient meteorological data. The existing instrumentation would be used on the taller tower. See Subsection 2.3.2 for additional information about the existing meteorological tower.

Exclusion Area Boundary
The exclusion area boundary (EAB) is the boundary on which limits for the release of radioactive effluents are based. The EAB is the same for both the B&W and AP1000 alternatives and is shown in Figure 2-3. This boundary was originally established as the licensing basis for BLN 1&2 and has not changed. The EAB follows the site property boundary on the land-bound side, the Tennessee River side, and the lower portion of Town Creek. The EAB extends beyond the site property boundary to the opposite shore of Town

Creek on the northwest side of the property. No residents live in this exclusion area. No unrestricted areas within the site boundary area are accessible to the public. The Town Creek portion of the EAB is controlled by TVA. The property is clearly posted and includes actions to be taken in the event of emergency conditions at the plant. The site's physical security plan contains information on actions to be taken by security personnel in the event of unauthorized persons crossing the EAB. The land and water inside the exclusion area is owned or controlled by TVA and is in the custody of TVA.

2.2.3. Current Status of Partially Constructed Facility

As described in Section 1.2, following deferral, BLN 1&2 were placed in a preventive maintenance and lay-up program to preserve plant assets. Over the years, the scope of this program was reduced when it was determined to be more economical to refurbish/replace certain plant components rather than continue the lay-up and preservation programs. The preservation maintenance and lay-up programs were continued until August 2005. Equipment maintained under this program would be evaluated to determine if it must be replaced or refurbished prior to completion and operation of a BLN unit.

In November 2005, TVA cancelled construction of BLN 1&2. TVA subsequently requested withdrawal of the construction permits from the NRC, and the NRC formally terminated the permits in 2006. After termination of the construction permits, TVA began an effort to recover sunk costs at the BLN site by disposing of plant assets. Some high value plant equipment was removed as part of these investment recovery activities. The *BLN Redress Environmental Assessment* (TVA 2006) discussed the need to remove equipment or structures not identified as necessary for other site activities. The items removed included piping, tanks, pumps, heat exchangers, valves, strainers, batteries, fans and motors, air compressors, shop equipment, and minor buildings. Other items removed included diesel generator fuel and other oils and lubricants. These buildings, equipment, fuel, and lubricants would be replaced as needed under Alternative B.

All major plant structures, including the reactor, auxiliary, control, turbine, and office and service buildings, and plant cooling towers were constructed for both Units 1&2 and remain intact. Some new construction would be required for the completion of either unit. The original power stores warehouse building has been removed and would need to be rebuilt. The auxiliary boiler building has been removed and would need to be replaced. It is expected that any new construction of buildings would occur on previously disturbed land. No new water intakes or outfalls are needed. The majority of the construction activities on plant systems and components would involve replacement or refurbishment of equipment contained within the current structures. As shown on Figure 2-1, all new construction support buildings, laydown areas, and parking areas except for the south security checkpoint would be situated on previously disturbed land within the original plant footprint.

As part of an update of the cost and schedule to complete BLN 1&2 that was completed in May 2008, TVA contracted with AREVA NP Inc. (AREVA) to assess the condition of selected plant features. AREVA conducted inspections of four mechanical systems, plant electrical systems/equipment, and plant civil/structural features in order to determine their condition. The inspections found BLN, accounting for removed equipment, was in generally good condition.

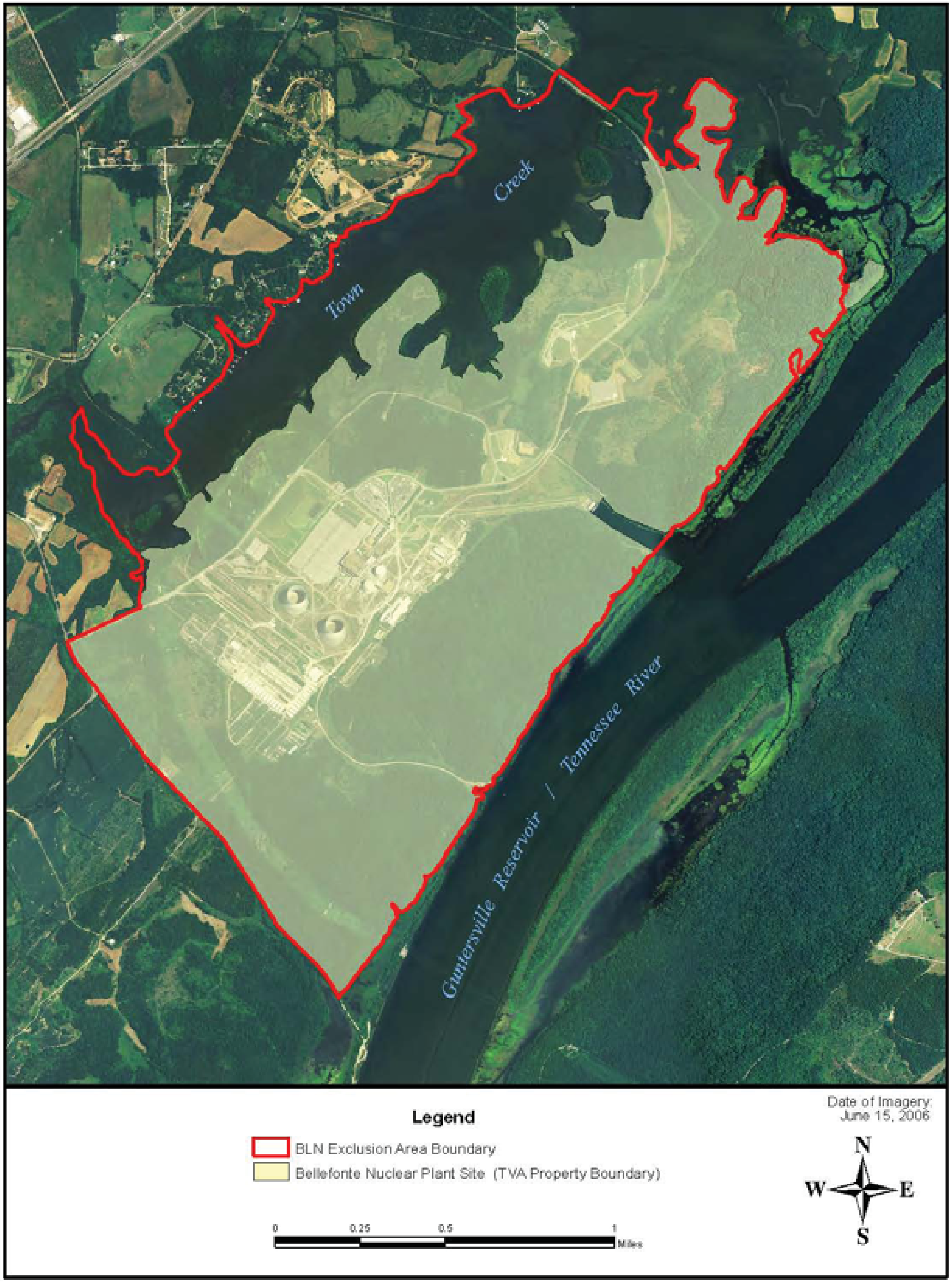


Figure 2-3. Exclusion Area Boundary for Alternatives B and C

TVA has completed a DSEP project to expand upon the AREVA effort and provide a more detailed assessment of the existing plant configuration and the requirements to complete engineering and construction. Experts in the area of construction, estimating, budgeting, and project controls have reviewed the elements to complete this project. The DSEP process was independently reviewed by a panel of experts to ensure that nothing major was overlooked. As a result of this review, refinements were made to the overall process that has resulted in a quality estimate and schedule.

The purpose of the DSEP project was to define the scope of completion, to develop licensing strategy, to determine the material condition of BLN 1&2, to define schedule and cost for completion and startup, to determine project risk, and to provide a reliable basis for decision-making. The study included physically inspecting and evaluating systems, structures, and components currently installed in the plant. It also provided a comprehensive assessment of the additional engineering, materials, components, and construction needed to complete the unit. The DSEP addresses all these factors and provides a high confidence level estimate for the cost and schedule to complete a B&W unit.

Because Bellefonte was previously estimated in detail for completion, the intent of this DSEP was to identify differences in the previous estimates with respect to investment recovery activities, withdrawal of construction permits, and subsequent suspension of the 10 CFR Part 50 Appendix B QA program, suspension of the preventive maintenance and lay-up program, and removal of environmental controls within the plant. In addition, regulatory changes and industry initiatives now require changes to the facility that were not known or included in the previous estimates. Obsolescence requires additional investigation to support long-term reliable operation of the units.

During the DSEP period that was conducted during 2009 and 2010, a detailed review of most major systems, components, and structures was conducted. This effort included over 100,000 hours of review by experts in engineering and plant systems. This allowed options to be evaluated based on current condition, including age and obsolescence of plant equipment.

A comprehensive evaluation of the reactor and other primary systems, as well as the controls for those systems, was conducted. A review was also completed on the turbine generator and the secondary plant systems, as well as, controls for those systems.

The plant utilizes a very efficient design. The secondary system will be more efficient than other operating commercial nuclear plants due to the use of once-through steam generators, a superheated steam cycle, and extensive use of reheat to limit heat loss in the secondary systems. Design features such as improved instrument and controls, steam generators, and turbine design will be modernized while still maintaining the original high efficiency.

BLN Structures

The structural condition of the existing facilities, with regard to structural integrity and safety requirements, have been evaluated. The initial engineering review performed to evaluate the potential for completing BLN 1 or 2 was conducted to determine if the existing completed seismic Category I structures could be documented to comply with the latest NRC seismic requirements. The designation of seismic Category I refers to safety-related structures, systems, and components that are designed and built to withstand the maximum potential earthquake stresses for the particular region where a nuclear plant is sited, without

loss of capability to perform their safety functions. A detailed review was performed to determine the effects of applying Bellefonte site-specific seismic criteria based on the requirements of Appendix S of 10 CFR Part 50. The results of this evaluation determined that the BLN seismic Category I safety-related structures would be able to withstand the effects of a seismic event as defined by the new criteria. These results have been reviewed by a panel of nuclear industry seismic experts who independently confirmed the results of the evaluation. The study does conclude that some internal supporting structures would require modifications, and these modifications are included in the completion estimate for the project. The original design of nonsafety-related structures, not governed by the NRC requirements, continues to meet current industrial building codes. In addition, detailed walkdowns of both the safety-related and nonsafety-related structures were performed during the DSEP to identify degradation or structural issues. No detrimental issues related to either type of structure were identified related to subsidence or settlement.

Review of the existing structures (through DSEP evaluations) to identify other structurally related considerations, including infestations, roofing integrity, and pavement structures was conducted. These evaluations considered historical water infiltration. Some water infiltration has occurred at the site mainly due to groundwater in-leakage through construction joints. A DSEP evaluation has validated the structural integrity of the affected buildings, and the project estimate carries an estimate for remediation of in-leakage sites. In addition, the existence of mold in the lowest elevations of the plant due to damp conditions has been evaluated. An industrial hygienist has evaluated the mold and provided approved methods for remediation. The structural integrity of roofing has also been evaluated, and a remediation plan is being implemented. Roofing systems for the turbine building were replaced in 2009. The project facility plan includes repair or replacement of the remaining roofing systems and is in the completion estimate.

The DSEP process evaluated plant structures for completion, including required updates associated with applicable codes and standards necessary to secure an operating license for the facility. The majority of the plant is constructed to seismic Category I requirements as set forth by the NRC. These facilities are made of high-strength concrete and steel supports that provide a robust structure for a long life. Commercial nuclear plants operating in the United States today are built to these standards, and the majority of plants have been granted a 20-year extension to the original 40-year operating life. As part of the life extension review, plants are required to address aging effects on the seismic Category I structures. In general, aging effects outside of normal maintenance practices have not been identified by the industry for these structures. Based on the extensive reviews conducted thus far, the seismic Category I structures for Bellefonte are intact and require minor maintenance to meet current requirements. As for the remainder of the plant structures outside of seismic Category I requirements, these were likewise built to stringent industrial standards, with minimal maintenance required to meet current standards.

The existing B&W structures, systems, and components have been evaluated against the current standards for terrorism threats, including impacts of large commercial aircraft. The facilities (seismic Category I structures) that contain the pressurized water reactor are complete, with minor modifications necessary to meet new regulatory requirements. Security requirements for nuclear power plants have been significantly upgraded since September 11, 2001, including the development of contingency plans to address 'beyond design basis' events. The BLN design will meet those licensing requirements and regulations, including those regarding aircraft impact, as are all currently licensed nuclear plants nationwide.

Existing Unit 1 structures are complete; seismic Category I safety-related structures comply with current NRC criteria, and nonsafety-related structures meet applicable industrial requirements. Figures 2-4, 2-5, and 2-6 provide a visual reference for the current status and condition of the existing BLN.

Figure 2-4. Bellefonte Nuclear Plant Entrance

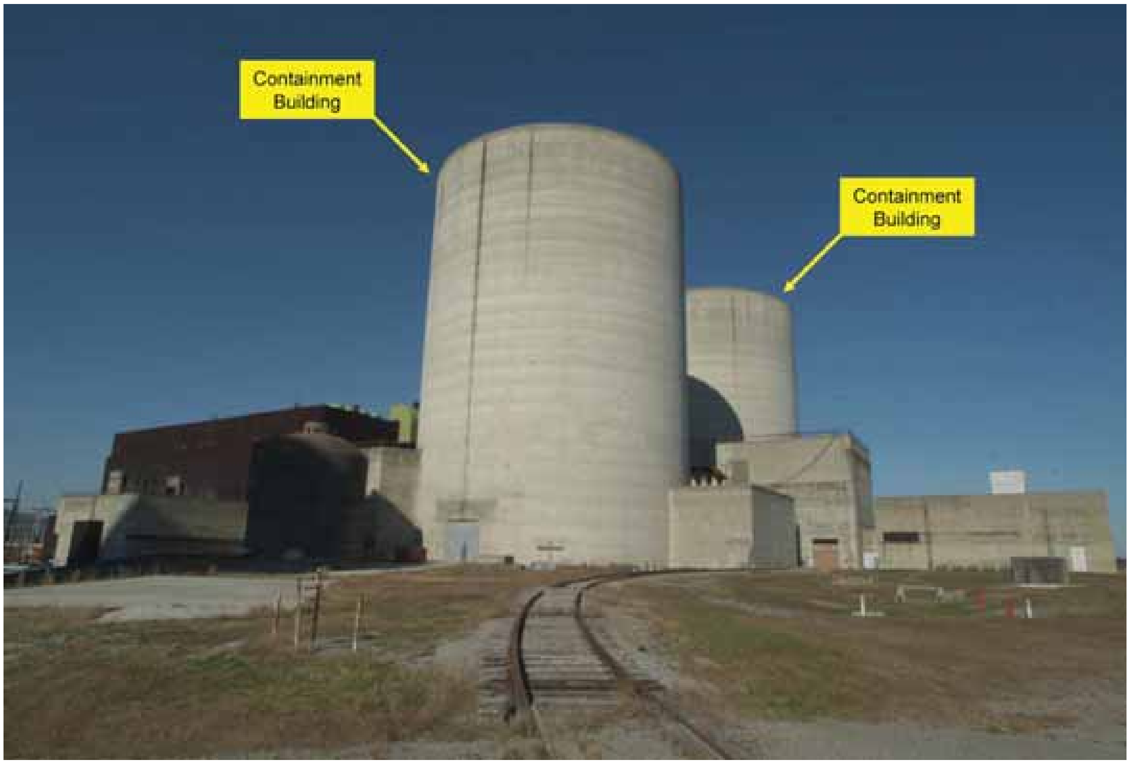


Figure 2-5. B&W Containment Buildings

Figure 2-6. View From BLN Parking Lot - Administration Building, Turbine Building, Containment Buildings, Cooling Towers, and Switchyard

B&W Systems and Components

The DSEP has developed a detailed status of the existing plant systems and components. When original construction was ceased, BLN 1&2 were substantially complete with the vast majority of plant structures, systems, and components installed and tested.

Evaluations of the existing systems and components have been performed to determine what equipment can be "used as is" and what refurbishment and replacement activities are necessary to complete the plants. Selected piping and components were salvaged during the investment recovery period in selected areas of the plant, although structures within the power plant were generally unaffected. In addition, obsolescence issues, changes in regulatory requirements, or industry best practices would require replacement of selected installed systems and components. Furthermore, refurbishment of some existing equipment would be required to ensure reliable operation in the future. As previously discussed, when construction of BLN 1&2 was halted in 1988, completion of the units was estimated at 90 percent and 58 percent, respectively. The DSEP shows that additional resources (time, manpower, and capital) will be needed to complete either unit following the investment recovery activities and to meet current construction standards. Therefore, the current completion estimate is 55 percent for Unit 1 and 35 percent for Unit 2. It should be noted that major construction is not anticipated to be required to complete the units, but the bulk of the resources will be used for internal refurbishment/modification.

Figures 2-7, 2-8, 2-9, 2-10, and 2-11 show various plant systems and components.

Figure 2-7. Unit 1 Turbine Generator

Figure 2-8. Unit 1 Main Control Room

Figure 2-9. Cable Spreading Room

Figure 2-10. Unit 1 Makeup High-Pressure Injection Pump

Figure 2-11. Unit 1 Large Bore Valve, Small Bore Valves, Piping

Quality Assurance Records

A total of 52,828 as-constructed drawings were prepared by the end of the original construction process. The original QA construction records have been confirmed to be available. Specific areas verified for completeness during DSEP include the American Society of Mechanical Engineers (ASME) Section III records for safety-related weld and material procurement and installation. These records were reviewed by the Authorized Inspection Agency (AIA), Hartford Steam Boiler Global Standards, and determined to be available, accessible, and maintained per the AIA's required storage quality level. NRC's December 2, 2009, *Inspection Report, Transition to Deferred Status* (see Appendix B), concluded that the QA records and the Bellefonte programs and procedures meet NRC QA requirements.

2.2.4. Proposed Plant Construction Activities

BLN Units 1&2 were being constructed on a staggered schedule, with Unit 1 scheduled for completion approximately two years before Unit 2. So, while construction of major buildings and supporting infrastructure were substantially completed for both units during the initial construction phase, in general, Unit 1 construction is further along than Unit 2. The identified major activities that would be required to complete the construction scope for BLN Unit 1 or 2, as well as planned enhancements, are listed below. Activities for either unit would be similar, but Unit 2 would require the completion of final piping structural supports, installation of instrumentation, installation of small piping and valves, insulation, and the completion of architectural features.

The following list of completion activities is based on cost and schedule information developed during the DSEP:

- Replace the two steam generators, which were affected by investment recovery activities (note: as described above, each B&W unit has two steam generators). The original steam generator tubing and shell sections were removed for salvage value and, as such, are damaged beyond repair. The replacement steam generators will be designed to incorporate industry lessons and will employ materials consistent with those used in operating plant steam generator replacement projects and new plant steam generator designs. A more complete description of the steam generator replacement process follows this list.
- Replace the existing analog and solid state instrumentation and controls systems with digital technology comparable to those utilized in new reactor designs.
- Replace the turbine rotating assemblies to ensure that the maximum energy can be extracted from the steam. This, in combination with the primary and secondary designs, would ensure one of the most efficient steam cycles in the country and would be better than new construction-type design.
- Replace major pumps, motors, heat exchangers, and tanks, and remove piping as part of investment recovery.
- Refurbish major equipment, such as reactor coolant pumps, control and instrumentation, diesel generators, and plant electrical breakers.
- Upgrade plant barge unloading dock in order to receive and unload steam generators and other major plant equipment. No dredging in the area of the barge unloading dock is required for construction of a B&W unit.

- Remove silt from the intake channel. From the pumping station to the shoreline (a distance of approximately 1,200 feet), approximately 10,000 cubic yards of dredged material would be removed. From the shoreline to the main river channel (a distance of approximately 760 feet), approximately 1,100 cubic yards of dredged material would be removed. Dredged material would be disposed of in an on-site spoils area above the 500-year flood elevation.
- Replace transmission system equipment utilized for plant operation, such as switchyard breakers.
- Upgrade a cooling tower, so that it would perform at 100 percent of original design capacity. Typical modifications of other TVA natural draft cooling towers have included (but are not limited to) modifying and extending distribution piping headers, replacing existing and adding spray nozzles, and adding or replacing fill material. Comparable modifications would be anticipated, but the exact nature of the cooling tower upgrades would be determined later.
- Update the plant control room and build a new simulator for operator training.
- Replace auxiliary boiler and auxiliary boiler building.
- Perform code inspection, documentation, and reconciliation to meet ASME standards.
- Install an intrusion barrier to provide security for the intake pumping station and intake channel.
- Construct security upgrades including addition of checkpoints and portals.
- Construct site facilities including nonplant-related administrative, maintenance, construction, fabrication, supply chain, and training buildings.

Steam Generator Replacement
The existing steam generator tubing and portions of the shell were removed for salvage value during investment recovery activities. The remainder of the old steam generators would be removed, similar to the installation of the new steam generators discussed below. The new steam generators would be transported from the fabrication facility by rail and/or barge to the BLN site. Once there, the replacement steam generators would be offloaded onto steel saddles for temporary storage. Two options for off loading could be used, based on contractor preference:

- Gantry crane. A gantry crane was used during the original BLN 1&2 construction, and the existing foundations may support the new gantry crane. However, some additional excavation may be needed for the foundation caissons.

- Barge drive off. Using this method, the barge interior cells would be filled with river water and stabilized at the height of the riverbank, and then a multiwheeled hauler vehicle would be driven onto the barge and under the steam generators. The vehicle would then rise up to lift the steam generators and drive off the barge.

The existing barge off-loading area would require some improvements, including excavation and foundation work for use with either barge off-loading system. The road leading from the barge off-loading to the BLN containment would be cleared of vegetation by grading and adding gravel to provide a level path for the multiwheeled hauler vehicle to travel.

Some steel piping on the old Unit 1 steam generator was removed from the inside, but the containment buildings are still intact. The remainder of the old steam generators would be removed as one piece, similar to the installation of new steam generator discussed below. After exiting the containment, the old steam generators would be placed on existing slabs and cut up and sold for scrap. The preferred method of old steam generator removal and installation of the new steam generators is discussed below:

- Removal of old and installation of new steam generators would use the existing equipment hatch for passage in and out of containment.
- The steel plenum of the heating, ventilation, and air conditioning (HVAC) inside containment just inside the equipment hatch would be cut to provide an opening approximately 14 feet by 14 feet. Next, a similar-size hole would be cut into the reactor pool concrete wall. This cut would either be done with chipping hammers or with the use of hydrodemolition equipment.
- A rail system would be installed from the outside of containment to the inside of the reactor pool. A multiwheeled cart would be set on the rail system to move the steam generators out and in.
- A temporary rigging device would be set on top of the polar crane girders for lifting the old steam generators from the cubicle to the multiwheeled cart. The old steam generator would be moved out of containment. An outside lift system would remove the old steam generators from the cart to a multiwheeled hauler vehicle, which would move them to a slab to be cut up and sold for scrap.
- In a reverse manner, the new steam generators would be taken from the storage slab by the multiwheeled hauler vehicle to a gantry crane outside containment, placed on the cart, rolled into containment on the rail system, upended in the reactor pool by a temporary lifting device, and placed in the steam generator cubicle.

In preparation for installation of the replacement steam generators into the containment building, some excavation and foundation work would be needed to install an outside lift system. The area next to the containment would be excavated as necessary and then backfilled back to the existing plant grade after the replacement. The steel and concrete components would be replaced to safety and engineering standards. Waste concrete would be transported to an appropriately permitted disposal site.

In general, the steam generator replacement process would entail activities and effects typical of other on-site construction activities including site reclearing, minor demolition and new construction, and equipment replacement. A hydrodemolition process, using a high-pressure water jet, could be used to remove concrete while leaving the steel reinforcement bar intact. The process would use approximately 450,000 gallons of water, likely from the local municipal source, and produce a water and concrete slurry. This wastewater would be captured, sampled, treated, and released through an approved NPDES discharge point.

2.3. Alternative C – Construction and Operation of a Westinghouse AP1000 Advanced Passive Pressurized Light Water Reactor

Under Alternative C, TVA would construct and operate a single AP1000 advanced passive pressurized light water reactor on the BLN site. The following AP1000 facility description is based on COLA FSAR Revision 1 (TVA 2009a) and COLA ER Revision 1 (TVA 2008a)

content, and *AP1000 Design Certification Document, Revision 17* (Westinghouse Electric Company [WEC] 2008). Existing main structures that would be used under Alternative C are discussed in Subsection 2.3.2.

2.3.1. Facility Description for Single Unit Operation

The nuclear steam supply system for the AP1000 is a Westinghouse-designed advanced passive pressurized light water reactor. The rated thermal power of the reactor is 3,400 MWt, with a nuclear steam supply system rating of 3,415 MWt (core plus reactor coolant pump heat), and an expected electrical output of 1,100 MW. The plant design life is 60 years.

An AP1000 power block complex is composed of five principal building structures: nuclear island, turbine building, annex building, diesel generator building, and radwaste building (see Figure 2-12). Each of these is constructed on an individual reinforced concrete foundation basemat. All safety-related structures, systems, and components are located on the nuclear island. The structures located off the nuclear island are neither safety-related nor seismic Category I.

The nuclear island is composed of the containment building, shield building, and auxiliary building. The containment building, a seismic Category I structure, is a freestanding cylindrical steel containment vessel with elliptical upper and lower heads. The containment vessel confines the release of airborne radioactivity following postulated design-basis accidents and provides shielding for the reactor core and reactor coolant system during normal operations. The containment building is surrounded by a seismic Category I reinforced shield building. In conjunction with the internal structures of the containment building, the shield building provides the required shielding for the reactor coolant system and the other radioactive systems and components housed in the containment. The shield building also protects the containment vessel and reactor coolant system from the effects of tornados and tornado-produced missiles. The auxiliary building is a seismic Category I reinforced concrete structure, which provides protection and separation for seismic Category I mechanical and electrical equipment located outside the containment building. The auxiliary building shares a common basemat with the containment building and the shield building. The nuclear island structures are designed to withstand the effects of natural phenomena such as hurricanes, floods, tornados, and earthquakes without loss of capability to perform safety functions. The nuclear island is designed to withstand the effects of postulated internal events such as fire and flooding without loss of capability to perform safety functions.

The annex building is a combination of reinforced concrete and steel-framed structure with insulated metal siding. The annex building provides the main personnel entrance to the power generation complex, includes the health physics facilities, and provides personnel and equipment access ways to and from the containment building and the rest of the radiological control area via the auxiliary building.

The diesel generator building is a single-story, steel-framed structure with insulated metal siding. The building houses two identical slide-along diesel generators separated by a three-hour firewall. The diesel generators provide backup power for plant operation if normal power sources are disrupted.

The turbine building is a steel column and beam structure that houses the main turbine, generator, and associated fluid and electrical systems. It also houses the makeup water

purification system and provides weather protection for the laydown and maintenance of major turbine/generator components.

The radwaste building includes facilities for segregated storage of various categories of waste prior to processing, for processing by mobile systems, and for storing processed waste in shipping and disposal containers. Additional plant structures include warehouses, administration/office buildings, switchyard, transmission towers, entrance roads, parking lots, and railroad spur.

The overall plant arrangement for an AP1000 unit is designed to minimize the building volumes and quantities of bulk materials (concrete, structural steel, rebar) consistent with safety, operational, maintenance, and structural needs to provide an aesthetically pleasing effect. Half of the plant would be constructed off site and transported to the site as modules. Natural features of the site would be preserved as much as possible and utilized to reduce the plant’s impact on the environment. Landscaping for the site, areas adjacent to the structures, and the parking areas would blend with the natural surroundings to reduce visual impacts.

Reactor Power Conversion System and Reactor Coolant System

The major components of an AP1000 reactor are a single reactor pressure vessel, two steam generators, and four reactor coolant pumps for converting reactor thermal energy into steam. A single, high-pressure turbine and three low-pressure turbines drive a single electric generator. The steam and power conversion system is designed to remove heat energy from the reactor coolant system via the two steam generators and to convert it to electrical power in the turbine generator.

The reactor contains fuel rods assembled into 157 mechanically identical fuel assemblies, along with control and structural elements. A fuel assembly is 14 feet long in a 17 by 17 square array. The core is designed to operate approximately 18 months between refueling outages.

The AP1000 reactor coolant system (see Figure 2-13) is designed to remove or to enable the removal of heat from the reactor during all modes of operation, including shutdown and accident conditions. The system consists of two heat transfer circuits, each with a steam generator, two reactor coolant pumps, and a single hot leg and two cold legs for circulating reactor coolant. The system also includes a pressurizer, interconnecting piping, valves, and instrumentation needed for operational control and safeguards actuation. All reactor coolant system equipment is located in the reactor containment.

During operation, the reactor coolant pumps circulate pressurized water through the reactor vessel and the steam generators. The water is heated as it passes through the core to the steam generators where the heat is transferred to the steam system. The water is returned to the reactor (core) by the pumps, and the process is repeated.

The turbine generator system is designed to change the thermal energy of the steam flowing through the turbine into rotational mechanical work, which rotates a generator to provide electrical power. It consists of a double-flow, high-pressure turbine and three double-flow, low-pressure turbines. It is a six-flow, tandem compound, 1,800-rpm machine. The turbine system includes stop, control, and intercept valves directly attached to the turbine and in the steam flow path, crossover and crossunder piping between the turbine cylinders and the moisture separator reheater. The turbine generator has an expected net generator electrical output of 1,100 MW for a reactor thermal output of 3,415 MWt.

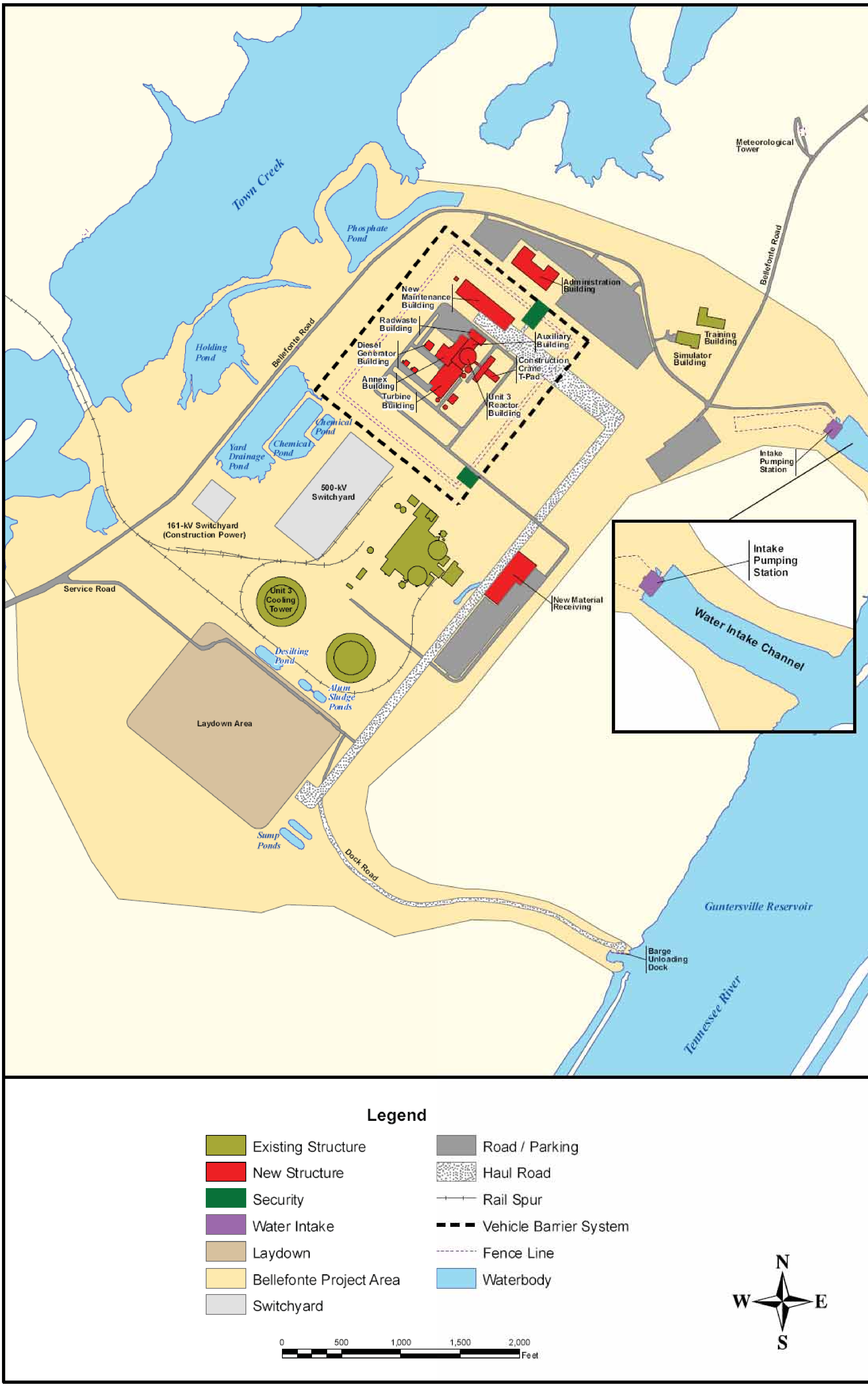
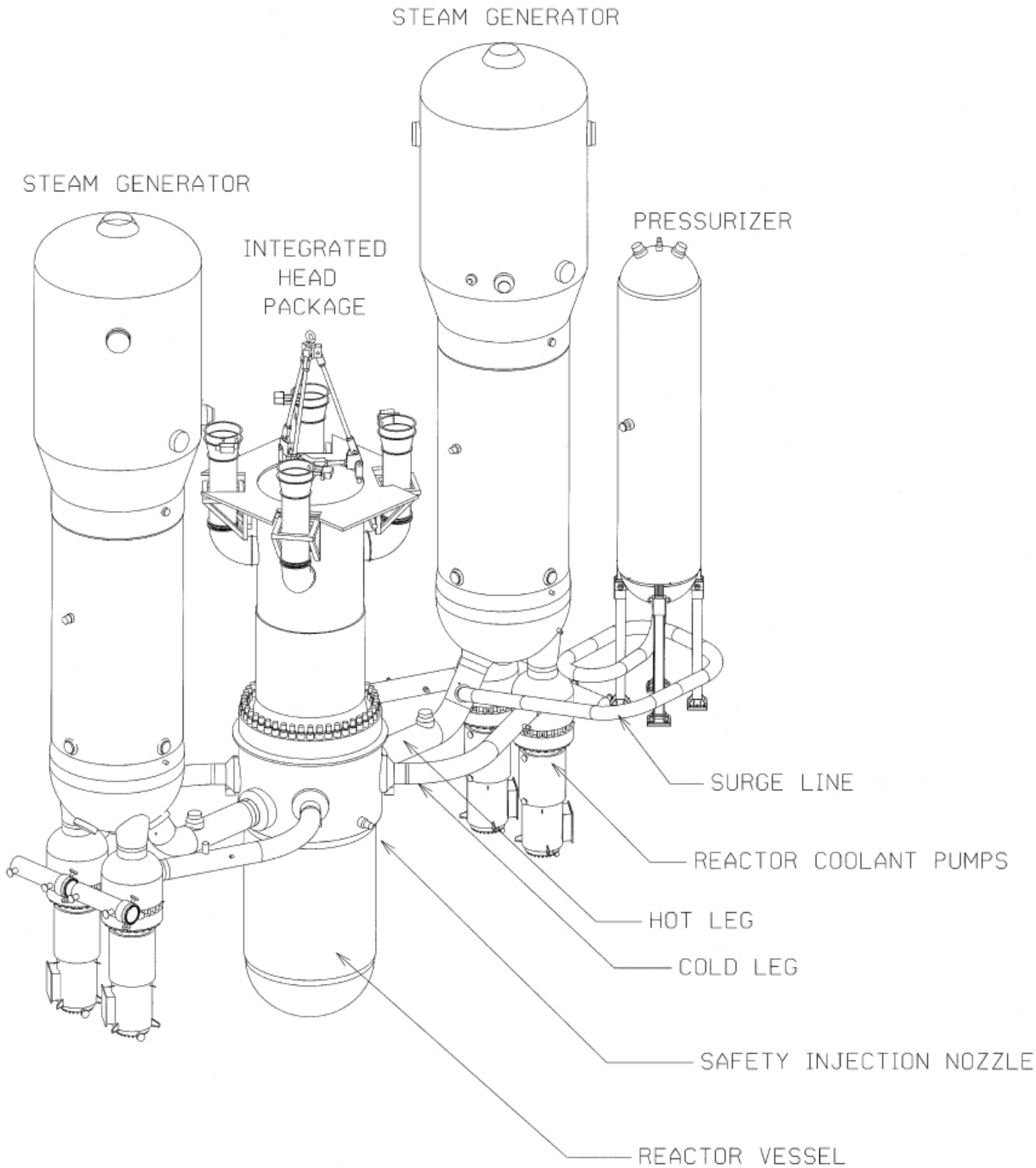


Figure 2-12. AP 1000 Site Plan



Source: WEC 2008

Figure 2-13. AP1000 Reactor Coolant System

The AP1000 unit design includes an independent electric power system. Two on-site standby diesel generators, each furnished with its own support subsystems, provide power to the selected plant nonsafety-related alternating current (AC) loads for a single AP1000 unit. Two ancillary AC diesel generators, located in the annex building, provide power for Class 1E post-accident monitoring, for control room lighting and ventilation, and for refilling the passive containment cooling system water storage tank and the spent fuel pool, when no other sources of power are available. Another on-site diesel generator provides backup power for the site technical support center.

Raw Water System
The raw water system supplies water from the intake to the circulating water system and the service water system to make up for water that has been consumed and discharged as part of the system operations. The circulating water system supplies cooling water to remove heat from the main condensers, the turbine building closed cooling water system heat exchangers, and the condenser vacuum pump seal water heat exchangers under varying conditions of power plant loading and design weather conditions. The service water system supplies cooling water to remove heat from the nonsafety-related component cooling water system heat exchangers in the turbine building. The raw water system supplies water to the circulating water system cooling tower (natural draft cooling tower) and the service water system cooling tower (mechanical draft cooling tower) to make up for water consumed as the result of evaporation, drift (water droplets swept out of the tops of the cooling towers in a moving air stream), and blowdown (water released to purge solids).

At the intake pumping station, the raw water is first strained by trash rakes and then passes through the traveling screens. Once in the raw water system, the water in each line is further strained. For the circulating water system, a back-washing feature of the strainers removes debris and sends it back to Guntersville Reservoir. A small portion of the raw water is used to supply two, 100-percent capacity screen wash pumps, and the remainder of the flow provides makeup to the circulating water system cooling tower. For the service water system, the water is then filtered to remove remaining debris and discharged to the river. The raw water then proceeds to the service water system cooling tower, where it provides the necessary makeup.

Engineered Safety Features
Engineered safety features protect the public in the event of an accidental release of radioactive fission products from the reactor coolant system. The engineered safety features function to localize, control, mitigate, and terminate such accidents and to maintain radiation exposure levels to the public below applicable limits and guidelines. The AP1000 engineered safety features are described below.

The containment vessel, an integral part of the overall containment system, confines the release of airborne radioactivity following postulated design-basis accidents and provides shielding for the reactor core and reactor coolant system during normal operations. The vessel also functions as the safety-related ultimate heat sink by safely transferring the heat associated with accident sources to the surrounding environment. The passive containment cooling system is designed to maintain the containment air temperature below a specified maximum value and to reduce the containment temperature and pressure following a postulated design-basis event. This system removes heat from the containment atmosphere and serves as the safety-related ultimate heat sink for other design-basis events and shutdowns. The passive containment cooling system limits the release of radioactive material to the environment by reducing the pressure differential between the

containment atmosphere and the external environment, which diminishes the driving force for leakage of fission products from the containment to the atmosphere.

The primary function of the containment isolation system is to allow the normal or emergency passage of fluids through the containment boundary while preserving the integrity of the containment boundary. This prevents or limits the escape of fission products, including radioactivity that may result from postulated accidents. Containment isolation provisions are designed so that fluid lines penetrating the primary containment boundary are isolated in the event of an accident.

The passive core cooling system is designed to provide emergency core cooling following postulated design-basis events. This system injects water into the reactor coolant system to provide adequate core cooling for the complete range of loss-of-coolant accident events. It also provides core decay heat removal during transients, accidents, or whenever the normal heat removal paths are lost.

The main control room emergency habitability system is designed so that the main control room remains habitable following a postulated design-basis event. With a loss of all AC power sources, the habitability system maintains an acceptable environment for continued operating staff occupancy.

Natural removal processes inside containment, the containment boundary, and the containment isolation system provide post-accident, safety-related fission product control. The natural removal processes, including various aerosol removal processes and pool scrubbing, remove airborne particulates and elemental iodine from the containment atmosphere following a postulated design-basis event.

Exclusion Area Boundary
The EAB for the AP1000 is the same as the EAB for the B&W alternative and is discussed in Subsection 2.2.1 (see Figure 2-3).

2.3.2. Use of Partially Constructed Facility

Approximately 400 acres of the 1,600-acre BLN site were previously disturbed for the partially constructed BLN 1&2 and associated plant structures. Construction of one AP1000 unit and associated structures is expected to require clearing of about 50 acres of forested land and reclearing and grading of previously disturbed ground. The existing turbine building and the office and service buildings at the BLN site would be removed under Alternative C.

Many of the other main structures from the partially completed BLN 1&2 would be used for the operation of an AP1000 reactor. These include natural draft cooling towers, intake channel and pumping station, blowdown discharge structure, transmission lines and switchyards, barge unloading dock, railroad spur, and meteorological tower (see Figure 2-12). Use of existing structures reduces the amount of additional land that would be disturbed and is cost-effective. The following is a description of these systems and how they would serve an AP1000.

Natural Draft Cooling Tower
TVA's 1974 FES considered several heat dissipation systems. Considering feasibility, environmental impact, and cost, the natural draft cooling towers represented the best balance and were selected as the best heat dissipation facilities for BLN 1&2 and were

constructed. For the same reasons identified above, TVA proposes to utilize one of the existing cooling towers to provide heat dissipation for an AP1000.

Intake Channel and Pumping Station
The intake channel and pumping station would provide makeup water to an AP1000. Removal of silt from the intake channel would be necessary. From the pumping station to the shoreline (a distance of approximately 1,200 feet), approximately 10,000 cubic yards of dredged material would be removed. Dredged material would be disposed of in an on-site spoils area above the 500-year flood elevation.

Blowdown Discharge Structure
The purpose of the existing discharge system is to disperse blowdown water from the cooling towers into the Guntersville Reservoir. Additional information about the blowdown discharge and diffuser can be found in Subsection 3.1.3. The blowdown discharge system configuration and function for an AP1000 unit would be the same as for a B&W unit.

Transmission Lines and Switchyards
A detailed discussion of the existing transmission lines and switchyards is provided in Section 2.6. No new transmission lines were proposed in the COLA ER, and none are proposed in this FSEIS.

Barge Unloading Dock
The barge unloading dock would allow the use of barges to transport heavy equipment, large reactor components (e.g., reactor vessel, steam generators, pressurizer), and construction modules too large to ship by train. With barge access, larger modules can be assembled in the factory, reducing on-site construction activity and workforce. An AP1000 unit would require an estimated total of 34 barge shipments over a three- to four-month period. These shipments of prefabricated modules would likely occur between the end of site preparation and beginning of construction commencement. Another 12 barge shipments, containing large vessels and heavy equipment, would likely be spread out over the duration of the construction period, and it is not anticipated that more than one or two barges would arrive at any particular time. Construction equipment barges would arrive as the equipment is needed, then depart as soon as the equipment is unloaded.

Dredging in the area of the barge unloading dock would be required for construction of an AP1000 unit, because the barge loads of AP1000 construction modules and components are expected to be heavier than those for a B&W unit. Approximately 240 cubic yards of dredged material would be removed. It is also likely there would be one barge for the maintenance dredging activity, with the spoils transferred to equipment that would haul it directly to the spoils area, and that barge would depart shortly after the dredging is completed. This refurbishment/maintenance activity would occur near the beginning of construction to prepare the barge unloading dock for the construction period activity. Dredged material would be disposed of in an on-site spoils area above the 500-year flood elevation.

Barge transportation would also be used to remove construction debris and other waste from the site.

Railroad Spur
The railroad spur would be refurbished to support the delivery of components and modules small enough to be shipped in a rail car (e.g., large pumps, bulk construction commodities).

Rail transportation would also be used to remove construction debris and other waste from the site.

Meteorological Tower

The existing meteorological tower was built in 2006. The meteorological facility consists of a 55-meter instrumented tower for wind and temperature measurements, a separate 10-meter tower for dewpoint measurements, a ground-based instrument for rainfall measurements, and a data collection system in an instrument building (environmental data station). The environmental data station is located west of the tower base and has been evaluated as having no adverse influence on the measurements taken at the tower. The data collected included wind speeds, wind directions, and temperatures at the 10-meter and 55-meter levels and dewpoint temperatures at the 10-meter level. The location of the meteorological tower is sufficiently removed from any plant structures or significant topographic features. This system would provide adequate data to represent on-site meteorological conditions and to describe the local and regional atmospheric transport and diffusion characteristics for operation of an AP1000 unit.

2.4. Other Energy Alternatives Considered

TVA evaluated over 100 supply-side (generation) and 60 demand-side (energy efficiency, energy conservation, etc.) resource options in its December 1995 *Energy Vision 2020* EIS. Subsequent environmental reviews, e.g., *Final Environmental Impact Statement for the Bellefonte Conversion Project* (TVA 1997), have updated these evaluations as appropriate for a number of the resource options. In general, the *Energy Vision 2020* evaluations remain adequate. However, TVA is again updating these evaluations in its ongoing IRP process. The consideration of alternatives to nuclear-powered generation at the BLN site tier from *Energy Vision 2020* and its evaluations and the updates of those evaluations in the documents identified in Section 1.7. This section addresses the merits of competing energy resource options with particular attention to those identified by commenters on the DSEIS.

The analysis of alternatives is summarized below and includes options that would not require new generating capacity (Subsection 2.4.1), those that would require new generating capacity (Subsection 2.4.2), and a combination of those alternatives (Subsection 2.4.3).

Reasonable alternatives to the construction and operation of nuclear generation at the BLN site are energy resource options, both supply-side and demand-side options, which substantially meet the purpose and need for the proposed nuclear unit at the BLN site. Supply-side resource options must be capable of delivering generation with a profile similar to that of nuclear generation. Resource options that are technically infeasible, impracticable, ineffective, substantially more expensive, or introduce greater environmental impact are not considered reasonable.

2.4.1. Alternatives Not Requiring New Generating Capacity

TVA considered several alternatives that could potentially replace new generating capacity. In reviewing these alternatives, TVA considered whether the option would provide a viable and reasonable alternative to the proposed BLN project. The alternatives below were considered but rejected for detailed consideration for the reasons discussed.

Power Purchases

TVA regularly reviews purchased power options (buying energy and/or capacity from other suppliers for use on the TVA system) and has entered into long-term contracts to obtain

firm capacity. Currently, TVA has a long-term base load purchase from the Red Hills coal-fired plant, a long-term lease of the Caledonia combustion turbine plant, a long-term hydroelectric purchase from SEPA, long-term power purchase agreements for wind energy resulting from the December 2008 Request for Proposals for Renewable Energy and/or Clean Energy Sources, and short-term purchases from the wholesale power market. Therefore, the use of purchased power is already included in TVA's current and future capacity estimates. Purchasing additional power from other generators was not addressed further because it (1) is already part of TVA's resource portfolio, (2) transfers environmental impacts to another location, and (3) involves additional potential impacts on transmission if sources are outside the TVA service area. There is also risk that purchased power will not be delivered.

Repowering Electrical Generating Plants

Repowering electrical generating plants is the process by which utilities update, change the fuel source, or change the technology of existing plants to realize gains in efficiency or output not possible at the time the plant was constructed. Power uprates would be a potential alternative source of base load electricity. NRC has approved power uprates for TVA's Browns Ferry Nuclear Plant (BFN), Sequoyah Nuclear Plant (SQN), and Watts Bar Nuclear Plant (WBN) since 1998, and TVA is seeking additional uprates for its BFN units. The need for power analysis in Section 1.4 provides more detailed information on the additional electrical generation that would be provided by approved or planned power uprates. However, power uprates are not sufficient by themselves to meet forecasted capacity needs of 7,500 MW from 2010 to 2019 (medium-load forecast). TVA continues to modernize its hydrogeneration, which increases its hydrogeneration capacity. TVA is considering converting some fossil units to biomass and studies are underway support this. Such conversions would change the operational characteristics of converted units but would not materially address TVA's base load needs. TVA is considering laying up additional coal-fired units. Such lay-ups increase the need to acquire replacement resources such as the proposed BLN unit.

Energy Conservation

Energy Efficiency and Demand Response (EEDR) programs, also sometimes called Demand Side Management (DSM) or energy conservation programs, offer potential ways to help TVA manage energy consumption and the growth in peak demand. Since the 1970s, TVA has had residential, commercial, and industrial programs to reduce peak demand and energy consumption. As currently implemented, TVA's EEDR portfolio focuses on reduction in peak demand. TVA has interruptible load contracts with industrial customers that allow TVA to reduce the flow of energy to them during high demand periods. TVA's experience to date is that successful energy conservation programs are highly dependent on the end users' recognition of the cost effectiveness of conservation.

TVA received comments on the DSEIS that energy efficiency should be used to reduce demand. TVA has reviewed the most recently published studies (Brown et al. 2009; Chandler and Brown 2009) identified by comment providers as well as reports published since the close of the comment period (Brown et al. 2010). These studies estimate the potential of EE to effectively add capacity to power systems–through energy savings–to replace or delay the construction of new generating plants through 2020 and/or 2030. For comparative purposes, TVA also reviewed a study by the Electric Power Research Institute that forecasted energy efficiency potential in southern U.S. states (EPRI 2009a).

TVA recognizes the important role conservation plays in shaping the load balance and is committed to building EEDR programs for their important resource potential. As part of the

Integrated Resource Planning process initiated in June 2009, TVA has developed program initiatives to focus on reducing energy consumption as well as decreasing peak demand. These EEDR program initiatives include the following elements:

- Residential programs for new site-built and manufactured homes, *energy right* home evaluations and in-home energy assessments, heat pump and high-efficiency air-conditioning installation and maintenance, and weatherization assistance.

- Commercial and industrial programs providing technical assistance, efficiency advice, incentives, and audits for new and existing facilities.

- Demand response programs for interruptible loads, direct load control, and conservation voltage regulation.

This FSEIS incorporates an EEDR program into the base case and all alternatives considered that reflects the energy efficiency that can result from TVA's programmatic efforts. These reductions are in addition to those energy savings that are naturally occurring due to existing legislation and policies and the independent programs of its distributors. The base case includes an EEDR program that reduces required energy needs by about 5,200 GWh in the 2018-2020 time period, averaging 0.3 percent reduction per year through 2020. This annual reduction is about 55 percent of the moderate achievable estimate of 0.5 percent annual reduction through 2020 by the Meta-Review study (Chandler and Brown 2009) and about 70 percent of the realistic achievable estimate of 0.4 percent for southern states by EPRI (2009). The Need for Power analysis in Section 1.4 shows that the base case EEDR program as well as the proposed nuclear unit and additional gas and nuclear expansion units are needed to meet the forecasted demand for power.

Each of the reports reviewed by TVA also suggest that additional savings are achievable with "transformational" policy intervention by businesses and governments. Several states and regions have developed legislation to mandate energy savings levels and regulatory mechanisms to make EE a sustainable business. Notably, TVA has found success stories in California, the Northwest and smaller states in the Northeast, where long-term application of aggressive conservation measures and existing funding mechanisms offset the need for new investment in generating facilities. The reports show that the Southern region lags far behind in developing its EE potential.

All of the reports acknowledge the technical and policy barriers to achieving the maximum potential energy reduction from aggressive energy efficiency programs. There is significant uncertainty associated with the implementation of such programs, given that widespread investment in new distribution technologies and other research is uncertain in TVA's service territory as its distributors ultimately make the decisions on most end-use technology investments. Substantial policy, legislative, and behavioral changes must occur before TVA can rely extensively on dependable capacity from conservation measures as a substitute resource for balancing generation and load.

Despite reservations about the ability of such programs to achieve such a goal, TVA constructed an enhanced case to evaluate the effect of a more extensive EEDR program on the portfolio mix and on power costs in the 2018-2020 time period. As with the base case EEDR program, the enhanced program focuses primarily on residential, commercial and industrial programs to reduce energy consumption. This is considered to be a

moderately aggressive EEDR program and would be challenging for the TVA power service area to achieve, as discussed above. The TVA Enhanced EEDR program averages 0.6 percent reduction per year through 2020. This is approximately 55-75 percent of the maximum achievable estimates of 1 percent by the Meta-Review study (Chandler and Brown 2009), 0.9 percent for southern states by EPRI (2009), 0.7 percent for Appalachia by the ARC (Brown et al. 2009), and 0.9 percent by the Energy Efficiency in the South study (Brown et al. 2010).

Figure 2-14 shows the forecasted reduction in energy consumption for both the EEDR base program and the Enhanced EEDR program.

As shown in the analysis of an Enhanced EEDR in Section 1.4, even with substantial energy replacement through conservation measures, TVA must still add new generation in the 2018-2020 time frame to balance resources with the projected load requirements. Therefore, energy conservation cannot meet the projected capacity needs in the 2018-2020 time frame and, consequently, does not meet the identified need.

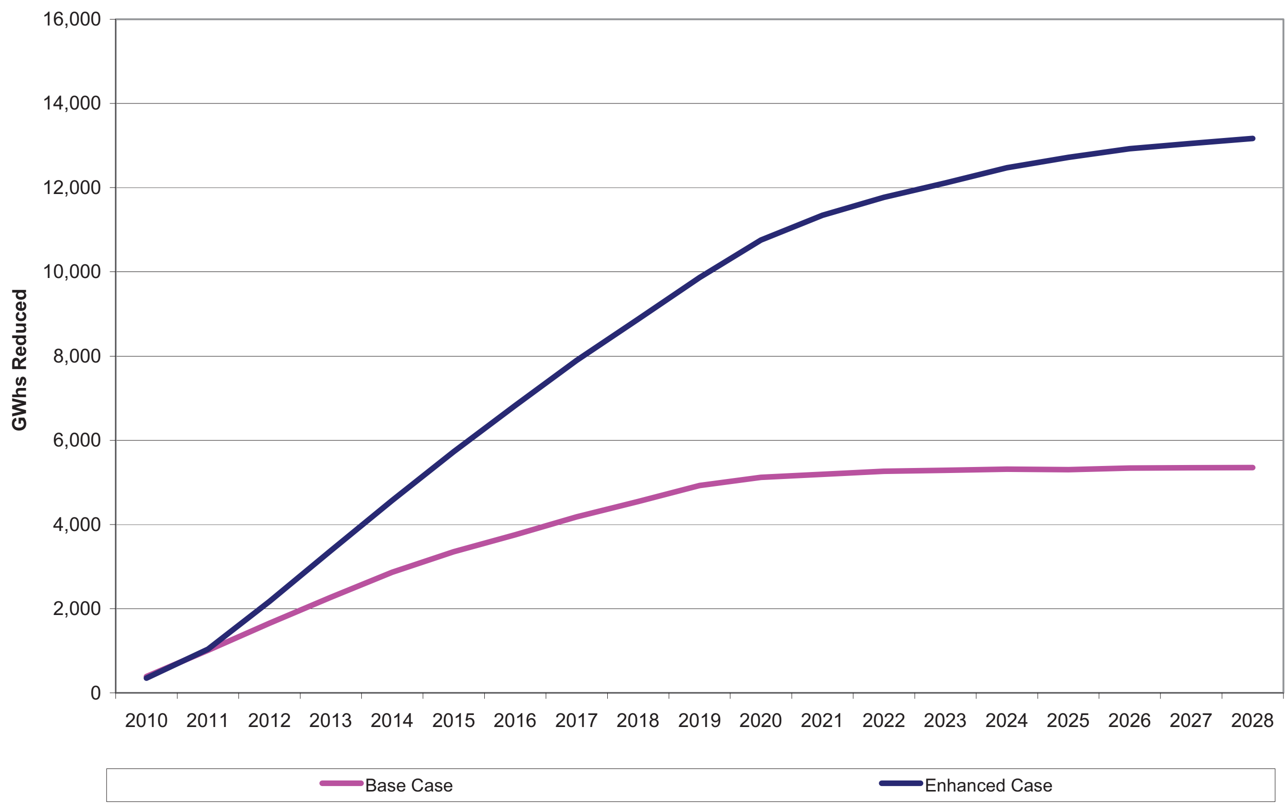


Figure 2-14. Energy Efficiency and Demand Response Scenarios

2.4.2. Alternatives Requiring New Generating Capacity

TVA also considered whether building new nonnuclear capacity would address the need for new capacity. Sources were examined alone and in combination to determine if the system capacity requirements could be met by other sources of energy.

Fossil Fuel Energy Sources
Primary fossil fuel alternatives to nuclear-powered electrical generation at the BLN site are coal-fired generation and natural gas-fired generation. In *Energy Vision 2020* and other reviews, TVA assessed several types of impacts for both sources: air quality, waste management, land use, water use and quality, human health, ecology, socioeconomics, aesthetics, historic and cultural resources, and environmental justice. The potential environmental impacts and merits of coal-fired or gas-fired generation have not materially changed since these options were evaluated in *Energy Vision 2020*. A coal-fired plant is not environmentally preferable to a nuclear plant, due primarily to impacts on air quality, waste management, and aesthetics. A natural gas-fired plant also is not environmentally preferable to a nuclear unit, due primarily to impacts on air quality. In addition, many of the construction-related environmental impacts of a nuclear unit at the BLN site have already occurred.

TVA has considered the conversion of the BLN site to an IGCC facility, as described in *Energy Vision 2020* and analyzed in a subsequent site-specific EIS (TVA 1997). Constructing an IGCC facility at the BLN site would not use existing assets at the BLN site to the same substantial degree as a nuclear unit, increasing environmental impacts directly and cumulatively. In addition, an IGCC facility emits CO_2, which makes it less environmentally desirable than nuclear generation. While the capture of CO_2 from an IGCC facility is technologically feasible, because CO_2 can be separated from the synthetic gas prior to combustion, further research and development is necessary to sequester the captured CO_2.

Wind
Wind turbines are commercially available today ranging from approximately 250 watts to 5 MW. The average size of wind turbines installed in the U.S. in 2008 was 1.65 MW. According to a Tennessee Wind Map and Resource Potential estimate from the DOE’s Office of Energy Efficiency and Renewable Energy (DOE 2010), approximately 4 GW of wind power capacity is available at a gross capacity factor of 28 percent, based on a turbine hub height of 100 meters. This hub height is taller than most current turbine installations, which typically use between 50 to 80 meters. However, 100-meter hub heights are technically feasible with current wind turbine technology, and taller turbines help make wind power more economically feasible in low wind areas such as the TVA service area. Taking into account electrical losses, environmental factors, and wake effects (of surrounding wind turbines), the net capacity factor for the TVA service area is projected to be 24.4 percent, which is on the low end of the typical range of net capacity factors for modern utility-scale wind power projects of 25 percent to 40 percent.

Using the above-average turbine capacity and capacity factor, approximately 23 200-MW wind projects, each consisting of 121 wind turbines, would be required to generate the annual electricity equivalent to that of the proposed nuclear facility. The 23 projects in total would require an estimated 436 square miles of land, of which 5 percent would be occupied by turbines, access roads, switchyards and other equipment, and the remainder would be required for adequate spacing to minimize wake effects of surrounding turbines. The required area is more than half the size of the Great Smoky Mountains National Park.

This estimate assumes that the demand for electricity is present at the time the generation is available from the wind turbines, which is impractical to assume. Energy storage can be coupled with wind power to simulate a profile comparable to base load generation. A compressed air energy storage (CAES) facility could capture the power of the wind during low load times and utilizes it during higher load times. The wind turbines provide the power

to compress the air into a storage volume, such as an underground salt cavern or aquifer. The compressed air is discharged from the storage volume into a set of gas turbines that are fired with natural gas. The efficiency of the turbines is improved because compression of the inlet air is provided by the CAES facility instead of by the turbine itself.

The only operating CAES system in the U.S. is the McIntosh Power Plant in Alabama. Using the same operating parameters as those in the McIntosh Plant, about 2,310 wind turbines, rated at 1.65 MW each, along with over 45 million British thermal units (BTU) of natural gas consumption per year would be required to generate annual base load electricity comparable to that of the proposed nuclear facility. The land requirement for wind technology, coupled with the impacts to air quality from the combustion of natural gas, make wind power with CAES less environmentally preferable to a nuclear plant. In addition, CAES technology is still in the demonstration phase and is not technologically mature.

Solar

Generation from solar power is available in two different technologies: concentrating solar power (CSP) and photovoltaic (PV). CSP technologies (i.e., solar thermal plants using parabolic troughs, power tower, etc.) were not considered in TVA's analysis due to the low rate of delivery of solar radiation within the TVA territory. Direct solar radiation in Memphis is approximately 4.4 kilowatt-hour per square meter per day (kWh/m^2/day), which is below the minimum level of 6.75 kWh/m^2/day required for a viable CSP generating facility. Solar PV can make use of both direct solar radiation and diffuse horizontal radiation, which is one reason PV is technically feasible in more areas of the United States than CSP technologies. The average solar radiation for PV technology was estimated from National Renewable Energy Laboratory's solar radiation map for the western portion of the TVA region as 4.9 kWh/m^2/day. The solar PV capacity factor in the western portion of the TVA service region is calculated at 17 percent, which is equivalent to approximately four hours of usable solar radiation available each day. Some days have more or less solar radiation available, but this assumption is used to simulate base load operation in the discussion below.

To match the generation profile of a nuclear plant, solar PV generation is assumed to be stored in batteries that generate electricity during periods of no or low solar radiation. Battery storage systems used for energy management are those that have a deployment duration exceeding one hour. Commercially available systems come in standard unit sizes, ranging from 250 kilowatts (kW) to 2 MW. Systems of batteries are assembled to meet the needs of a particular project. Currently one of the biggest battery storage systems installed for energy management applications has 34 MW power capacity with six hours of storage capacity. A sodium sulfur (NaS) standard battery size of 2 MW with six hours of storage capacity and an electrical efficiency of 70 percent was used for the purposes of this evaluation. The battery system will be recharged from the PV modules during daylight and will be discharged when the PV power is not available. Batteries with a rating of 2 MW per battery were used. A solar to electric efficiency of 8.6 percent is typical for the complete PV panel and battery system.

The total installed land area required for commercial PV on a fixed 30-degree tilt support structure with appropriate spacing between panels for roads and to avoid shadow effects is estimated to be 5.9 acre/MW. Approximately 193 50-MW PV facilities with a total footprint of 57,000 acres (about 89 square miles) would be required to generate electricity equivalent to that of the proposed nuclear facility. The large land area requirement for such a PV system makes the option less environmentally preferable to the proposed nuclear plant.

Biomass
Biomass power plants use organic matter to generate electricity. It is one of the few renewable power options that can be operated at a relatively high capacity factor (85 percent) and is "dispatchable," meaning that its generation can be planned and scheduled much like a conventional fossil-fueled unit. TVA is currently performing biomass fuel availability surveys in the region, and a comprehensive study is underway to assess the feasibility of converting one or more coal-burning units to biomass fuel. Biomass generation was a qualifying technology in TVA's request for proposal issued in 2008 for renewable resources. However, no competitive bids sourced from biomass were received. This may suggest doubt in the market place about the sustainability of biomass generation in the TVA region at reliably competitive prices.

Agricultural and forest resources provide the most prevalent form of biomass fuel available in the TVA region. These include agricultural "crop" residues (i.e., by-products of harvest), dedicated energy crops (i.e., switchgrass on Conservation Reserve Program [CRP] lands), forest residues (i.e., waste products from logging operations) and methane gas by-products from livestock manure. Biomass resources, such as primary milling residues (i.e., by-products of commercial mills), secondary milling residues (i.e., by-products of woodworking and furniture shops), urban wood residues (i.e., waste wood products from construction, demolition, and residential), and methane gas by-products from landfills and wastewater treatment facilities are not as prevalent in less densely populated regions such as the TVA service territory.

Agricultural residues by state and county were obtained from the U.S. Department of Agriculture's National Agricultural Statistics Service. Data from 2006-2009 were averaged to estimate the typical crop production. It was assumed that 35 percent of the total gross residue is available for collection, leaving the remaining residue on the land to ensure healthy land and soil quality. Dedicated energy crops by state and county were estimated from data obtained from the Farm Service Agency (FSA) of the U.S. Department of Agriculture. The data compiled by the FSA include total CRP acreage by county. The land within the TVA service region can yield 5.0 dry tons of switchgrass per acre. Switchgrass production was calculated over the land area, assuming that 100 percent of CRP land is devoted to switchgrass.

Forest and primary milling residues by state and county were obtained from the U.S. Forest Service Southern Research Station's Timber Product Output Reports (USFS 2007). Data from 2007 were used and are the most recent available. Reported volumetric data are converted to mass using a uniform density factor of 25 pounds per cubic foot of forest product. Residues from primary wood-using mills are classified as utilized and unutilized. Most primary milling residues in the TVA region are classified as utilized and are assumed not to be available for biomass power generation. Secondary milling residues, urban wood residues, and methane gas amounts by state were obtained from a National Renewable Energy Laboratory (NREL) report (NREL 2005) and scaled to the area of each state within the TVA region.

The capacity and energy from each of the biomass fuel sources was estimated by assuming the most likely generation technology to be used. A stoker or bubbling fluidized bed technology with a heat rate of 15,000 BTU/kWh was assumed for solid fuel. For methane gas as fuel, an internal combustion engine at a heat rate of 12,500 BTU/kWh was assumed. Approximately 2,500 MW of biomass generation is estimated from agricultural and forest resources. Some 210 MW of biomass generation is estimated from unutilized

primary and secondary mill residues and urban wood residues. Another 60 MW is estimated from landfill and wastewater treatment methane sources.

Whether based on agricultural or forest resources, or population-based sources, biomass fuel is dispersed and must be collected and processed for use in biomass generating units. Consequently, the cost of collection system infrastructure and diesel fuel generally limits biomass collection to a 50-mile radius, which in turn limits plant capacity to a maximum of 30-50 MW. Biomass generating units with required emissions controls provide about the same capacity factor and environmental impacts as a small coal plant. A biomass-fired plant is not environmentally preferable to a nuclear plant due primarily to impacts on air quality, waste management, and the impacts of biomass fuel collection infrastructure.

Hydropower

The DOE EERE study (DOE 2006) was used to develop an estimate of hydropower resources that are feasible for development within the TVA region. The EERE report estimates the megawatts available for development and, of those available, how many would be feasible to develop. Available megawatts are based on those sites that are not located in zones where hydropower development is unlikely. The available megawatts are also not colocated with existing hydropower plants. The determination of availability also did not consider ownership or control of available sites. The project feasibility criteria included such factors as land use and environmental sensitivities, prior development, site access, and load and transmission proximity.

The TVA service territory encompasses much of the state of Tennessee and portions of neighboring states. The portion of available annual average hydropower in each state was determined by estimating the number of sites within the TVA coverage area for that state as compared to the number of sites in the entire state. The amount of feasible megawatts in each state was estimated to be in the same proportion as the feasible to available megawatts in that state in total. Using this approach, the total feasible hydropower capacity is 843 MWa (MWa = annual generation/annual hours). None of the feasible capacity is from large power sources (>30 MWa). Seventy percent of the feasible hydro was small hydro (1 MWa ≤Pa ≤30 MWa), and 30 percent was low power resources (<1 MWa). Low power resources include conventional technology, ultra low head and kinetic energy turbines, and micro-hydro power.

Compared to nuclear generation, new hydropower has lower capacity factors and more severe environmental impacts. Also, feasible new sites for hydroelectric facilities are limited.

2.4.3. Consideration of Other Alternatives and Combination of Alternatives

Combining alternatives could achieve an energy profile similar to base load operation. There are many possible combinations of the coal, gas, solar, wind, biomass, and hydro alternatives described above. Combinations can utilize storage technology with wind or solar technology or augment the variability of wind and solar power with the dispatchability of fossil generation (coal and gas) or biomass generation.

A storage technology other than CAES that could be combined with wind generation is pumped storage. TVA has an existing 1,600-MW pumped storage plant at Raccoon Mountain, near Chattanooga, Tennessee. Excess energy from lower cost generating resources is used to pump water from Nickajack Reservoir to the upper reservoir during periods of low power demand. The pumps are reversible and utilized as turbines to

produce power using water from the upper reservoir during periods of high demand. Additional pumped storage sites are available in the TVA region and could be developed in place of CAES to store excess wind energy from off-peak periods and produce power in periods when wind power is not available. Pumped storage plants require 2,000 to 3,000 acres for the upper pool, the generating plant, and a lower pool if another reservoir is not available. The environmental impacts associated with construction of a pumped storage plant are typical of projects of this scope and size, including recreation and scenic impacts, potential disruption of terrestrial and aquatic habitats, cultural resource impacts, and socioeconomic impacts. Operational impacts include environmental impacts of the operation of thermal plants that might be used to supply power to the plant in pumping mode.

Renewable generation also could be combined with fossil or generation instead of a storage technology to provide energy when renewable resources are not available. A natural gas-fired plant generally has fewer environmental impacts than a coal-fired plant. But the natural gas-fired facility alone has environmental impacts that are greater than nuclear, particularly those related to the emissions of air pollutants and greenhouse gases. As a result, the combination of a natural gas-fired plant and wind, solar, or hydro facilities would have environmental impacts that are equal to or greater than those of a nuclear facility.

Each of the potential combinations discussed above requires large land areas and/or has impacts to air quality due to combustion of natural gas or biomass. Therefore, the environmental impacts of combination alternatives are less preferable to those of the proposed nuclear facility.

2.4.4. Summary

TVA has concluded in Section 1.4 that new generating capacity is necessary to maintain system reliability. TVA's existing generating supply consists of a combination of existing TVA-owned resources, budgeted and approved projects (such as new plant additions and uprates to existing assets), and/or power purchase agreements. This supply includes a diverse combination of coal, nuclear, hydroelectric, natural gas and oil, market purchases, and renewable resources designed to provide reliable, low-cost power while reducing the risk of disproportionate reliance on any one type of resource.

TVA has considered alternatives to nuclear-powered generation, including those that do not require new generating capacity. Purchasing additional power from other generators was not addressed further because it is already part of TVA's portfolio of resources, transfers environmental impacts to another location, involves additional potential impacts on transmission if sources are outside the TVA service area, and has increased risk components to TVA-owned and controlled resources. Power uprates are not sufficient by themselves to meet forecasted capacity needs. Even with substantial energy replacement through conservation measures, TVA must still add new generation to balance resources with the projected load requirements.

The addition of other types of generating capacity as an alternative to nuclear capacity was also evaluated and included fossil fuel energy sources as well as renewable energy sources. In general, coal-fired and natural gas-fired power was found not to be environmentally preferable to a nuclear plant due primarily to impacts on air quality, waste management, and aesthetics.

Renewable energy sources such as wind and solar have significant land requirements to generate electricity comparable to that of a nuclear facility. Additionally, to provide generation profiles similar to a nuclear unit, they must be coupled with energy storage capacity, which increases the land requirement to compensate for additional efficiency losses or with fossil-fueled generation, which increases the impact on air quality. Biomass as a renewable fuel can be used to provide base load power provided adequate fuel supply exists; however, the air quality impacts are much greater than nuclear resources. Hydroelectric power has been concluded to be less environmentally preferable given its low capacity factors, environmental impacts, and the limited availability of feasible new sites in the TVA territory.

2.5. Alternative Sites Considered

Alternative sites and selection of the BLN site for the construction and operation of a nuclear-powered electricity generation facility (BLN 1&2) were discussed in TVA's 1974 FES (TVA 1974a). The COLA ER (TVA 2008a) most recently addressed site screening and selection, alternative sites, and selection of the BLN site for nuclear generation of electricity with AP1000 units. In addition to the COLA ER alternative site analyses, TVA submitted the following supplemental white papers to the NRC in 2008:

- "Descriptions of Existing Facilities and Infrastructure for Alternative Sites to the Selected Bellefonte Site," June 2008 (TVA 2008c).
- "Criteria and Basis for Comparative Ratings Among Alternative Brownfield and Greenfield Sites," August 2008 (TVA 2008d).
- "Site Screening Process: Information Complementary to Subsection 9.3.2 of the Bellefonte Nuclear Plant, Units 3 and 4, COLA Applicant's Environmental Report," August 2008 (TVA 2008e).

2.5.1. Identification and Screening of Potential Sites

The consideration of alternatives is required by NEPA and 10 CFR §51.45. The Electric Power Research Institute (EPRI) siting guide (EPRI 2002), the industry standard for site selection, was used as a general guideline in site selection analysis for the COLA. The EPRI guide's stated objective of site comparison is "to identify and rank a relatively small number of candidate sites for a more detailed study, with the goal of selecting a preferred site from among candidate sites."

TVA's region of interest (ROI) for the COLA ER was and remains the TVA power service area, as previously described in Section 1.4 of this FSEIS.

One of the earliest, integral, and most critical components of planning for future energy facilities has been the identification and selection of suitable locations for their construction and operation. Historically, and on an ongoing basis through the 1960s and 1970s, TVA conducted initial high-level screening assessments of more than 200 sites for electricity generation across the TVA service area. The TVA service region (ROI) was divided into five system study areas that roughly coincided with the concentration of load centers in the region. This division does not represent a real physical division in the power service area, because all these areas are strongly interconnected with transmission lines. One purpose of this approach was to identify superior sites within each area that would reduce the need for construction of additional transmission to meet load requirements. This concern remains valid today, but load growth across the TVA service area, as well as improved

transmission system characteristics and ability for load balancing, now further reduces that concern.

Four general criteria were used to guide potential site identification.

1. Potential site areas that exhibited a suitable combination of engineering, environmental, land use, cultural, and institutional characteristics for power plant siting.
2. Potential site areas of a developable size (1,000 acres or more).
3. Manageable number of potential sites.
4. Relatively even distribution of potential sites along the Tennessee River corridor and within the defined TVA service area.

Broad-based interdisciplinary TVA teams that reflected power planning, transmission, environmental, and financial interests conducted these screening efforts. These studies identified sites that warranted further detailed investigations. Of these, eventually nine sites were selected for purchase as inventory for nuclear generation sites: BLN, Yellow Creek (YCN), Hartsville (HVN), Phipps Bend (PBN), WBN, BFN, SQN, Murphy Hill (MH), and Saltillo (STO).

TVA constructed multiunit nuclear generation facilities at three of the above sites: BFN near Athens, Alabama; SQN near Chattanooga, Tennessee; and WBN near Spring City, Tennessee. In addition, TVA obtained construction permits from the NRC to build nuclear units at the BLN, YCN, HVN, and PBN sites. Site preparation and construction of nuclear units proceeded in varying degrees at each of these sites. Due to slowing demand for power, TVA subsequently halted construction at the latter three sites (HVN, PBN, and YCN) and conveyed portions of them to other governmental entities for potential industrial development. TVA has maintained the MH and STO sites as part of its inventory of potential generation sites. However, due to uncertainties regarding foundation conditions, the STO site was eliminated from consideration in the COLA ER.

The COLA ER site analysis initially considered the BLN site and the other seven potential sites for new nuclear generation: the three operating TVA nuclear sites (BFN, WBN, and SQN), three brownfield sites (HVN, PBN, and YCN), and one greenfield site (MH). These eight sites had already undergone evaluation and documentation under NEPA, and except for MH, they had also undergone licensing evaluation and documentation processes of the AEC (predecessor to the NRC). The eight potential sites considered in the COLA ER are described further in the paragraphs below.

Operating Nuclear Plants

The BFN site is situated beside Wheeler Reservoir on the Tennessee River and has three operating nuclear reactors. The BFN site has two substantive limitations regarding its potential for co-locating an additional nuclear reactor. First, the operation of an additional nuclear unit, even operating in closed-cycle mode, would increase thermal loading to Wheeler Reservoir, which could exacerbate the existing challenges to managing the three BFN units in compliance with thermal limits, especially during low flow or drought conditions. Second, because the BFN site is approximately 850 acres and already accommodates three operating nuclear reactors, the site is not large enough to accommodate an additional nuclear reactor. Additional property would have to be acquired. Because of these site issues, TVA decided that co-locating an additional nuclear reactor at

BFN is not advantageous and does not consider the BFN site a viable alternative for new nuclear generation.

The WBN site comprises approximately 1,100 acres situated on the northern end of Chickamauga Reservoir in east Tennessee and has one operating nuclear reactor, WBN Unit 1. TVA is currently completing the partially constructed WBN Unit 2. A delay in completing WBN Unit 2 would likely have resulted in overlapping construction of the AP1000 units. This overlap would have unnecessarily affected not only project management resources, but produced greater strain on plant operations, local community services, and infrastructure. It was also anticipated that once WBN Unit 2 was completed and operating, the combined total thermal discharges to the river could often approach allowable NPDES thermal limits. Therefore, co-locating an additional nuclear unit at the site would exacerbate existing thermal loading and could potentially affect the operation of WBN Units 1 and 2. Because of these site issues, TVA decided that co-locating an additional nuclear reactor at WBN is not advantageous and does not consider the WBN site a viable alternative for new nuclear capacity for the 2018-2020 time frame.

The SQN site is situated beside Chickamauga Reservoir and has two operating nuclear reactors. The SQN site has two substantive limitations for co-locating an additional nuclear reactor. First, as in the case of BFN and WBN, the SQN site has a small thermal discharge margin that would be exacerbated by co-locating an additional nuclear reactor there. Second, because the SQN site is approximately 630 acres and already accommodates two operating nuclear units, the site is not large enough to accommodate an additional reactor. Additional property would have to be acquired. Because of these site issues, TVA decided that co-locating an additional nuclear reactor at SQN is not advantageous and does not consider the SQN site a viable alternative for new nuclear capacity for the 2018-2020 time frame.

Because TVA concluded that co-location at existing nuclear sites (BFN, SQN, or WBN) is not an acceptable alternative for reasons related to thermal issues, unavailability of adequate land, the inability to make beneficial use of existing assets, and large-scale changes underway on site, the three operating nuclear plants were eliminated from further consideration in the COLA ER alternative site analysis.

Brownfield Sites

TVA selected four brownfield sites (BLN, HVN, PBN, and YCN) and one greenfield site (MH) as candidate sites in its ROI for potential siting of a new nuclear facility in the COLA ER, which also reviewed each of these sites in detail. For each of the four brownfield sites, construction permits had been obtained under the regulations and evaluation procedures of the period. The respective historical review documents are as follows:

- *Final Environmental Statement, Bellefonte Nuclear Plant Units 1 and 2* (TVA 1974a)
- *Final Environmental Statement, Hartsville Nuclear Plants* (TVA 1975a)
- *Environmental Report, Phipps Bend Nuclear Plant Units 1 and 2* (TVA 1977a)
- *Final Environmental Statement, Yellow Creek Nuclear Plant Units 1 and 2* (TVA 1978b)

The BLN site is located beside Guntersville Reservoir on the Tennessee River near the town of Hollywood and city of Scottsboro. Construction activities at BLN were deferred in 1988. The BLN site is reviewed at length in this FSEIS and the COLA ER.

The former HVN site is situated on the north shore of Old Hickory Reservoir on the Cumberland River in Smith and Trousdale counties, Tennessee. Construction permits were issued for two nuclear plants (Plants A and B) with two units each. The HVN site nuclear units were cancelled in 1983 (Plant B) and 1984 (Plant A).

The former PBN site is located on the Holston River in Hawkins County, Tennessee. Construction at PBN was cancelled in 1982.

The former YCN is located on the Yellow Creek embayment of Pickwick Reservoir (Tennessee River). Construction at YCN was cancelled in 1984.

Although nuclear plant construction was never completed at any of these sites, the brownfield sites offer some of the advantages of an operating nuclear site (e.g., existing infrastructure and facilities, prior screening and NEPA review, available site characterization information). However, because the HVN, PBN, and YCN sites, or portions thereof, were sold for industrial development, TVA would need to reacquire portions of the industrial parks. This would impact existing industrial uses on developed areas of the sites. Transportation corridors to all four of the sites were constructed to facilitate construction of the nuclear plants.

Greenfield Site

The MH site consists of approximately 1,200 acres located in northeast Marshall County, Alabama, on the southern bank of Guntersville Reservoir. Part of the site was graded for a coal gasification project. No other development has occurred on this site to date, and it is currently designated by TVA for natural resource conservation purposes. The MH greenfield site was chosen and evaluated as a site that is representative of other greenfield sites that TVA has previously evaluated. The environmental impacts of construction and operation of a nuclear power generation facility at a greenfield site would be similar to or greater than those at a brownfield or partially developed site. The greenfield site (MH) had been evaluated for a coal gasification project for which TVA prepared an FEIS. This project was cancelled after TVA had done some site grading. The respective historical review document is *Final Environmental Impact Statement, Coal Gasification Project* (TVA 1981a).

2.5.2. Review of Alternative Sites

The alternative site review compared the five candidate locations to determine whether any alternatives are obviously superior to the proposed BLN site. The analysis considered Safety Criteria (geology, cooling system suitability, plant safety, accident effects, operations effects, transportation safety); Environmental Criteria (proximity to natural areas, construction-related effects on aquatic and terrestrial ecology, and wetlands, operations-related effects on aquatic and terrestrial ecology); Socioeconomics Criteria (construction- and operations-related effects, environmental justice, land use, cultural resources); and Engineering and Cost-Related Criteria (water supply, transportation, transmission, and site preparation). Portions of the studies, data, and conclusions of the initial evaluations of each candidate site were used to support this comparison. The sites were evaluated in each area of comparison and given a numerical rating scale of 1 to 5 (least suitable to most suitable). No weighting factors were applied to these criteria. The review process is discussed in detail in the COLA ER, and in the 2008 TVA white papers cited above (TVA 2008c, TVA 2008d, and TVA 2008e).

The alternative sites analysis compared the BLN site with the four alternatives to determine if there was an obviously superior location among the candidate sites. A simultaneous

comparison considered the additional economics, technology, and institutional factors among the candidate sites to see if any was obviously superior. Based on the comparison, there were no obviously superior sites among the candidate sites. The BLN site was selected as the preferred site for additional nuclear generation for the reasons described below.

- Alternative nuclear, brownfield, and greenfield sites are not environmentally preferable to the BLN site. Construction and operation of a new nuclear plant at each of the alternative sites would entail environmental impacts that are equal to or greater than those at the BLN site.
- Existing facilities and infrastructure at the BLN site (e.g., transmission lines, intake and discharge structures, cooling towers, switchyard, barge dock, rail spur, and roads) allow TVA to maximize assets that are currently underutilized, reducing the amount of construction material needed, construction costs, and environmental impacts associated with construction of infrastructure.
- A construction permit for a B&W pressurized water reactor was previously issued for the BLN site. There is no reason to believe the BLN site would not also be suitable for an AP1000 advanced passive pressurized light water reactor.
- TVA siting program studies do not show appreciable differences in most attributes for the sites that were considered in the alternatives analysis. However, the BLN site has several advantages. The BLN site remains under TVA ownership. In addition to allowing the beneficial use of existing assets, the BLN site was rated second highest with respect to the availability of cooling water, as river flow past the BLN site is approximately three times that of PBN and more than twice the flow past HVN. Environmental data were already updated as part of the EIS for potential tritium production at the BLN site (DOE 1999).

2.6. Transmission and Construction Power Supply

The following is a description of the current transmission system associated with the BLN site, the system needs in response to the proposed action, and the types of activities these improvements would entail. This SEIS provides a programmatic-level review of the transmission lines affected by the alternatives. Prior to conducting transmission line upgrades, site-specific reviews would be conducted to further investigate potential effects to the environment. If warranted, additional NEPA documentation would be prepared.

2.6.1. Description of Current System and Needs

Transmission infrastructure, including corridors and switchyards, to support operation of a nuclear plant at the BLN site was identified, reviewed, and evaluated in the earlier environmental review documents prepared by TVA and the AEC for the original facility encompassing BLN 1&2. That review and evaluation included siting data for the potential corridors identified by TVA. The AEC subsequently approved and issued a construction license for BLN 1&2 and the supporting transmission infrastructure into and at the site. The approved transmission system was constructed before the plant entered deferred status.

The existing 500-kV switchyard constructed on the BLN site has been deenergized for a number of years. Four 500-kV transmission lines (the Widows Creek-Bellefonte #1 and #2 500-kV lines, the Bellefonte-Madison 500-kV line, and the Bellefonte-East Point 500-kV line) and two 161-kV transmission lines (the Widows Creek-Bellefonte 161-kV and the Bellefonte-Scottsboro 161-kV) now terminate in the BLN switchyard. The section of the

500-kV lines going into BLN are not energized at present but would be reconnected to the TVA system and energized if the nuclear plant is built and operated. The two 161-kV lines, which are underbuilt (i.e. lines strung on the same structures) on portions of the Bellefonte-Madison 500-kV and the Widows Creek-Bellefonte #1 500-kV lines, are energized and currently connect Widows Creek Fossil Plant (WCF) generation to the TVA transmission system. None of the power being transmitted is generated on the BLN site.

The Widows Creek-Bellefonte #1 and #2 500-kV lines would require uprating (see Subsection 2.6.4). Sections of the Bellefonte-Madison 500-kV and Bellefonte-East Point 500-kV only need to be connected and reenergized. Right-of-way (ROW) vegetation management on the deenergized 500-kV transmission line segments would be brought back to current TVA standards for energized lines. Any needed maintenance on the line would be performed, and any ROW clearing needed to meet TVA and Federal Energy Regulatory Commission (FERC) standards would be carried out. The Widows Creek-Bellefonte and the Bellefonte-Scottsboro 161-kV lines would not need to be changed to support operation of BLN.

In addition to the lines coming into the switchyard, there are six 161-kV lines and one additional 500-kV line that are located elsewhere. The proposed actions related to the transmission system are the same under Alternative B (B&W unit) and Alternative C (AP1000 unit). These lines would be reconductored and/or uprated, as described in Subsection 2.6.4.

2.6.2. Construction Power Supply

The Bellefonte Nuclear Construction Substation was constructed in 1974 as a temporary 46-4.16-kV substation to support the construction of BLN 1&2.

In 2007, TVA retired the Bellefonte Nuclear Construction 46-kV Substation. Subsequently, TVA contracted with North Alabama Electric Cooperative to provide electric service to the BLN site. A 2-mile, 13-kV three-phase circuit has been constructed by North Alabama Electric Cooperative to provide this service. No additional work is expected to be necessary to supply construction power for the proposed BLN unit.

2.6.3. Alternatives Considered

In order to accommodate the delivery of power produced from a single nuclear unit at the BLN site, an *Interconnection System Impact Study* (TVA 2009b) was carried out for the TVA transmission system. This study evaluated the incremental impact of the proposed new generation facility at the BLN site on the TVA power system during various loading conditions. Transmission network upgrades are required if overloading with the new generation is at least 3 percent more than the loading without the new unit. The study assumed operation of the new unit at full capacity and standard operational contingencies on the remainder of the transmission system.

The study projected line overloading and recommended upgrading the electrical capacity of the overloaded transmission lines. As a result, the two alternatives for the transmission line system are the No Action Alternative and the Action Alternative. No new transmission lines would be needed under these transmission alternatives, and therefore no additional ROW would be required.

No Action Alternative
Under the No Action Alternative, current maintenance status and activity would be continued. TVA routinely conducts maintenance activities on transmission lines, which includes removal of vegetation in ROWs, pole replacements, installation of lightning arrestors and counterpoise, and upgrading of existing equipment.

Transmission lines are inspected by aerial surveillance using a helicopter and by ground observation. These inspections are conducted to locate damaged conductors, insulators, and structures, and to report any abnormal conditions that might hamper the normal operation of the line or adversely impact the surrounding area. During these inspections, the condition of vegetation within the ROW, as well as vegetation immediately adjoining the ROW is noted. These observations are then used to plan corrective maintenance or routine vegetation management, which would consist of felling "danger trees" adjacent to the cleared ROW and controlling vegetation within the cleared ROW. Any trees located off the ROW that are tall enough to pass within 10 feet of a conductor or structure (if they were to fall toward the line) are designated as danger trees and would be removed.

Regular maintenance activities for vegetation control occur on a cycle of three to five years. Transmission corridors are managed to prevent woody growth from encroaching on energized transmission lines and potentially causing disruption in service or becoming a general safety hazard. This periodic vegetation management is conducted along ROWs to maintain adequate clearance between tall vegetation and transmission line conductors.

Prior to these activities, TVA biologists and cultural resource specialists conduct a Sensitive Area Review (SAR) of the transmission line area (including the ROW) to identify any resource issues that may occur. A description of the SAR process is contained in Appendix D. These reviews are conducted on a recurring basis that coincides with the maintenance cycle, to ensure that the most current information is provided to the organizations conducting maintenance on these transmission lines.

Because TVA's transmission system comprises approximately 16,000 ROW miles, it is not possible to field survey every mile of ROW. Therefore, TVA utilizes the best tools available to determine the likelihood of any listed plant or animal inhabiting the section of line under review. TVA maintains a database of more than 30,000 occurrence records for protected plants, animals, caves, heronries, eagle nests, and natural areas for all 201 counties in the entire TVA power service area. All protected species and natural areas that are present, or are potentially present, in transmission line ROWs are taken into consideration when conducting these transmission line reviews. Wetland information maintained by TVA includes National Wetlands Inventory (NWI) wetland maps for the entire power service area. Soil survey maps are also used to identify potential wetland areas. The TVA also maintains records of known archaeological sites and routinely gathers information from the seven-state power service area.

TVA staff examines videos of the transmission line corridors to determine the kinds of habitats present in the project area. Aerial photographs, U.S. Geological Survey (USGS) topographical maps, and low-altitude flyovers are used to detect the presence of sensitive areas that meet habitat requirements for rare species of plants or animals. TVA staff then overlay the ROW with records of sensitive plants and animals, NWI maps, county soil surveys, and other available data in order to identify areas that may require alternative maintenance practices. The standard TVA criteria and guidelines are then applied to make conservative vegetation and/or land management recommendations to the maintenance project managers.

TVA is responsible for many miles of transmission lines that cross aquatic habitat and therefore has procedures in place for ROW maintenance to protect aquatic species. Aquatic biologists review county lists and database records to determine the potential presence of protected animals. Once an occurrence or likely occurrence is identified based on presence of habitat, the area is delineated on TVA maps and assigned a color and corresponding restriction class. Biologists make recommendations specific to the situation, and specialists consult as appropriate.

Management of vegetation within the cleared ROWs uses an integrated vegetation management approach designed to encourage low-growing plant species and discourage tall-growing plant species. A vegetation reclearing plan would be developed for each transmission line segment based upon the periodic inspections described above. The two principal management techniques are mechanical mowing, using tractor-mounted rotary mowers, and herbicide application. Any herbicides used would be applied in accordance with applicable state and federal laws and regulations. Only herbicides registered with the EPA would be used.

Where transmission lines cross natural areas, TVA uses geographic information system (GIS) software to draw boundaries of potentially affected areas including a 0.5-mile buffer. After reviewing available data and consulting with the area specialist or resource manager, potentially affected management areas are assigned a restriction class. Examples of restrictions include hand clearing only and selective spraying of herbicides to shrubs or tree saplings.

Activities associated with the construction, maintenance, and use of TVA transmission lines can be subject to the *National Historic Preservation Act* (NHPA) and its implementing regulations in 36 CFR Part 800. TVA cultural resources staff review the areas of maintenance activity on a case-by-case basis under the SAR process to identify whether the undertaking has any potential for adverse effects on cultural resources, such as historic structures or buried prehistoric sites. If the undertaking has potential for adverse effects, then procedures for avoidance or mitigation of the effects are put into place. Avoidance is generally feasible for transmission line maintenance projects when cultural resources are present. GIS is used to generate a map showing areas that are sensitive from the standpoint of cultural resources, and a code is applied that indicates restrictions on methods of clearing (e.g., no mechanized equipment). These maps are provided to the transmission lines crew supervisors so that crew supervisors will be aware of the necessary restrictions. Restrictions are typically required when a previously recorded cemetery, prehistoric mound, or earthwork occurs within 0.25 mile of the transmission line.

Action Alternative

Under the Action Alternative, the 500-kV switchyard and 500-kV transmission lines would be reenergized, and other existing transmission lines would be refurbished and upgraded as described in Subsection 2.6.4. If either Alternative B (B&W) or Alternative C (AP1000) were selected and implemented for the purposes of nuclear generation, the Action Alternative for the transmission system would also be selected. The scope of work for the transmission Action Alternative is the same under Alternatives B and C, and the affected transmission line ROWs are shown in Figure 2-15.

2.6.4. Proposed Refurbishments and Upgrades Under the Action Alternative

This section provides a description of the switchyard and transmission line upgrades under the Action Alternative. To accommodate the proposed nuclear unit operation, the 500-kV

switchyard would need to be refurbished. The 500-kV breakers and switches would be replaced and two additional 500-kV breakers would be added in the Widows Creek 500-kV switchyard. The generators connected to the TVA system would be equipped with a power system stabilizer (SERC Reliability Corporation [SERC] 2008) and out-of-step tripping relay for generators. Other components of the switchyard's protection and control system would be refurbished or replaced. The 161-kV switchyard would not require refurbishment.

The proposed transmission line upgrades consist of two types: uprating and reconductoring.

Uprates typically consist of retensioning or "resagging" of the existing electrical transmission line conductor. This results in a greater clearance above ground, allowing the line to operate safely at a higher temperature and, thus, increasing the current-carrying capacity of the transmission line. A total of 100.5 miles of transmission line would be uprated.

Reconductoring consists of replacing the conductor with a new conductor capable of carrying higher current levels. A total of 121.4 miles of transmission line would be reconductored.

All resagging or reconductoring activities would be confined to the existing ROWs. The following activities are typically involved in resagging or reconductoring.

- *Engineering* - Engineering analysis is conducted to determine where resagging or reconductoring is needed and to determine the nature of system changes needed to ensure optimum line sag, given the expected load, conductor temperature, diameter and stress/strain properties, and seasonal changes in the weather.

- *Equipment and Crews* - Field crews equipped with hoists, climbing gear, trucks, heavy equipment, testing and measuring equipment, safety items, communications equipment, and other necessary items are assembled on site.

- *Line Resagging* - If needed, existing conductors are disconnected from insulators, placed in stringing blocks, and then raised to the proper level, retensioned, and secured. Heavy equipment is sometimes used at each location where the conductors are "pulled" to accept the horizontal forces incurred after line disconnection. Vans and trucks for transporting ancillary equipment and workers would be used to access points along the ROW where resagging activities are required.

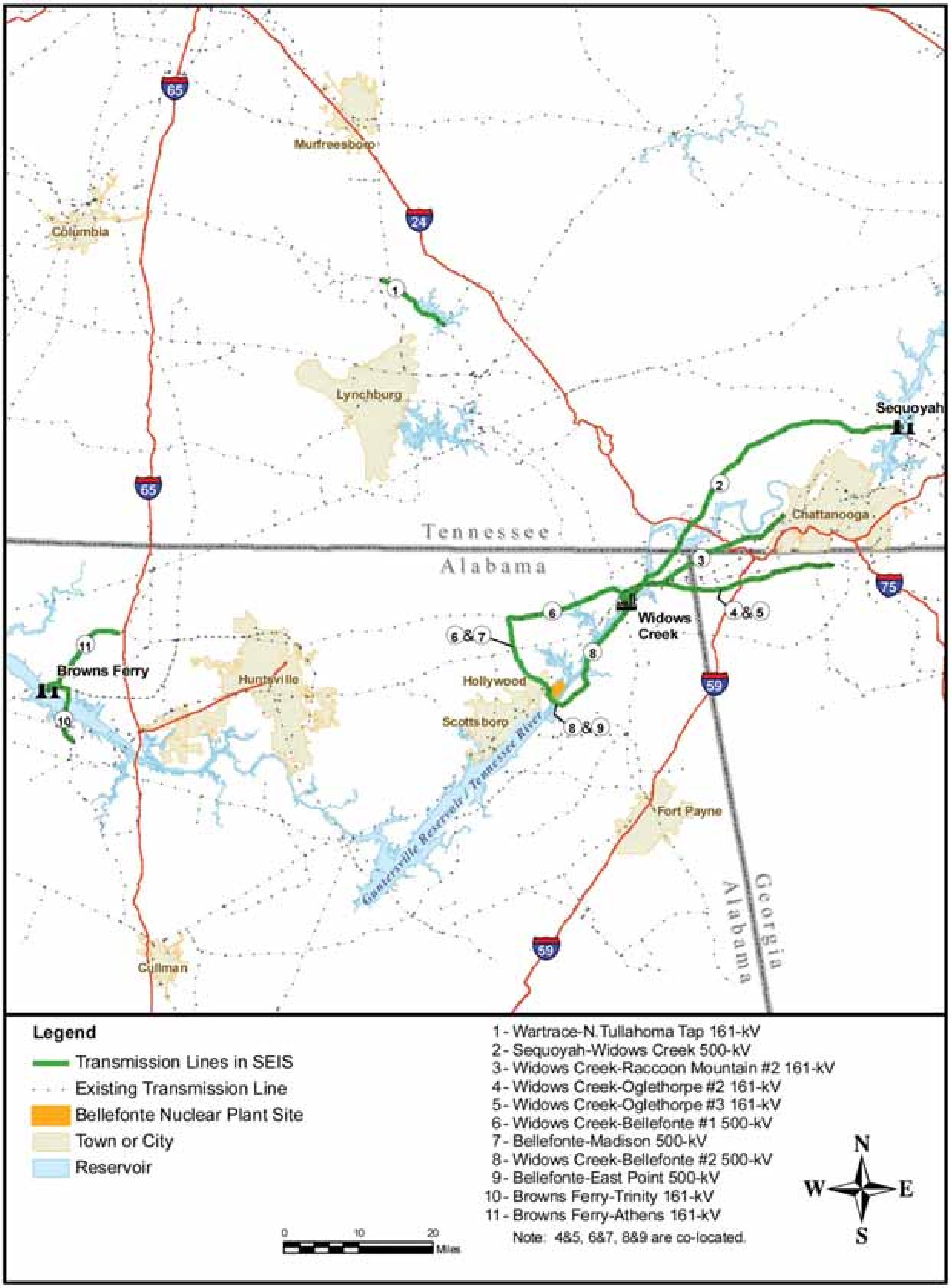


Figure 2-15. Transmission Line Rights-of-Way Affected by the Action Alternatives

- *Line Reconductoring* - If conductor replacement is needed, existing conductors are disconnected from insulators, placed in stringing blocks, and then connected to the new conductor, which is to be installed. The old conductor is then pulled onto empty conductor reels, simultaneously pulling the new conductor into place. As discussed above, heavy equipment is sometimes used at each location where the conductors are "pulled" to accept the horizontal forces incurred after line disconnection. Vans and trucks for transporting ancillary equipment and workers would be used to access points along the ROW where these activities are required. In some cases, the existing conductor could be removed to reels and the new conductor pulled into place on empty structures using ropes or cables. The retired conductor would be reused elsewhere or recycled.

- *Structure Addition/Replacement* - In the event taller structures were needed, the existing structures would be removed, and new ones would be placed along the existing ROW. Structures that have been removed would be disposed of according to TVA's Power System Operations Environmental Compliance Program. Steel from retired structures would be maintained in inventory for future use or recycled. If additional structures were needed, they would be placed where needed along the existing ROW. Holes would be excavated with digging/boring equipment, and a crane would lift the new/replacement structure into place.

- *Anchoring* - In very rare instances, bulldozers are used to accept the horizontal forces incurred with line disconnection while the structure serves as a pivot. This occurs when the structure by itself would not resist the toppling forces incurred when one of the lines is detached. However, other existing lines attached to the affected structures/towers almost always serve to sufficiently stabilize them, thereby negating the need for additional support or anchoring.

- *Logistics* - Vans, trucks, bulldozers, and other equipment would be used to access points along the ROW where resagging or reconductoring activities are required. This equipment would not, except under very rare circumstances, traverse the ROW, but instead enter from and exit to the nearest roadway using the most convenient and established ROW access point. Best management practices (BMPs) would be in place for upgrade activities, and ground surveys would take place to identify wetland areas where avoidance, minimization, or mitigation measures would be required. Movement of equipment would normally utilize access routes that are currently in place and presently being used by line maintenance crews.

- *Crews and Schedule* - The typical field crew and equipment involved in a line resagging or reconductoring operation numbers four bulldozers, four trucks, two equipment operators, and two supervisors. Actions at pulling points would be repeated until the entire line segment has been resagged. TVA construction crews would follow BMPs during the resagging or reconductoring process to minimize erosion and stream impacts and would comply with applicable TVA procedures.

The ROWs that are occupied by the transmission lines affected by this proposal have typically been kept clear of tall vegetation with the exception of portions of the Widows Creek-Bellefonte #1 and #2 500-kV, the Bellefonte-East Point 500-kV, and the Bellefonte-Madison 500-kV transmission lines. Mowing and other maintenance activities have been conducted periodically on these lines. Some of these lines were reviewed for

environmental effects prior to the time of initial construction. As a result, it is less likely that the activities associated with transmission line upgrading would impact significant resources than if new transmission lines were constructed on new ROWs. However, field studies of the transmission line ROWs to be upgraded would be carried out to better confirm if any significant environmental resources or other sensitive features are present. If these are identified, appropriate actions would be taken to avoid or minimize impacts to these resources during upgrade activities.

A total of nine transmission lines or segments of these lines would require reconductoring or uprating. Sections of two 500-kV lines need to be connected and energized. A list of the 11 TVA transmission lines that would be affected under the Action Alternative is provided in Table 2-1.

Table 2-1. Transmission Lines Affected by Proposed Operation of a Single Nuclear Unit at the BLN Site

Transmission Line		Proposed Upgrade/Action	Miles of Line Affected
Identification Number	Name		
1	Wartrace-N. Tullahoma Tap 161-kV	Reconductor to 954 aluminum conductor, steel supported (ACSS) @ 180°C (446-518 megavolt-ampere [MVA])	10.9
2	Sequoyah-Widows Creek 500-kV	Uprate to 100°C capability (2,598 MVA)	49.5
3	Widows Creek-Raccoon Mountain #2 161-kV	Reconductor to 2x956 ACSS @ 180°C (957-1,068 MVA)	25.3
4	Widows Creek-Oglethorpe #2 161-kV[1]	Reconductor to 954 ACSS @ 180°C (446-518 MVA)	30.5
5	Widows Creek-Oglethorpe #3 161-kV[1]	Reconductor to 954 ACSS @ 180°C (446-518 MVA)	30.6
6	Widows Creek-Bellefonte #1 500-kV[2]	Uprate to 100°C capability (2,598 MVA)	29.8
7	Bellefonte-Madison 500-kV[2]	Energize	12.4
8	Widows Creek-Bellefonte #2 500-kV[3]	Uprate to 100°C capability (2,598 MVA)	21.2
9	Bellefonte-East Point 500-kV[3]	Energize	3.4
10	Browns Ferry-Trinity 161-kV	Reconductor to 1,590 ACSS @ 180°C (669-734 MVA)	10.0
11	Browns Ferry-Athens 161-kV	Reconductor to 1,590 ACSS @ 180°C (669-734 MVA)	14.1

[1] The Widows Creek-Oglethorpe #2 and #3 161-kv lines are co-located.

[2] Portions of the Widows Creek-Bellefonte #1 and Bellefonte-Madison 500-kV lines share a common ROW.

[3] Portions of the Widows Creek-Bellefonte #2 and Bellefonte-East Point 500-kV lines share a common ROW.

2.7. Comparison of Alternatives

In this section, proposed actions anticipated under the three alternatives for nuclear plant completion or construction and operation are compared based upon the information and analysis provided in Sections 2.1–2.3 and Chapter 3 (Nuclear Generation Alternatives on the Bellefonte Site). Additionally, two alternatives (No Action and Action) for upgrading electric transmission lines associated with the proposed nuclear plant are compared, based upon the information and analysis in Section 2.6 and Chapter 4 (Transmission System Alternatives).

A comparison of the design, construction, operation, and cost characteristics of the generation alternatives is presented in Table 2-2. Potential environmental impacts of the three alternatives are summarized in Table 2-3. Potential environmental impacts of the transmission system alternatives are summarized in Table 2-4. Mitigation measures designed to avoid or minimize impacts of the proposed action are listed in Section 2.8.

In this review, TVA has found that few new or additional cumulative effects beyond those identified in earlier NEPA documents are expected to result from completing or constructing and operating a single nuclear unit at the Bellefonte site. As summarized in Table 2-3, only minor temporary or insignificant effects are expected for most of the resources considered. As such, these effects are not expected to contribute to cumulative impacts on most affected resources.

2.7.1. Nuclear Plant Licensing and Construction

Both the AP1000 design and the partially completed B&W design will require NRC review and approval to obtain an operating license. The licensing process for the B&W units will continue under 10 CFR Part 50 (consistent with the current construction permits and all other TVA operating units), while the AP1000 will be licensed under the newer NRC licensing regulations contained in 10 CFR Part 52. The construction permits for Units 1 and 2 have been reinstated by the NRC, and recently the NRC has confirmed that the Units 1 and 2 programs and procedures, including the QA records, successfully address the elements of the NRC's policy on deferred status, and have authorized TVA to transition BLN 1 and 2 to the deferred status. Consistent with the NRC policy, construction can be reactivated (assuming a TVA Board approval of a completion project) by issuing a letter to NRC at least 120 days before planned reactivation.

For the AP1000, licensing of both construction and operation of the facility would be accomplished in a single proceeding. Because of this, significant construction activities cannot begin until the NRC issues the COL. Issuance of the COL is predicated on successful Design Certification of the AP1000 amended design, currently under review by NRC. The Design Certification process is not under the direction of TVA, but is being accomplished independently by the design's owner. While this combined process provides additional confidence that a schedule can be met once the COL has been issued, the Design Certification process is outside of TVA's control. Consequently, the schedule for bringing a unit online using the COL process may be longer than the schedule for completing a single unit under 10 CFR Part 50.

Both designs will be reviewed in detail by the NRC to confirm that NRC regulation and guidance are met and that the health and safety of the public is protected. In addition, both designs will require a Regulatory Guide 1.200 compliant Probabilistic Risk Assessment. Both of the designs are expected to have Probabilistic Risk Assessment results that are within the NRC published safety goals (NRC Policy Statement, "Safety Goals for the Operations of Nuclear Power Plants," 51 *Federal Register* 28044, August 4, 1986).

Both of the nuclear generation Action Alternatives, Alternatives B and C, would meet the future demands for power described in Section 1.4 above. Alternative A, No Action, maintaining construction permits in a deferred status, does not address the need for power. Compared to the Action Alternatives, Alternative A would result in no new construction, no operation of a nuclear plant, and no changes to the electric transmission lines or supporting equipment. Under Alternative A, maintenance, inspections, and security functions would continue as required so long as construction permits remain valid.

Table 2-2. Summary of Generation Alternative Characteristics

Characteristics		Generation Alternative		
		A – No Action	Alternative B – B&W Unit	Alternative C – AP1000 Unit
Licensing	Regulation	Not Applicable	10 CFR Part 50	10 CFR Part 52
Plant Design	Power generation capability	Not applicable	Rated 3,600 MWt; 3,760 MWt stretch	Rated 3,400 MWt; 3,415 MWt nuclear steam rating
	Electrical output		Expected 1,260 MW	Expected 1,100 MW
	Thermal efficiency		35 percent	32.4 percent
	Number of fuel assemblies		205 - 12 Feet length	157 - 14 feet length
	Original design life		40 years	60 years
	Engineered safety features		Active shutdown and cooling system powered by AC generators	Passive core cooling system based upon gravity, natural circulation, and compressed gases
	Steam generator system		Once-through - 50º superheated steam	U-tube - saturated steam
	Cooling system		Closed-cycle	Closed-cycle
	Ultimate heat sink		Guntersville Reservoir	Atmosphere
Construction	Duration of construction	Not applicable	Approximately 4.7 years (56 months)	Approximately 6.5 years (two years site preparation and 54 months construction)
	Peak on-site workforce		Approximately 3,000	Approximately 3,000
	Previously disturbed (approximate)	400 acres	400 acres	400 acres
	Project area	Not Applicable	606 acres	606 acres
	Site clearing/grading	Negligible	Minor reclearing and grading of previously disturbed ground	Clearing of about 50 acres of forested land, blasting, reclearing, and grading of previously disturbed ground
	Completion or construction of facilities	No change – routine maintenance	Activities include: replace steam generators, refurbish or replace instrumentation and various equipment, upgrade cooling tower, construction of support buildings	Activities include: upgrade barge unloading dock, off-site construction of modules delivered to BLN via barge and completed on site, construction of support buildings, upgrade cooling tower
	Demolition	Little to none	Several support buildings demolished; no major buildings demolished	Several buildings demolished, including turbine building and administration complex
	Quantity of hazardous waste generated	Not applicable	6.3 tons solid; 56.7 tons liquid	7.25 tons solid and liquid
	Dredging	None	11,100 cubic yards dredged from 1,960 feet of intake channel	10,000 cubic yards dredged from 1,200 feet of intake channel, and 240 cubic yards from barge unloading dock

Characteristics		Generation Alternative		
		A – No Action	**Alternative B – B&W Unit**	**Alternative C – AP1000 Unit**
Operation	Typical amount of water withdrawn from Guntersville Reservoir for plant cooling	Not applicable	35,000 gallons per minute (gpm) (0.2% of average river flow)	24,000 gpm (0.14% of average river flow)
	Typical amount of water discharged to Guntersville Reservoir	approximately 400,000 gallons per quarter year	23,000 gpm (0.13% of average river flow)	8,000 gpm (0.05 % of average river flow)
	Water consumption for plant cooling	Not applicable	12,000 gpm (0.07% of average river flow)	16,000 gpm (0.10% of average river flow)
	Size of thermal mixing zone plume in Guntersville Reservoir	Not applicable	250 feet from diffuser and extending the entire depth of the reservoir	
	Temperature limits on discharged water	Not applicable	Monthly average 92°F; daily maximum 95°F; maximum in-stream temperature increase no more than 5°F above ambient water temperature	
	Frequency of maintenance dredging	Not applicable	Approximately 12-15 years as needed in intake channel	Approximately 12-15 years as needed in intake channel
	Number of on-site staff	50	Approximately 800	Approximately 650
	Quantity of nonhazardous solid waste generated	about 100 cubic yards/year (average)	500 tons/year	400 tons/year
	Quantity of hazardous waste	less than 100 kilograms (kg)/month	Approximately 1,300 pounds (lb)/year (600 kg/year)	Approximately 1,300 lb/year (600 kg/year)
	Radiological effects of normal operations	None	Doses to the public from discharge of radioactive effluents would be a small fraction of the dose considered safe by the NRC (10 CFR Part 50, Appendix I)	
	Number of months between refueling	Not applicable	18	18
	Number of refueling cycles in 40 years	None	26	26
	Number of fuel assemblies needed for 40-year operation	None	2,285	1,821
	Total spent fuel (metric tons uranium [MTU]) for 40-year operation	None	946	894 (946 MTU when normalized for the B&W generation capability--3,600 MWt)
	Spent fuel discharged (MTU/MWt)	None	0.26 MTU/MWt	0.26 MTU/MWt
Cost	Construction	Not applicable	$3,120 – $3,360/kilowatt electric (kWe)	$3,300 – $4,900/kWe
	Operation and maintenance	Not applicable	$.0131/kWh	$.0126/kWh

Table 2-3. Summary of the Environmental Impacts of the Three Alternatives Under Consideration

Resource	Attribute/Potential Effects	Alternative		
		A - No Action	B – One B&W Unit	C – One AP1000 Unit
Surface Water	Chemical or thermal degradation of surface water quality; changes to hydrology and consumptive use of surface water.	No impacts or changes anticipated.	Temporary and minor impacts from construction. No impacts are anticipated to water supply from plant water use. Near-field and far-field effects (e.g., cumulative) to water quality associated with cooling water discharge are not expected to be significant. Minor impacts from chemical discharges.	Temporary and minor effects from construction. No impacts are anticipated to water supply from plant water use. Insignificant effects on water quality similar to Alternative B, but slightly less due to smaller amount of water withdrawal and blowdown discharge. Minor impacts from chemical discharges.
Groundwater	Chemical impacts to groundwater quality; changes in use of groundwater.	No impacts expected.	No impacts expected to groundwater hydrology or groundwater use on site or locally. Insignificant impacts to groundwater quality. No cumulative effects expected.	As with Alternative B, no impacts expected to groundwater hydrology or groundwater use on site or locally. Insignificant impacts to groundwater quality. No cumulative effects expected.
Floodplain and Flood Risk	Construction or modification to the floodplain. Flooding of the plant site from the river, Town Creek, or Probable Maximum Precipitation (PMP).	No anticipated adverse impacts to the floodplain. All safety-related structures are located above the Probable Maximum Flood (PMF) and PMP drainage levels or are flood-proofed to the resulting levels.	Minor impacts from construction and dredging. All safety-related structures are located above the PMF and PMP drainage levels or are flood-proofed to the resulting levels. No cumulative effects to flood risk.	Minor impacts from construction and dredging. All safety-related structures are located above the PMF and PMP drainage levels or are flood-proofed to the resulting levels. The new administrative building would be located above the 100-year and Flood Risk Profile elevations. No cumulative effects to flood risk.

Resource	Attribute/Potential Effects	Alternative		
		A - No Action	**B – One B&W Unit**	**C – One AP1000 Unit**
Wetlands	Destruction of wetlands or degradation of wetland functions.	No impacts.	No impacts.	Impacts to 12.2 acres of wetlands with no net loss of wetland function due to in-kind mitigation within the watershed, No indirect or cumulative impacts expected.
Aquatic Ecology	Destruction of aquatic organisms; degradation or destruction of aquatic habitat.	No impacts.	Minor impacts to benthos from dredging intake channel, to aquatic communities from thermal discharge, impingement, and entrainment. No cumulative effects	Effects similar to Alternative B but slightly less dredging. Impacts from thermal discharge and impingement and entrainment minor and less than Alternative B due to smaller intake water volumes. No cumulative effects.
Terrestrial Ecology	Removal or degradation of terrestrial vegetation, wildlife habitat, and/or wildlife.	No impacts.	Insignificant impacts from minor vegetation clearing. No indirect or cumulative effects expected.	Similar to Alternative B. Minor direct impacts from removal of about 50 acres of forest and native grass. No indirect or cumulative effects expected.
Endangered and Threatened Species	Mortality, harm, or harassment of federally listed or state-listed species including impacts to their critical habitat.	No impacts.	No impacts from site construction or runoff. Adverse direct, indirect, and cumulative impacts to the pink mucket mussel from dredging and towing barges. Minor indirect effects from stress of potential mussel host fish from thermal effluent; negligible effect of impingement/entrainment of potential host fish.	No impacts from site construction or runoff. Little or no impact to Indiana bats from removal of low-quality potential roost habitat with some moderate-quality potential roost trees. Adverse direct, indirect, and cumulative impacts to the pink mucket from dredging and towing barges. Fewer individuals affected than under Alternative B. Operational impacts to pink mucket and other aquatic species same as Alternative B.

Resource	Attribute/Potential Effects	Alternative		
		A - No Action	B – One B&W Unit	C – One AP1000 Unit
Natural Areas	Degradation of the values or qualities of natural areas.	No impacts.	No direct or indirect impacts. Minor cumulative effects.	No direct or indirect impacts. Minor cumulative effects.
Recreation	Degradation or elimination of recreation facilities or opportunities.	No impacts.	Minor impacts from construction and operation, noise, and withdrawal of water. No cumulative effects.	Minor impacts from construction and operation, noise, and withdrawal of water. No cumulative effects.
Archaeology and Historic Structures	Damage to archaeological sites or historic structures.	No impacts.	No impacts. Mark and avoid site 1JA111.	No impacts. Mark and avoid site 1JA111.
Visual	Effects on scenic quality, degradation of visual resources.	No additional impact.	Minor, temporary impacts during construction. Minor impact of vapor plume. Little or no additional impacts to scenic quality. Minor cumulative impacts to regional visual setting.	Construction of new buildings offset by removal of existing buildings; construction impacts minor. Minor impact of vapor plume. Little or no additional impacts to scenic quality. Minor cumulative impacts to regional visual setting.
Noise	Generation of noise at levels causing a nuisance to the community.	No impact.	Small to moderate impacts from temporary noise during hydrodemolition and other construction. Minor impacts during operation.	Small to moderate impacts from temporary noise during blasting and other construction. Minor impacts during operation.
Socioeconomics and Environmental Justice	Changes in population, employment, income, and tax revenues.	No impact.	No substantial change in population; no significant adverse effects; minor beneficial impacts.	No substantial change in population; no significant adverse effects; minor beneficial impacts.
	Disproportionate effects on low income and/or minority populations.	No impact.	No disproportionate impact.	No disproportionate impact.
	Changes in availability of housing.	No impact.	Minor to potential significant adverse impacts during construction; minor impacts during operation. Potentially apply measures to mitigate demand for housing.	Minor to potential significant adverse impacts during construction; minor impacts during operation. Potentially apply measures to mitigate demand for housing.

Resource	Attribute/Potential Effects	Alternative		
		A - No Action	B – One B&W Unit	C – One AP1000 Unit
	Effects on water supply, wastewater, schools, police, fire and medical services.	No impact.	Minor and insignificant with the exception of significant increase in demand for schools during construction; moderate increase in demand for schools during operation.	Minor and insignificant with the exception of significant increase in demand for schools during construction; moderate increase in demand for schools during operation.
	Changes in land use, land acquisition, land conversion or road locations.	No impact.	No change in designated land use. Minor indirect impact from increased residential use.	No change in designated land use. Minor indirect impact from increased residential use.
	Elevated levels of traffic from construction workforce and deliveries.	No impact.	Impacts on transportation corridors from construction workforce and deliveries would be minor on all roads except for County Road 33 where temporary minor to moderate impacts are expected. Operational effects expected to be minor.	Impacts on transportation corridors from construction workforce and deliveries would be minor on all roads except for County Road 33 where temporary minor to moderate impacts are expected. Operational effects would be minor; impacts would be minor.
	Cumulative effects	No impact.	Minor impact, minor cumulative effects.	Minor impacts, minor cumulative effects.
Solid and Hazardous Waste	Generation and disposal of solid and hazardous waste.	No impact related to construction; minor indirect impact of off-site disposal in permitted facilities.	No direct or cumulative impacts; minor indirect impacts during construction and operation from off-site disposal in permitted facilities.	Quantity of construction waste greater than under Alternative B. No direct or cumulative impacts; minor indirect impacts during construction and operation from off-site disposal in permitted facilities.
Seismology	Seismic adequacy.	No change.	No adverse seismic effects anticipated.	No adverse seismic effects anticipated.

Resource	Attribute/Potential Effects	Alternative		
		A - No Action	B – One B&W Unit	C – One AP1000 Unit
Air Quality	Radiological emissions resulting in increases of air pollutants.	No impacts expected.	Small radiological doses to workers and members of the public from routine radioactive emissions during normal plant operation. Releases would be well below the regulatory limits; impacts are expected to be insignificant. Calculated impacts from design-basis accident releases would be well below the regulatory limit and therefore insignificant.	Impacts would be similar to Alternative B.
	Gasoline and diesel emissions from vehicles and equipment.	No impacts expected.	Minor impacts from vehicular and equipment emissions, controlled to meet applicable regulatory requirements.	Minor impacts from vehicular and equipment emissions, controlled to meet applicable regulatory requirements.
Radiological Effects	Effects to humans and nonhuman biota from normal radiological releases.	No impacts expected.	Annual doses to the public well within regulatory limits; no observable health impacts. Doses to nonhuman biota well below regulatory limits; no noticeable acute effects.	Annual doses to the public well within regulatory limits; no observable health impacts. Doses to nonhuman biota well below regulatory limits; no noticeable acute effects.

Table 2-4. Summary of the Environmental Impacts of the Two Transmission Upgrade Alternatives

Resource	Attribute/Potential Effects	Alternative	
		No Action	**Action**
Surface Water	Chemical or thermal degradation of surface water quality; changes to hydrology and surface water use.	No impacts.	Minor, temporary impacts during upgrade activities. Minor impacts during routine maintenance. No cumulative impacts.
Groundwater	Chemical impacts to groundwater quality; changes in use of groundwater.	Minor impacts to groundwater quality from ROW maintenance.	Minor impacts to groundwater quality from ROW maintenance.
Aquatic Ecology	Degradation of water quality; destruction of aquatic organisms.	Minor direct and indirect impacts from ROW maintenance. No cumulative impacts.	No impacts from ROW clearing; no additional impacts of ROW maintenance as compared to No Action.
Terrestrial Ecology	Removal or degradation of terrestrial vegetation, associated wildlife habitat, and wildlife.	No local or regional impacts.	No local or regional impacts.
Endangered and Threatened Species	Mortality, harm, or harassment of federally listed or state-listed species.	No impacts.	No effect and may affect determinations to some listed species.
Wetlands	Destruction of wetlands or degradation of wetland functions.	No impacts.	No adverse impacts.
Floodplains	Construction or modification to a floodplain.	No floodplains affected.	No adverse impacts.
Natural Areas	Degradation of the values or qualities of natural areas.	No impacts.	Minor direct impact to natural areas on ROWs, no impact to natural areas nearby.
Recreation	Degradation or elimination of recreation facilities or opportunities.	No impacts.	Minor impact from refurbishing lines and routine maintenance.
Land Use	Changes in land use and effects to uses of adjacent land.	No changes to current land use.	Minor disruption during upgrade activities.
Visual	Effects on scenic quality, degradation of visual resources.	No impacts.	Minor short-term impacts during construction and minor long-term impacts from taller structures.

Resource	Attribute/Potential Effects	Alternative	
		No Action	Action
Archaeology and Historic Structures	Damage to archaeological sites or historic structures.	No impacts.	Potential for adverse impact to archaeological sites and/or historic structures. Effects would be avoided or mitigated in accordance with memorandums of agreements (MOAs) developed in consultation with the appropriate State Historic Preservation Officers (SHPOs).
Socioeconomics	Changes, at local and regional scales, in the human population; employment, income, and tax revenues; and demand for public services and housing.	No impacts.	Minor impacts during construction.
Environmental Justice	Disproportionate effects on low income and/or minority populations.	No disproportionate effects.	No disproportionate effects.
Operational Impacts	Potential effects of electromagnetic fields (EMFs), lightning strike hazard, electric shock hazard, and generation of noises and odors.	No impacts.	No significant impacts from EMFs; no alteration of line grounding, minor noise, no odors.

Under Alternatives B and C, construction activities would incorporate existing facilities and structures and use previously disturbed ground where possible. Both a B&W and an AP1000 unit would use the existing intake channel and pumping station, cooling towers, blowdown discharge diffuser, switchyard, and transmission system. Under Alternative B, a partially constructed B&W unit would be completed on previously cleared ground, and minimal new site clearing or grading would occur. The majority of the construction activities on plant systems and components would involve replacement or refurbishment of equipment contained within the current structures.

Under Alternative C, an AP1000 unit would be constructed on a new nuclear island located on vacant ground within the BLN project area. Construction of one AP1000 unit and associated structures is expected to require clearing of about 50 acres of forested land and reclearing and grading of previously disturbed ground. Site preparation would require blasting. The existing turbine building and the office and service buildings would be removed.

Although more site preparation and construction would be necessary under Alternative C, this would be offset by the somewhat simpler design and modern modular construction techniques used to construct the AP1000 unit. Factory-built modules can be assembled at the site, significantly reducing both construction duration and construction site labor requirements. Therefore, the construction duration and site construction labor force for an AP1000 unit is comparable to the estimated duration and labor requirements to complete one of the partially constructed B&W units.

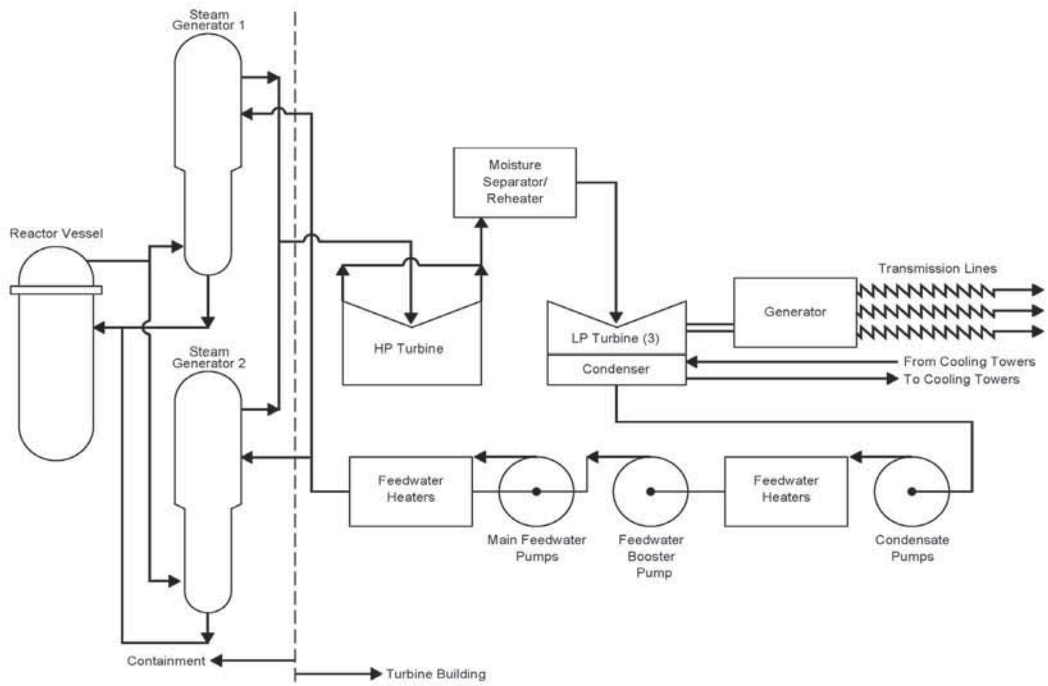
Under Alternatives B and C, initial dredging and periodic maintenance dredging would be necessary. The areas requiring dredging vary between the two alternatives. Alternative B would require the removal of about 10 percent more material from the intake channel than would Alternative C; it would also require dredging from the main river channel that would not occur under Alternative C. However, Alternative C would require dredging 240 cubic yards of material from the barge unloading area.

Potential effects to the environment from construction activities proposed under Alternatives B and C are described in Table 2-3.

2.7.2. Nuclear Plant Operation

The B&W and AP1000 alternatives are functionally very similar in that they are both pressurized light water reactors with a reactor vessel, reactor coolant pumps, a pressurizer, two steam generators, and a power conversion system consisting of high pressure and low pressure turbines, a generator, and feedwater system as illustrated in Figure 2-16. Both plants would generate comparable quantities of radioactive waste and use similar chemicals and processes for water treatment.

One of the most significant differences between these two systems is that the B&W plant utilizes once-through steam generators that produce about 50 degrees of superheated steam, whereas the AP1000 uses a U-tube steam generator system that produces saturated steam. By utilizing a superheat design, working steam is supplied well above saturation points and can deliver working energy more efficiently. Therefore, a superheat cycle plant would, in general, provide more energy for useful work (turning a generator) than a comparable nonsuperheat cycle design. The ability to create superheated steam makes the B&W unit thermally more efficient. The efficiency of the B&W plant is 35 percent compared to 32.4 percent for the AP1000.



Source: TVA 2008a

Figure 2-16. Typical Pressurized Light Water Reactor - Reactor Power Conversion System and Reactor Coolant System

Both the B&W and AP1000 would use closed-cycle cooling systems, discharging cooling tower blowdown via a diffuser in Guntersville Reservoir, requiring only a small amount of water compared both to the average flow and the minimum expected drought flow in the Guntersville Reservoir. The two plant designs differ in volumes of operating water flows (see Table 2-5). For a single B&W unit, intake water would make up 12,000 gallons per minute (gpm) for evaporation, plus about 23,000 gpm of cooling tower blowdown, resulting in a typical withdrawal from Guntersville Reservoir of 35,000 gpm (or 0.21 percent of the average flow through Guntersville Reservoir). For a single AP1000 unit, intake water would make up for 16,000 gpm for evaporation plus about 8,000 gpm cooling tower blowdown, resulting in a typical withdrawal from Guntersville Reservoir of 24,000 gpm (or about 0.14 percent of the average flow through Guntersville Reservoir). Both plants would meet the same specifications for temperature of discharged water. The larger makeup and blowdown volumes for the B&W design would be partly offset by the lower evaporative losses and the expected 160 MWe increase in electrical production.

Table 2-5. B&W and AP1000 Water Use

	B&W[1]	Percent Average River Flow[2]	AP1000[3]	Percent Average River Flow[2]
Condenser Circulating Water Flow Rate (Closed Cycle)	420,000 gpm	N/A	500,000 gpm	N/A
Evaporation (Consumption)	12,000 gpm	0.07%	16,000 gpm	0.10%
Blowdown (Discharge)	23,000 gpm	0.13%	8,000 gpm	0.05%
Makeup (Withdrawal)	35,000 gpm	0.21%	24,000 gpm	0.14%

[1]B&W operating water flow rates source: TVA 1976; T. Spink, TVA, personal communication, March 2010.
[2]Average River Flow at Bellefonte is 37,300 cubic feet per second (approximately 16,700,000 gpm). Source: P. Hopping, TVA, personal communication, February 2010.
[3]AP1000 operating water flow rates source: TVA 2008a

A comparison of spent fuel production for the B&W and AP1000 is provided in Table 2-6. A comparison based on the number of fuel assemblies discharged over the 40-year lifetime can be misleading because of different fuel assembly length (B&W - 12 feet versus AP1000 - 14 feet) and power level (3,600 MW versus 3,400 MW). Fuel is limited in its burnup to approximately 62,000 megawatt-days (MWD)/metric tons uranium (MTU). Allowing for power peaking factors, the average discharge burnup is expected to be approximately 50,000 MWD/MTU for both the AP1000 and the B&W BLN plant designs. Because this fuel characteristic parameter is expected to be the same for both fuel designs, this indicates that the expected amount of fuel to be discharged is proportional to the amount of energy produced.

Table 2-6. Spent Fuel Quantity Determination for BLN Single Unit Operation

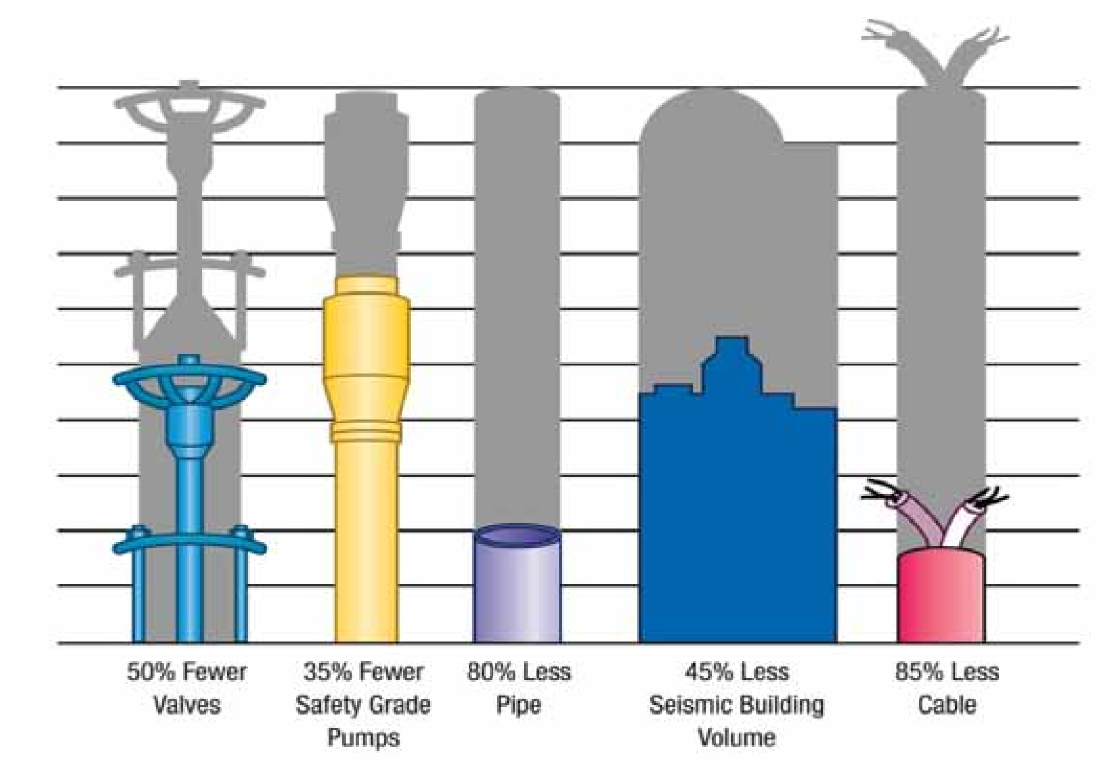
Data Parameter	BLN B&W	BLN AP1000	BLN AP1000 Normalized for Power
Core thermal power, MWt	3,600	3,400	3,600
Operating cycle length	18 months	18 months	N/A
Number of assemblies in the core	205[1]	157[2]	N/A
Number of fresh fuel assemblies per refueling cycle	80[3]	64[4]	N/A
Height of active fuel, feet	12	14	14
Number of refueling cycles in 40 years[5]	26	26	N/A
Number of fuel assemblies for 40-year operation[6]	2,285	1,821	N/A
Total Spent Fuel (MTU) for 40-year operation	946	894	946

[1] (TVA 1978a)
[2] (TVA 2008a)
[3] (T A Keys, TVA, personal communication, September 3, 2009)
[4] (TVA 2008a)
[5] Forty years of operation covers 26 refueling cycles and 27 operating cycles. Spent fuel is discharged a total of 27 times from each unit, which includes the last cycle discharge of the entire core.
[6] Number includes assemblies from 26 refueling cycles, plus assemblies in the core.

Another significant difference between the B&W and the AP1000 designs is that the AP1000 works on the concept that, in the event of a design-basis accident (such as a coolant pipe break), the plant is designed to achieve and maintain safe shutdown condition without any operator action and without the need for AC power or pumps. Instead of relying on active components such as diesel generators and pumps, the AP1000 relies on the natural forces of gravity, natural circulation, and compressed gases to keep the core and containment from overheating. The ultimate heat sink for the AP1000 is the atmosphere, whereas the ultimate heat sink for the B&W is the river. These passive design concepts greatly simplify the design and construction of the AP1000 plant and reduce its overall footprint. For example, the AP1000 uses far less equipment than a typical nuclear plant, as illustrated in Figure 2-17.

The B&W 205 unit is an evolution of the existing operating B&W 177 units. The design incorporates improved safety features to address lessons learned and NRC requirements resulting from the Three Mile Island event. In addition, both the B&W and the AP1000 designs require a detailed Probabilistic Risk Assessment, and both of the designs are expected to have Probabilistic Risk Assessment results that are within the NRC published

safety goals (NRC Policy Statement, "Safety Goals for the Operations of Nuclear Power Plants," 51 *Federal Register* 28044, August 4, 1986).



Source: WEC 2009

Figure 2-17. AP1000 Simplified Design - Fewer Components

As a result of the AP1000's design simplicity and significant reduction in safety-related systems and equipment, operations and maintenance costs for the AP1000 should be slightly lower than for the B&W unit, although partially offset by the B&W unit's higher thermal efficiency and generating capacity.

2.7.3. Transmission System

Should a nuclear plant at the Bellefonte site become operational, electricity generated by the new plant would overload the existing transmission infrastructure. To address the projected overloading, TVA evaluated potential effects of implementing two alternatives; this evaluation is summarized in Table 2-4.

2.8. Identification of Mitigation Measures

Mitigation of potential environmental impacts includes measures to avoid, minimize, rectify, reduce, or compensate for adverse impacts. Mitigation measures have been identified in TVA's 1974 FES and subsequent environmental reviews. Those measures would be implemented as described. The AEC's 1974 FES (AEC 1974) includes a list of seven conditions for the protection of the environment during construction and operation of BLN 1&2. After reviewing these conditions, TVA has concluded that these conditions either have been met during plant construction or will be addressed by required permits and

authorizations. This supplemental document identifies mitigation measures to address impacts beyond those discussed in the earlier reviews. TVA will identify specific mitigations and commitments selected for implementation in the ROD for this project.

TVA has identified the following measures that could be implemented during construction or operation of a single nuclear unit at the Bellefonte site to address those potential impacts.

Completion of Construction and Operation of a Nuclear Unit
If Alternative B or C were adopted, TVA would avoid disturbing archaeological site 1JA111. The site would be fenced off and its location would be marked on BLN drawings. Prior to the adoption of any future modification to current project plans having potential to affect this site, site 1JA111 would be subjected to further testing to determine the extent and nature of adverse effects.

If either Action Alternative were implemented, TVA would review the availability of housing, traffic congestion, and impacts to schools during the construction phase to assess whether efforts to mitigate such impacts in Jackson County are needed. Such efforts could include housing assistance for employees, transportation assistance for commuting employees, or remote parking areas with shuttles.

If either Action Alternative were implemented, in accord with the results of formal Section 7 consultation under the *Endangered Species Act* (ESA) of 1973, TVA would provide a total of $30,000 to be used for research and recovery of pink mucket

If Alternative C were selected and implemented, TVA would conduct a survey to further investigate the presence of Indiana bats prior to clearing forest on the BLN site. The need for measures designed to avoid or minimize impacts to Indiana bats would be determined based upon results of the survey and in coordination with the USFWS.

If Alternative C were selected for implementation, TVA would compensate for wetland impacts caused by construction activities by purchasing wetland mitigation credits at Robinson Spring Wetland Mitigation Bank, which is located within the same watershed as the proposed impacts. TVA would determine the exact extent of wetland fill required and would obtain and comply with a Section 404/401 permit.

If Alternative C were adopted, preparation for the construction of an AP1000 unit would also require blasting, which would cause temporary noise impacts. Potential mitigation measures include, but are not limited to, the use of blasting blankets, notification of the surrounding receptors prior to blasting, and limiting blasting activities to daylight hours.

Transmission System Impacts
Should TVA select Alternative B or C, the following mitigation measures could be implemented to address the potential impacts of the proposed transmission upgrades.

Federally listed and state-listed plant species have been previously documented along small portions of the transmission ROWs. Prior to implementing any ground-disturbing work on transmission ROWs, appropriately timed botanical surveys would be conducted to examine all sites where listed plant species have been previously reported to confirm whether the rare species are still present and the full extent of the plants in the ROWs. If survey results indicate listed plants are present in the project area, the following mitigation measures would be used to reduce or eliminate impacts to the species:

- Locations of areas with federally listed plant species would be noted in the transmission line and access road engineering design specification drawings used during the design and construction of the upgrades. TVA botanists would help fence these areas to ensure construction crews would avoid the sites. Depending on the species present, construction may be timed so work takes place during the dormant season when plants are less likely to be harmed by construction. Any new structures would be placed to avoid impacting these areas. Additionally, access roads and the associated vehicle traffic would be excluded from these areas.

- Areas where state-listed species occur in the project area would be avoided unless there is no practical alternative. Avoidance measures would be comparable to those used for federally listed plants.

Prior to implementing any proposed upgrade activities, TVA would conduct a ground survey to confirm the exact extent of any wetland areas located within the corridors proposed for upgrade. Pending this review, specific commitments may be placed on wetland areas to ensure no significant impacts or loss of wetland function occurs as a result of the transmission line upgrade activities. These commitments would result in avoidance strategies, minimization measures, or mitigation measures should wetland functions be compromised. Mitigation would be provided for any other activity that reduces the functional capacity of a specific wetland. BMPs would be in place for upgrade activities, and ground surveys would take place to identify wetland areas where avoidance, minimization, or mitigation measures would be required. No significant impacts to potential wetland areas within the ROW would be anticipated from the transmission line upgrade.

TVA would also evaluate the presence of historic structures and archaeological sites in areas to be disturbed. This evaluation would be guided by the memorandums of agreement (MOAs) with Georgia (executed April 29, 2010) and Alabama (pending) for identification and evaluation of historic properties. Instead of an MOA in Tennessee, TVA would use the phased identification and evaluation of historic properties pursuant to 36 CFR Part 800.4(b)(2). TVA would, in consultation with the SHPO (for which the property is located) and other consulting parties, develop and evaluate alternatives or modifications, that would avoid, minimize, or mitigate any adverse effects to historic properties. Mitigation measures requiring data recovery for an archaeological site(s) would require a separate MOA developed in consultation with the SHPO and consulting parties pursuant 36 CFR Part 800.6.

2.9. Preferred Alternative

On the basis of TVA's integrated assessment of the two alternatives (completing a B&W unit or constructing an AP1000), completing Bellefonte Unit 1 (a B&W unit) has been identifed as TVA's preferred alternative. The assessments conclude that from financial, schedule, and risk-minimization perspectives, this is the preferred generation option. In support of the preferred alternative, the transmission system also would be upgraded.

CHAPTER 3

3.0 NUCLEAR GENERATION ALTERNATIVES ON THE BELLEFONTE SITE – AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

The BLN site has been the subject of several environmental reviews. The environmental consequences of constructing and operating BLN 1&2 (B&W units) were addressed comprehensively in TVA's 1974 FES and AEC's 1974 FES. Subsequent environmental reviews updated these analyses (see Section 1.7). By 1988, when TVA deferred construction activities, most of the land-disturbing construction effects had already occurred. The environmental consequences of constructing and operating BLN 3&4 (AP1000 units) were addressed in the COLA ER, Revision 1 (TVA 2008a). This chapter updates the information contained in those earlier reviews; identifies any new or additional direct, indirect, and cumulative effects that could result from the completion or construction and operation of a single nuclear unit at the BLN site; and assesses the potential environmental impacts.

The investigations and analyses described in this chapter were conducted within the Bellefonte project area illustrated in Figures 2-1 and 2-12, unless otherwise specified. As noted in Section 2.0 and shown in updated Figure 2-1, the south security checkpoint has been added to the B&W project area. Additional fieldwork was conducted in February 2010 to assess the potential for effects to this small additional area to be disturbed. The effects were found to be insignificant.

The potential for additional construction and operational cumulative effects are considered in the following assessments. Cumulative effects of constructing and operating BLN Units 1&2 were considered in both TVA's and NRC's 1974 FESs. Cumulative effects are also considered in many of the documents incorporated by reference and/or tiered from for this supplement. Most notably, cumulative effects of spent fuel storage and transportation were addressed in CLWR FEIS (DOE 1999); cumulative effects of transportation of radioactive materials were addressed in NUREG-75/038 (NRC 1975), and cumulative hydrothermal and water supply effects of TVA operations were addressed in the ROS FEIS (TVA 2004). With the exception of Section 3.13, Socioeconomics, cumulative effects are discussed in the environmental consequences section along with direct and indirect effects. The cumulative effects on socioeconomics are discussed at the end of Subsection 3.13.11.

In response to public and agency comments on the DSEIS, several of the following sections, particularly plant water use, global climate change, aquatic communities, socioeconomic effects, and radioactive emissions, have been revised.

3.1. Surface Water Resources

3.1.1. Surface Water Hydrology and Water Quality

3.1.1.1. Affected Environment

Guntersville Reservoir extends 76 river miles from Guntersville Dam in northeast Alabama (TRM 349.0), across the Alabama-Tennessee state line (TRM 416.5), to Nickajack Dam in southeast Tennessee (TRM 424.7). The Sequatchie River enters Guntersville Reservoir at TRM 422.7, just downstream of Nickajack Dam. Guntersville Reservoir has a drainage

area of 24,450 square miles, of which 2,589 square miles are not regulated by upstream dams. The reservoir has a shoreline length of 890 miles, a volume of 1,018,000 acre-feet, and a water surface area of 67,900 acres at a normal maximum pool elevation of 595 feet mean sea level (msl). The width of the reservoir ranges from 900 feet to 2.5 miles. Average flow (1976-2008) at Guntersville Dam is 40,000 cubic feet per second (cfs).

Consistent with the *TVA Act,* Guntersville Dam and Reservoir are operated for the purposes of flood protection, navigation, and power production, as well as to protect aquatic resources and provide water supply and recreation. During normal operations, the surface elevation of Guntersville Reservoir varies between 593 feet msl in winter and 595 feet msl in summer. During high-flow periods, the top of the normal operating elevation range may be exceeded to regulate flood flows. From mid-May to mid-September, TVA varies the elevation of Guntersville Reservoir by 1 foot to aid in mosquito population control. Because of the need to maintain a minimum depth for navigation, Guntersville is one of the most stable TVA reservoirs, fluctuating only 2 feet between its normal minimum pool in the winter and its maximum pool in the summer.

The BLN site at TRM 391.5 is located on a peninsula formed by the Town Creek embayment on the right (western) bank of Guntersville Reservoir (Figure 1-1). The Town Creek embayment borders the northern and western property boundaries of the BLN site. Town Creek originates approximately 3 miles southwest of the BLN site and flows northwestward into Guntersville Reservoir at TRM 393.4. The drainage area of Town Creek at the BLN site is approximately 6 square miles.

The State of Alabama has designated the reach of the Tennessee River in the vicinity of BLN for public water supply, swimming and other whole-body water-contact sports, and fish and wildlife use classifications. The state also assesses the water quality of streams in the state. Those not meeting water quality standards are listed in a federally mandated report, referred to as a 305(b) report (from the section of the CWA). This report is published in alternate years. The 2008 version of the report (ADEM 2008) lists two impaired tributary streams to Guntersville Reservoir, neither of which are in the immediate area of BLN: Town Creek (a different stream from the one at the BLN site), which enters the reservoir at TRM 361.5; and Scarham Creek, a tributary to Short Creek, the mouth of which is at TRM 360.5.

TVA has conducted the Vital Signs (VS) Monitoring Program on Guntersville Reservoir in alternate years since 1994. The VS program uses five metrics to evaluate the ecological health of TVA reservoirs: chlorophyll concentration, fish community health, bottom life, sediment contamination, and dissolved oxygen. Values of good, fair, or poor are assigned to each metric. Scores from monitoring sites in the deep area near the dam (forebay, TRM 350), midreservoir (TRM 375.2), and at the upstream end of the reservoir (inflow, TRM 420 and 424) are combined for a summary score. The data from these sites characterize the surface biological and water quality of the reservoir and the BLN site.

The ecological health condition of Guntersville Reservoir rated at the upper end of the fair range in 2008 (see Figure 3-1). Guntersville's ecological health scores had fluctuated within the good range in prior years. The lower score in 2008 was largely because several ecological indicators at the forebay (dissolved oxygen, chlorophyll, and bottom life) received their lowest scores to date. The lower scores may have been influenced by drought conditions that occurred in 2007 and 2008. Ecological health scores tend to be lower in most Tennessee River reservoirs during years with low flows, because chlorophyll concentrations are typically higher and dissolved oxygen levels are lower. As in past years,

scores for the ecological health indicators at the midreservoir and inflow locations were among the highest observed for all TVA reservoirs.

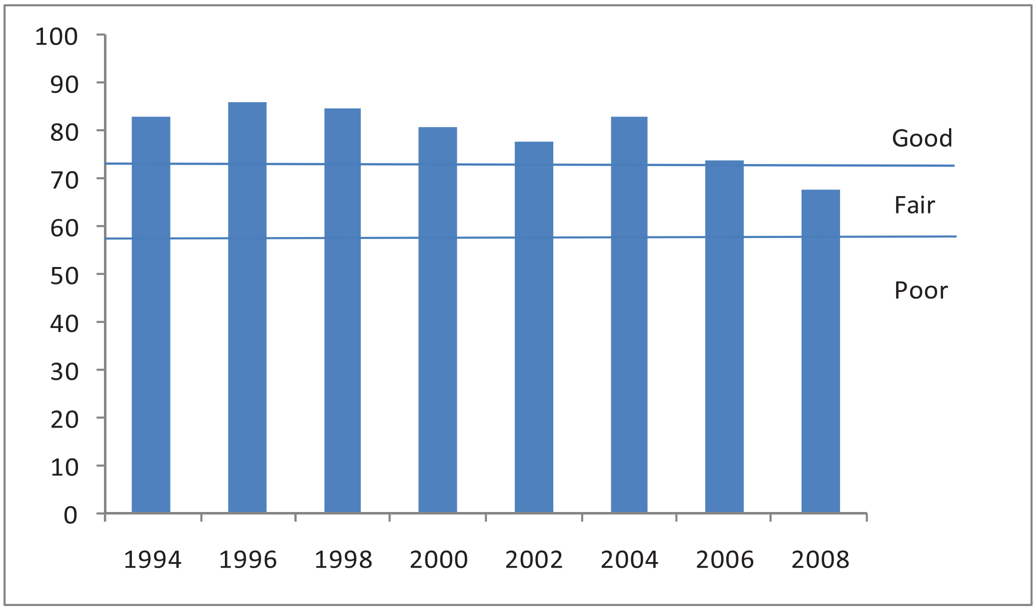


Figure 3-1. Guntersville Reservoir Ecological Health Ratings, 1994-2008

In 2008, the five individual metrics scored good or fair at all sites except for chlorophyll in the forebay station, which rated poor (Table 3-1). These metrics are briefly explained in the paragraphs that follow.

Table 3-1. Ecological Health Indicators for Guntersville Reservoir, 2008

Monitoring Locations	Dissolved Oxygen	Chlorophyll	Fish	Bottom Life	Sediment
Forebay	Fair	Poor	Fair	Fair	Fair
Midreservoir	Good	Good	Fair	Fair	Good
Inflow	*	*	Fair	Good	*

* Not measured at inflow station

Dissolved Oxygen. Dissolved oxygen (DO) levels typically rate good at both monitoring locations, and the midreservoir continued to do so in 2008 (Table 3-1). However, the forebay received its first fair rating for DO, rating at the upper end of the fair range. This was because concentrations were low in a small area along the bottom of the reservoir in early summer.

Chlorophyll. Chlorophyll rated poor at the forebay and good at the midreservoir monitoring location. Chlorophyll concentrations were elevated at the forebay during several sample periods, likely a result of the low flow conditions in the reservoir. Chlorophyll ratings have fluctuated between good, fair, and poor at the forebay, generally in response to reservoir flows. Chlorophyll concentrations at the midreservoir monitoring location have consistently rated good.

Fish. As in previous years, low catch rates contributed to fair ratings for the fish community at all locations. While the fish assemblage generally rates fair at the forebay and midreservoir, ratings at the inflow have fluctuated between good and fair and even poor in 2000 (one point from fair), the lowest score to date for the reservoir. This fish rating rebounded to good in 2002 and to a “high fair” in 2004, possibly indicating that the poor rating was an anomaly.

Bottom Life. Bottom life rated fair at the forebay and midreservoir and good at the inflow. Bottom life typically rates fair or good at all monitoring locations. However, bottom life rated at the low end of the fair range at the forebay in 2008—lower than in previous years. The lower rating was due to the reduced density and diversity of organisms in the samples collected from the reservoir bottom.

Sediment. Sediment quality rated good at the midreservoir monitoring location because no polychlorinated biphenyls (PCBs) or pesticides were detected, and no metals had elevated concentrations. The forebay rated fair because PCBs were detected. Sediment quality typically rates fair at the forebay due to the presence of one or more contaminants: PCBs, chlordane, or zinc. The sediment rating at the midreservoir has fluctuated between good and fair due primarily to chlordane, which was detected in 1996, 2002, and 2004; PCBs were detected at this location in 2002.

Fish Consumption Advisories. There are no fish consumption advisories on Guntersville Reservoir. TVA collected channel catfish and largemouth bass from the reservoir for tissue analysis in autumn 2004. All contaminant levels were either below detectable levels or below the levels used by the State of Alabama to issue fish consumption advisories.

3.1.1.2. Environmental Consequences

Alternative A

No changes in the plant facilities or operations would occur under this alternative, and the NPDES permit would be maintained. Consequently, there would be no impacts or changes in current surface water conditions.

Alternatives B and C

While both the B&W and AP1000 involve some land-disturbing construction activities, land disturbances would be greater for the AP1000. As development of either alternative occurs, soil disturbances associated with access roads and other construction activities could potentially result in adverse water quality impacts. Improper water management or storage and handling of potential contaminants could result in polluting discharges or surface runoff to receiving streams. Erosion and sediment could clog small streams and threaten aquatic life. Improper use of herbicides to control vegetation could result in runoff to streams and subsequent aquatic impacts.

Precautions would be included in the project design, construction, operation, and maintenance to minimize the potential impacts. Construction, operation, and maintenance activities would comply with state construction and runoff permit requirements. BMPs sufficient to avoid adverse impacts would be followed for all construction activities. Site grading and soil removal would be minimized to preserve and protect the environment and receiving waters. Clearing operations would be staged so that only land that would be developed promptly is stripped of protective vegetation. Mulch or temporary cover would be applied whenever possible to reduce sheet erosion. Permanent vegetation, ground

cover, and sod would be installed as soon as possible after site preparation. All natural features, such as streams, topsoil, trees, and shrubs would be preserved to the extent possible and incorporated into the final design layout. Sediment basins or other control options would be used to control sediment runoff. Surface runoff would be managed to avoid adverse impacts. Landscape maintenance would employ only EPA-registered herbicides used in accordance with label directions. These and other similar precautions would minimize potential construction impacts such that no mitigation measures would be necessary.

Under Alternatives B (B&W) and C (AP1000), construction activities would incorporate existing facilities and structures and use previously disturbed ground where possible. Both a B&W and an AP1000 unit would use the existing intake channel and pumping station, cooling towers, blowdown discharge diffuser, barge unloading dock, switchyard, and transmission system.

Under Alternative B dredging in the intake channel from the intake pumping station to the shoreline (a distance of approximately 1,200 feet) would result in removal of approximately 10,000 cubic yards of dredged material (Figure 3-2). Additionally, from the shoreline boom to the main river channel (a distance of approximately 760 feet), approximately 1,100 cubic yards of dredged material would be removed. Periodic maintenance dredging of the intake channel would be conducted in the future. No dredging in the area of the barge unloading dock would be required. Dredged material would be disposed of in an on-site spoils area above the 500-year flood elevation. During the dredging operation, temporary increases in turbidity are expected in the immediate vicinity. All appropriate permits would be obtained prior to dredging. No significant or long-term water quality impacts are expected. The steam generator replacement process could entail hydrodemolition using a high-pressure water jet to remove concrete. The process would use approximately 450,000 gallons of water, likely from the local municipal source, and would produce a water and concrete slurry. This one-time generation of wastewater would be captured, sampled, treated, and released through an approved NPDES discharge point.

Under Alternative C, there would be slightly less dredging (Figure 3-2). Dredging of the area between the intake pumping station and the shoreline would be the same as under Alternative B and there would be no dredging between the shoreline and the main river channel. Periodic maintenance dredging of the intake channel would be conducted in the future. Additionally, dredging in the area of the barge unloading dock would involve removal of approximately 240 cubic yards of dredged material. Impacts to water quality would be similar to Alternative B. Dredged material would be disposed of in an on-site spoils area above the 500-year flood elevation. During dredging, temporary increases in turbidity are expected in the immediate vicinity. As with Alternative B, all appropriate permits would be obtained prior to dredging. No significant or long-term water quality impacts are expected.

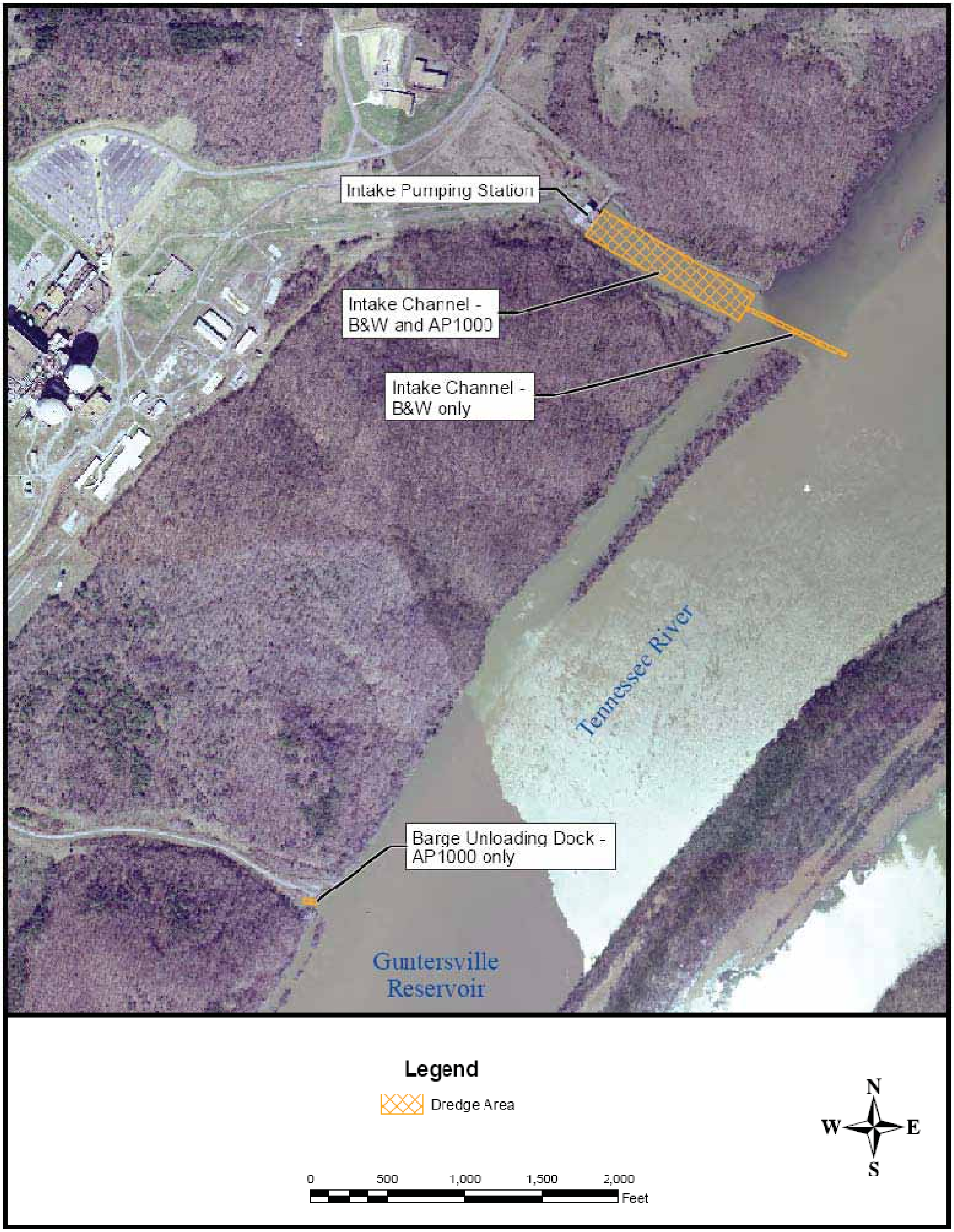


Figure 3-2. Areas to be Dredged Under Alternative B (B&W) or Alternative C (AP1000)

In summary, under Alternatives B and C, initial dredging and periodic maintenance dredging of the intake channel would be necessary. The areas requiring dredging vary between the two alternatives. Alternative B would require the removal of about 10 percent more material from the intake channel than would Alternative C; it would also require dredging out to the main river channel that would not occur under Alternative C. However, Alternative C would require a one-time dredge at the barge unloading area.

Construction of either a B&W or an AP1000 unit is expected to result in temporary and minor impacts to surface waters. The proximity of the Tennessee River and the magnitude of the river flow provide a ready source of raw water of sufficient quantity to meet foreseeable needs, including the operation of a natural draft cooling tower. No cumulative construction impacts are anticipated.

3.1.2. Surface Water Use and Trends

3.1.2.1. Affected Environment

Surface water supply withdrawals within the Guntersville Reservoir catchment area in 2005 totaled approximately 1,523 millions of gallons per day (MGD), or less than 6 percent of the average flow through Guntersville Reservoir (Bohac and McCall 2008). Table 3-2 identifies the water users, the supply source, and water demands in 2005 and projections for 2030. The total return flow in 2005 was 1,501 MGD; thus, the net consumptive use was approximately 22 MGD.

Table 3-2. Surface Water Withdrawals in Guntersville Watershed

Facility Name	Source	County, State	2005 Rate (MGD[1])	2030 Rate (MGD)
Public Systems				
Dunlap Water System	Sequatchie River	Sequatchie, Tenn.	0.75	1.01
Monteagle Public Utility	Laurel Lake	Grundy, Tenn.	0.43	0.55
Jasper Water Dept.	Sequatchie River	Marion, Tenn.	0.47	0.59
South Pittsburg Water System	Guntersville Reservoir	Marion, Tenn.	1.02	1.27
Taft Youth Center	Bee Creek	Bledsoe, Tenn.	0.06	0.08
Tracy City Water System	Big Fiery Gizzard	Grundy, Tenn.	0.47	0.60
Whitwell Water Dept.	Sequatchie River	Marion, Tenn.	0.80	1.00
Albertville Municipal Utilities	Short Creek	Marshall, Ala.	11.64	14.46
Arab Water Works Board	Guntersville Reservoir	Marshall, Ala.	4.31	5.35
Bridgeport Utility Board	Guntersville Reservoir	Jackson, Ala.	2.36	3.12
North Marshall Utilities	Guntersville Reservoir	Marshall, Ala.	1.20	1.49
Northeast Alabama Water	Guntersville Reservoir	Marshall, Ala.	1.36	1.69
Scottsboro Water Board	Guntersville Reservoir	Marshall, Ala.	4.66	6.15
Section & Dutton Water	Guntersville Reservoir	Jackson, Ala.	3.06	4.03
Guntersville Water Works	Guntersville Reservoir	Marshall, Ala.	2.66	3.03
Fort Payne Water Works	Guntersville Reservoir	DeKalb, Ala.	0.47	0.60
Industrial				
Bellefonte Nuclear Plant	Guntersville Reservoir	Jackson, Ala.	0	48.00 / 36.00[2]
Widows Creek Fossil	Guntersville Reservoir	Jackson, Ala.	1,476.30	1,476.30

Facility Name	Source	County, State	2005 Rate (MGD[1])	2030 Rate (MGD)
Plant				
Avondale Mills	Guntersville Reservoir	Jackson, Ala.	0.05	0.07
Shaw Industries	Guntersville Reservoir	Jackson, Ala.	0.20	0.28
Smurfit-Stone Container	Guntersville Reservoir	Jackson, Ala.	8.53	12.26
Irrigation			1.77	2.21
Total			**1,522.57**	**1,584.13 / 1,571.31**

Source: Bohac and McCall 2008
[1] MGD = Millions of gallons per day
[2] Estimated water withdrawal is 48.00 MGD for the B&W and 36.00 MGD for the AP1000.

3.1.2.2. Environmental Consequences

Alternative A
No changes in the plant facilities or operations would occur under this alternative. Consequently, there would be no impacts or changes in current surface water use at the BLN site.

Alternatives B and C
As indicated in Table 3-2, the BLN water intake is one of 21 surface water withdrawals within the Guntersville Reservoir catchment area. All plant water, except for potable water, would be withdrawn from Guntersville Reservoir via the existing intake. Potable water would be supplied by the Jackson County Water Authority. Sanitary waste would be pumped through existing sewer pipes to the Jackson County Water Authority's County Road 33 wastewater treatment facility for treatment.

A 1,200-foot intake channel connects Guntersville Reservoir with the BLN intake pumping station (Figure 2-1). The station has four intake openings slightly more than 10 feet wide and approximately 36 feet high. The top of the openings is at elevation 592.75 feet and the bottom at elevation 557 feet. An intrusion barrier would be installed across the intake channel to provide security for the intake channel and pumping station. The pumping station would be protected by a trash rake and a traveling screen on each of the intake openings.

The approximate alignments of the intake conduit that would carry cooling water to the plant and the discharge conduit that would carry cooling tower blowdown back to the reservoir are shown for operation of the B&W units in Figures 3-3 and 3-4. The approximate alignments of the same conduits for an AP1000 unit are shown in Figure 3-5. Both Action Alternatives use the same intake pumping station and the same blowdown conduit and diffuser.

Both the B&W and AP1000 would use closed-cycle cooling systems, discharging cooling tower blowdown via a diffuser in Guntersville Reservoir, requiring only a small amount of water compared both to the average flow and the minimum expected drought flow in the Guntersville Reservoir. The two plant designs differ in volumes of operating water flows (see Table 3-3). For a single B&W unit, a total of 35,000 gpm (0.20 percent of the average flow) would be withdrawn from Guntersville Reservoir. About 12,000 gpm would be consumed by evaporation, and the remaining 23,000 gpm would be discharged to the reservoir as blowdown. For a single AP1000 unit, a total of 24,000 gpm (0.14 percent of the average flow) would be withdrawn, 16,000 gpm consumed by evaporation, and 8,000

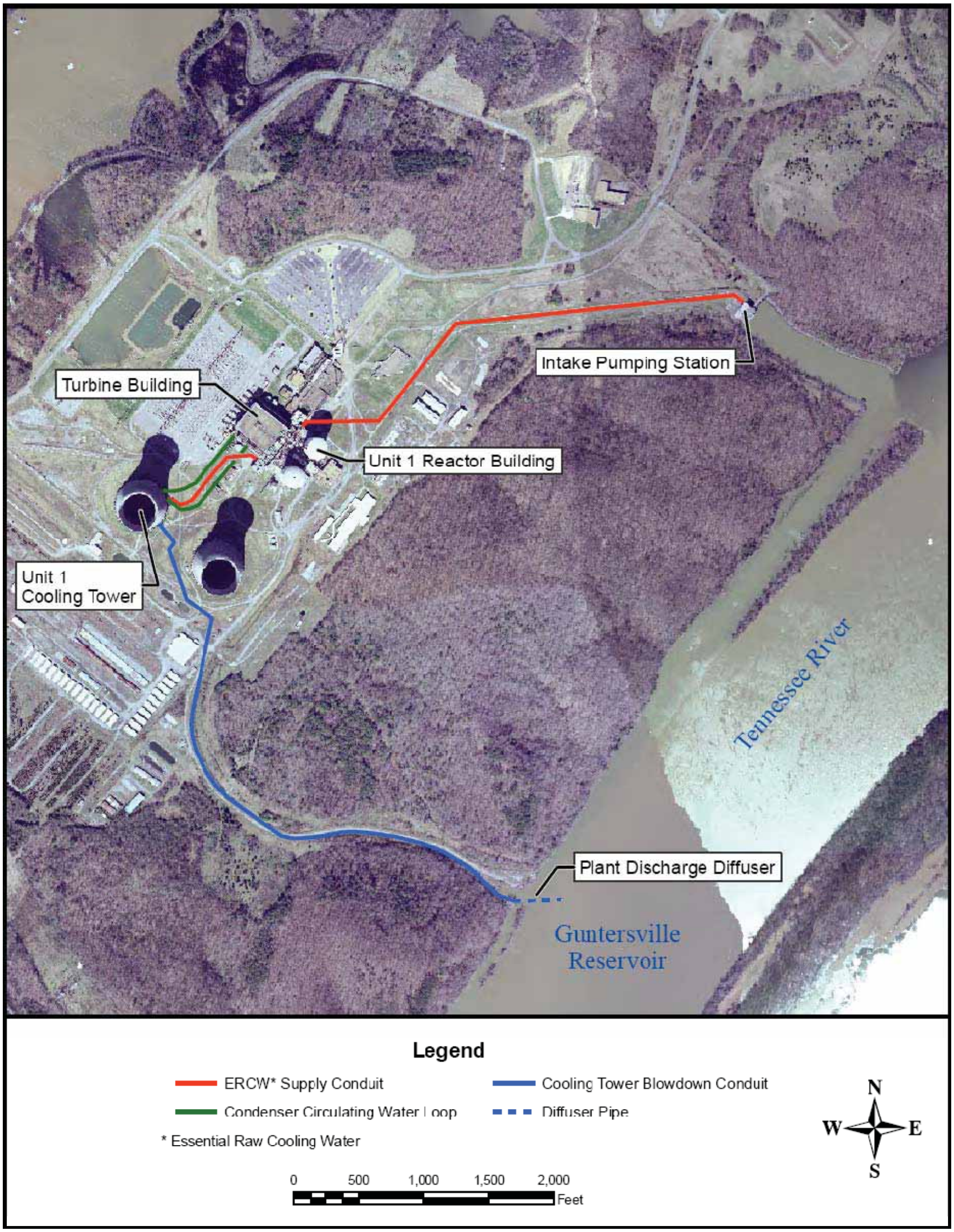


Figure 3-3. B&W Unit 1 Water Intake and Discharge Facilities

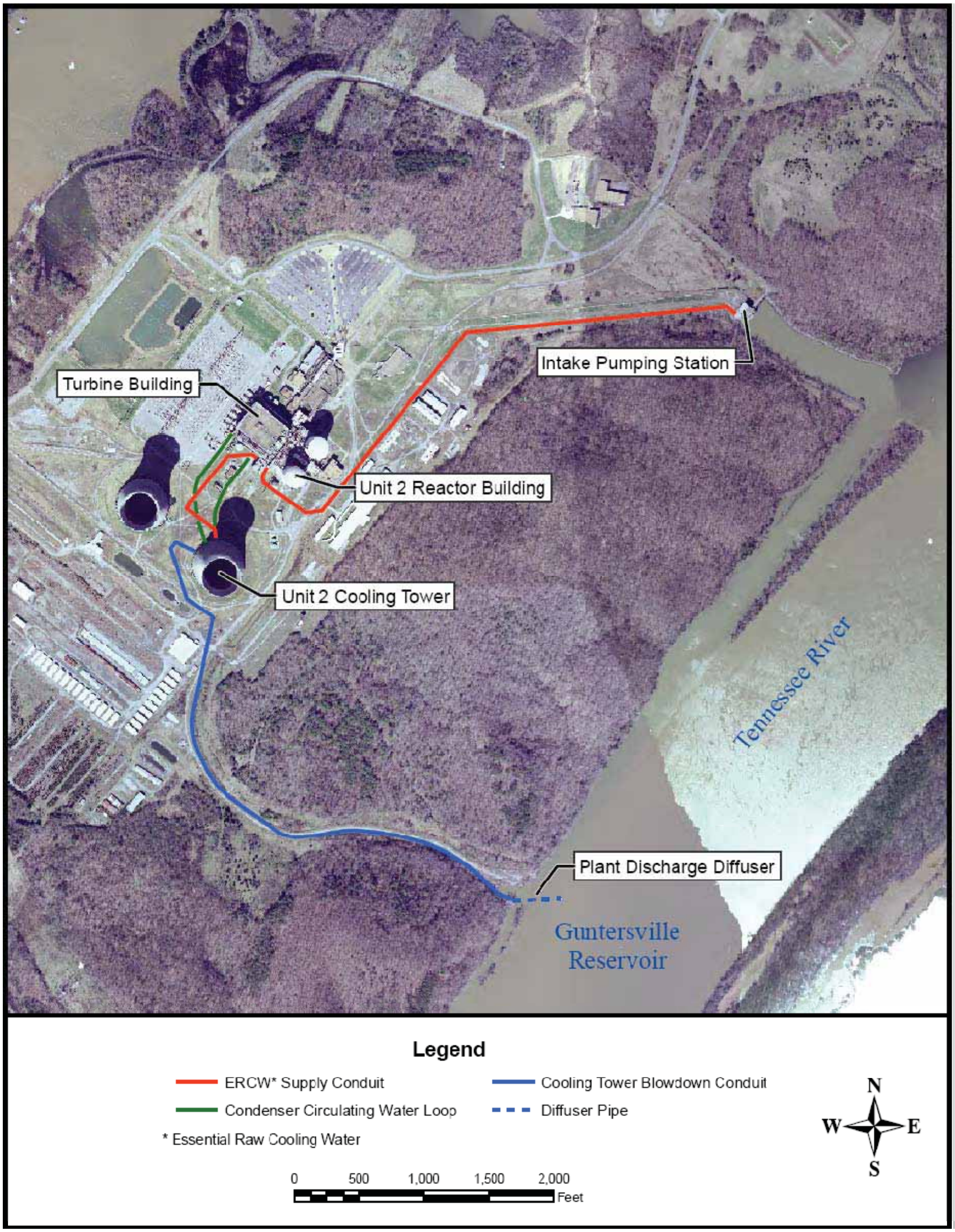


Figure 3-4. B&W Unit 2 Water Intake and Discharge Facilities

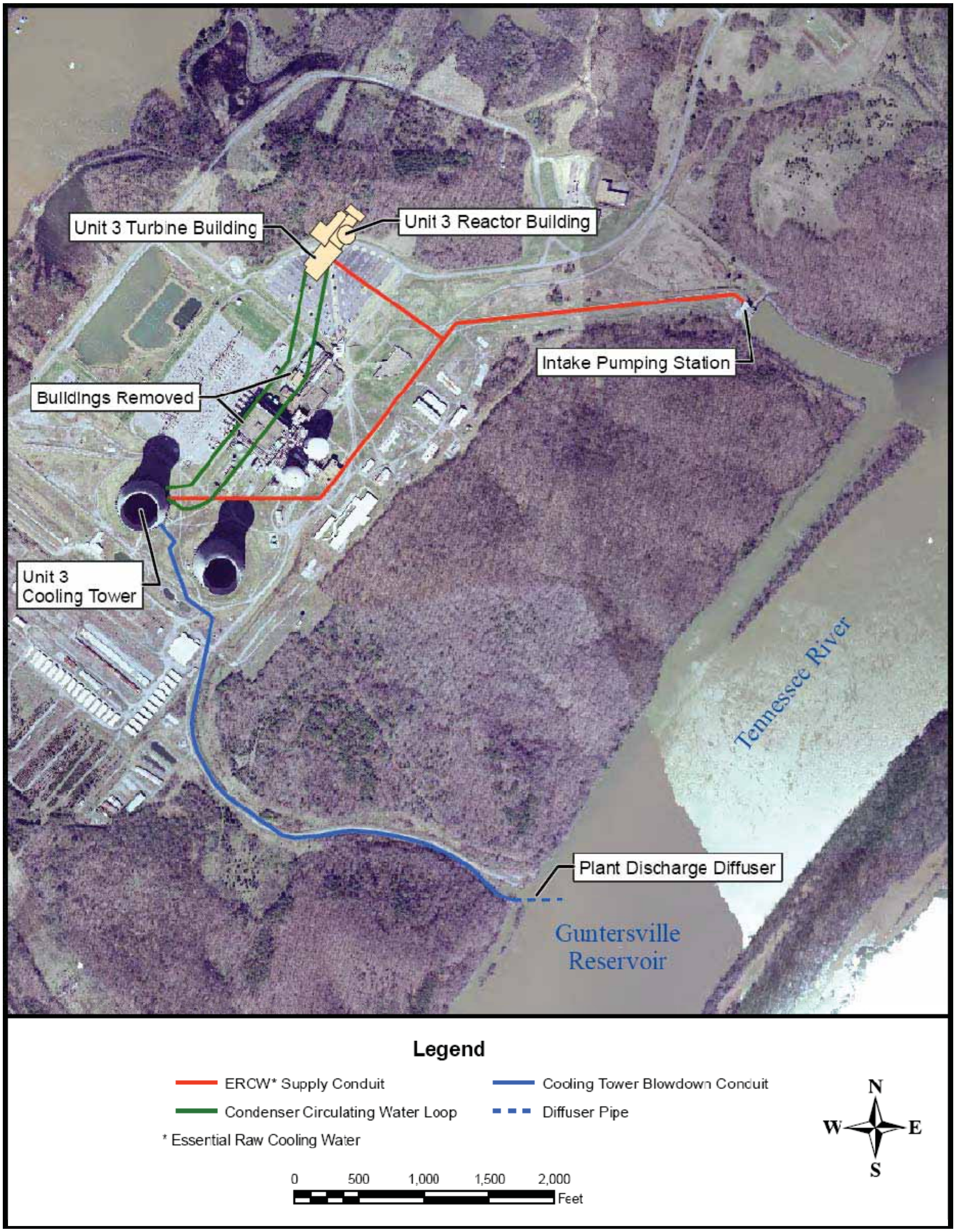


Figure 3-5. AP1000 Unit 3 Water Intake and Discharge Facilities

gpm discharged to the reservoir. Both plants would meet the same specifications for temperature of discharged water. Consequently, no water supply impacts or cumulative effects are expected from the construction or operation of either a B&W or an AP1000 unit. The impacts of the proposed action on local water supply are further discussed in Subsection 3.13.5.

Table 3-3. B&W and AP1000 Water Use

	B&W[1]	Percent Average River Flow[2]	AP1000[3]	Percent Average River Flow[2]
Condenser Circulating Water Flow Rate (Closed Cycle)	420,000 gpm	N/A	500,000 gpm	N/A
Evaporation (Consumption)	12,000 gpm	0.07%	16,000 gpm	0.1%
Blowdown (Discharge)	23,000 gpm	0.13%	8,000 gpm	0.05%
Makeup (Withdrawal)	35,000 gpm	0.21%	24,000 gpm	0.14%

[1]B&W operating water flow rates source: TVA 1976 and T. Spink, TVA, personal communication, March 2010.
[2]Average River Flow at Bellefonte is 37,300 cfs (approximately 16,700,000 gpm). Source: P. Hopping, TVA, personal communication, February 2010.
[3]AP1000 operating water flow rates source: TVA 2008a.

3.1.3. Hydrothermal Effects of Plant Operation

3.1.3.1. Affected Environment

Closed-Cycle Cooling Water System

Under both Alternative B and Alternative C, BLN would withdraw water from and discharge wastewater to Guntersville Reservoir to provide cooling water for the operation of one unit. For a B&W or an AP1000 unit, the proposed operation would follow the design strategy for BLN 1&2, which sought to minimize thermal impacts to Guntersville Reservoir by using a closed-cycle cooling system. Closed-cycle cooling systems are considered the “best technology available” to minimize hydrothermal, entrainment, and impingement impacts (see Section 3.5). The cooling system for the B&W unit is described in the 1974 FES (TVA 1974a), and the cooling system for the AP1000 is described in the COLA ER. Two natural draft hyperbolic cooling towers, one for each of the two units, were built for BLN 1&2. In a closed-cycle cooling system, waste heat removed from the steam cycle by the plant condensers is rejected to the atmosphere by evaporation in a cooling tower. The cool water exiting the cooling tower is then cycled back through the condensers for reuse.

In a closed-cycle cooling system, a small fraction of the condenser circulating water is continuously lost by evaporation and drift in the cooling tower. In this process, to control the concentrations of additives and natural minerals in the water, a small portion of the condenser circulating water must be continuously removed and replaced with fresh water supplied by the plant intake pumping station. The temperature of the water removed from the system, or blowdown, is the same as that of the cooling tower effluent, and would vary with wet bulb temperature and other meteorological conditions. For the proposed operation of either a B&W or an AP1000 unit, cooling tower blowdown would be discharged to Guntersville Reservoir via the NPDES-permitted outfall Discharge Serial Number 003, shown in Figure 3-6.

The outfall includes an existing two-pipe multiport diffuser on the bottom of the river, as shown in Figure 3-7. The upstream pipe extends about 475 feet into the reservoir in an upstream direction at an angle of about 65 degrees from the shoreline. The diffuser section includes the last 45 feet of the pipe and is 36 inches in diameter. The downstream pipe is parallel to and 45 feet shorter than the upstream pipe. The diffuser section of the downstream pipe includes the last 75 feet of the pipe and is 42 inches in diameter. For both pipes, the outlets for the diffuser section are centered 22 degrees above the horizontal and point downstream.

Current NPDES Permit

The NPDES permit, AL0024635, for the BLN site was renewed in November 2009, and the permit is next subject to renewal in November 2014. This permit is amended as new wastewater streams are identified. The NPDES permit establishes criteria that are protective of water quality for the receiving stream. For BLN, ADEM has established criteria to protect Guntersville Reservoir water quality for its designated uses as a drinking water source, recreation, and industrial use such as cooling.

Within the permit, point-source discharge outfalls are assigned a discharge serial number (DSN). For each discharge point shown in Figure 3-6, the NPDES permit establishes limitations as to the types and quantities of effluents, monitoring and reporting requirements, and required sampling locations. BLN is currently authorized to discharge as follows:

DSN002: Impoundment pond discharge consisting of main plant area storm water runoff and fire and supply test water associated with electric power generation.

DSN003: Diffuser discharge consisting of cooling tower blowdown and other wastewater resulting from electric power generation.

DSN004: East culvert impoundment discharge consisting of storm water runoff.

DSN005: Plant intake trash sluicing consisting of intake screen and strainer backwash and intake pumping station sumps/drains.

DSN007: Simulator Training Facility treated sanitary, equipment room floor drains, and laboratory wastewaters.

DSN008: Simulator Training Facility once-through cooling water, HVAC and atomic adsorption unit condensate, and fire protection system flush water.

DSN009-015: Uncontaminated storm water runoff.

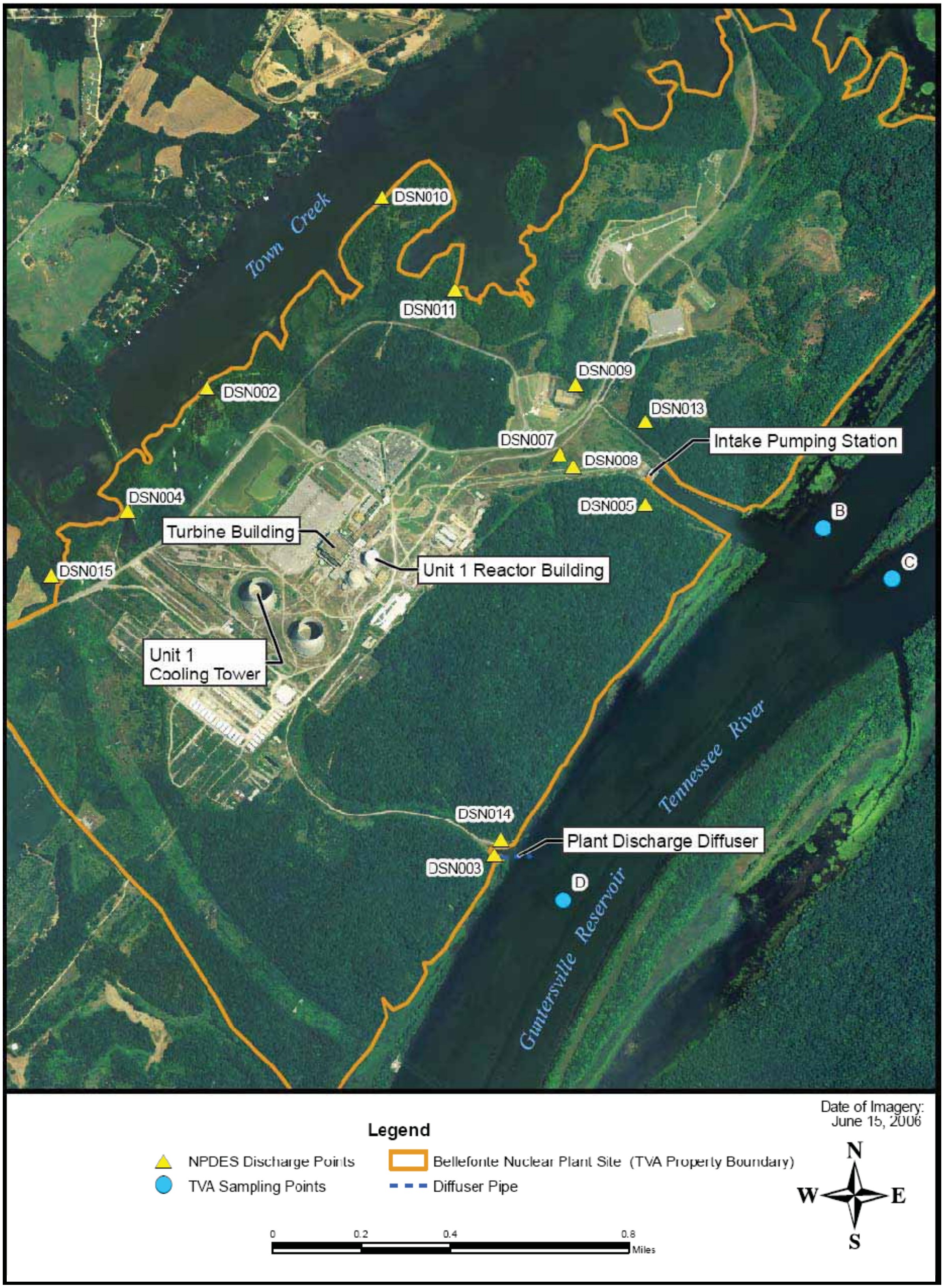


Figure 3-6. Outfalls for NPDES Permit AL0024635 of November 2009

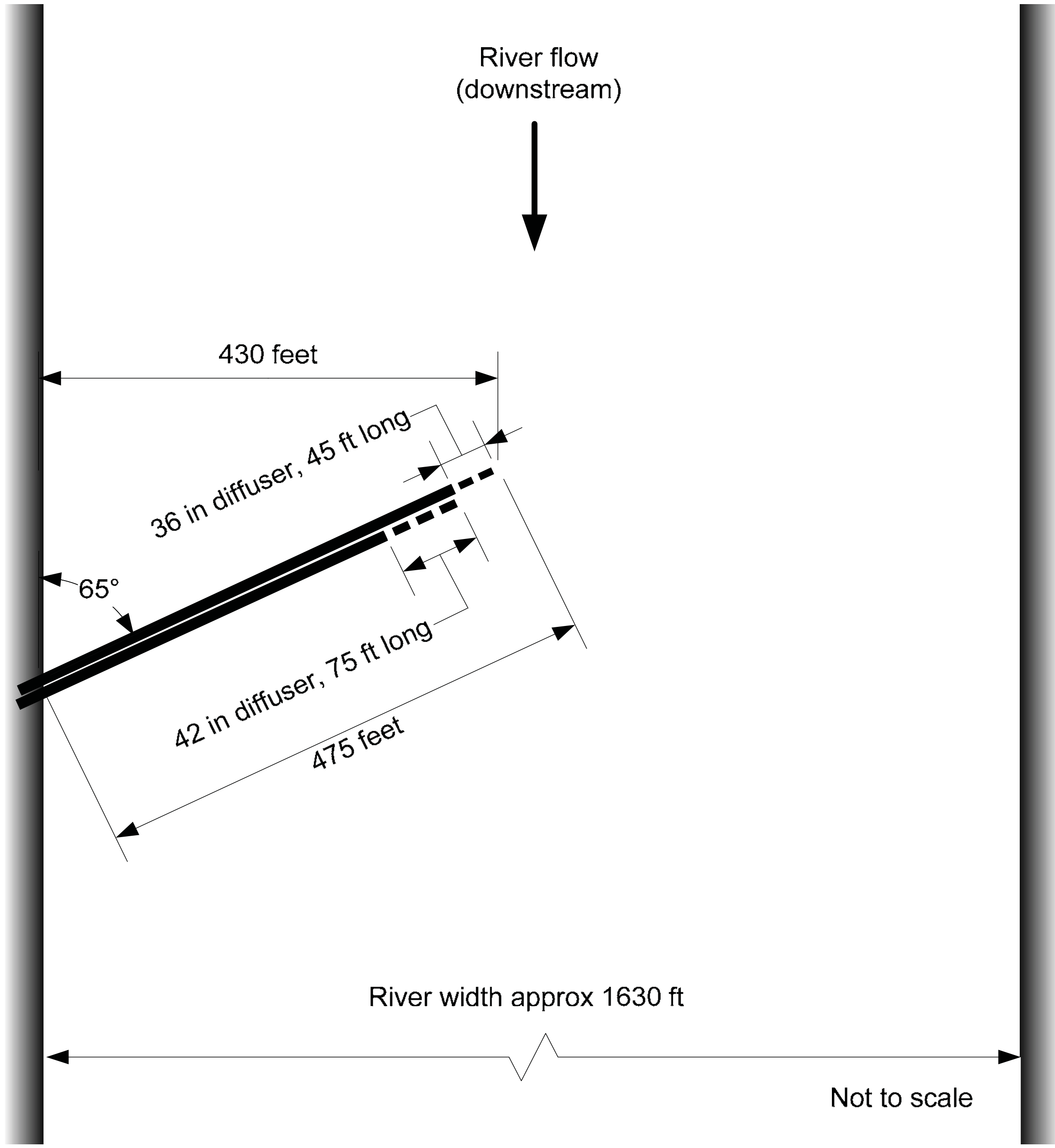


Figure 3-7. Diffuser for Blowdown Discharge, Outfall DSN003

NPDES Permit Temperature Limits and Mixing Zone for Cooling Tower Blowdown

Under the current NPDES permit, the discharge water temperature for the cooling tower blowdown is limited to a monthly average of 92°F and a daily maximum of 95°F (Table 3-4). The mixing zone for this discharge is defined by the locus of points 250 feet from the diffuser and extending over the entire depth of the reservoir (TVA 1977c). Consistent with Section 316(a) of the CWA, the discharge temperature limitations (92°F/95°F) would ensure that the temperature at the edge of the mixing zone would not exceed 90°F, the temperature considered as protective of maintaining a balanced indigenous population of fish, shellfish, and aquatic life (ADEM 1998; TVA 1982a). TVA would request a

continuation of these temperature limits in the operational stages of the plant under Section 316(a). In addition to these limits, Alabama water quality standards prohibit the addition of artificial heat by a discharger that would cause the maximum instream temperature rise above ambient water temperature to exceed 5°F (ADEM 2008).

Table 3-4. NPDES Discharge Limits for BLN Outfall DSN003 to the Tennessee River

Effluent Characteristic	Units	Discharge Limitations			Monitoring Requirements	
		Daily Minimum	Daily Maximum	Monthly Average	Measurement Frequency	Sample Type
Flow	MGD	N/A	Monitor	Monitor	Continuous	Totalized or Recorder
Temperature	°F	N/A	95	92	Continuous	Recorder or Multiple Grabs

Hydrothermal Modeling of Potential Heat Effects

Potential near-field and far-field hydrothermal effects associated with the blowdown discharge were examined using two models: (1) CORMIX to examine near-field effects of the thermal plume near the diffuser and (2) CE-QUAL-W2 to examine far-field, reservoirwide effects within Guntersville Reservoir. CORMIX is an EPA-supported mixing zone model for assessment of regulatory mixing zones resulting from steady, continuous point source discharges (Jirka et al. 2007). CE-QUAL-W2 is a two-dimensional, laterally averaged, hydrodynamic and water quality model for reservoirs (CE-QUAL-W2 1995). It models basic eutrophication processes to estimate the distribution and fate of constituents such as heat (water temperature), DO, nutrients, algae, organic matter, and sediment.

CORMIX was used to evaluate the near-field performance of the cooling system and diffusers (DSN003) relative to thermal limits contained in the current NPDES permit as well as the state water quality standards for temperature rise (i.e., 95°F daily maximum and 92°F monthly average blowdown discharge temperatures from the NPDES permit, and 5°F instream rise at the end of the mixing zone above the ambient river temperature for the state water quality standards). The analyses encompassed worst-case conditions based on potential ranges for river flow, river temperature, meteorology, and plant operations. The range of river flow was based on historical hydrology and the expected future operating policy for the TVA river system. The range of river temperature was based on historical measurements at various stations in Guntersville Reservoir, and the range of meteorology was based on local airport data. More than 30 years of data were examined for each factor (i.e., river flow, river temperature, and meteorology). With this information, the CORMIX model was used to predict the river temperature and plume dimensions at the edge of the 250-foot diffuser mixing zone. The following cases were identified as producing worst-case conditions in the receiving water (Loyd 2009).

Case 1. Maximum River Temperature Rise (March) — This condition would arise for a day with warm, humid weather occurring concurrently during a period when the river temperature is cold. Historical data indicate that this would likely occur in March. The expected minimum ambient river temperature for March is about 41°F. The expected highest wet bulb temperature for the same month is about 71.3°F. Based on the performance of the plant cooling system, this would produce blowdown with a discharge temperature of about 86.4°F, which is 45.4°F above the minimum river temperature for March. This case was modeled using the expected minimum 24-hour average river flow for March, about 3,130 cfs.

Case 2. Minimum 24-hour River Flow (April) — This condition would likely arise in a dry year, again for a day with warm, humid weather occurring concurrently during a period when the river temperature is cold The expected minimum 24-hour average river flow past the BLN site is about 190 cfs, occurring during reservoir filling in April. For the month of April, the expected minimum ambient river temperature is about 52°F, and the expected highest wet bulb temperature is about 76.2°F. Based on the performance of the plant cooling system, this would produce blowdown with a discharge temperature of about 90.4°F, which is 38.4°F above the minimum river temperature.

Case 3. Maximum Discharge Temperature (July) — This condition would likely arise in a hot, dry year, when humid “heat waves” produce both high ambient river temperature and reduced cooling tower performance. Historical data indicate that this would likely occur in July. The expected maximum ambient river temperature for July is about 89.5°F and the expected minimum 24-hour average river flow is about 3,760 cfs. The expected maximum wet bulb temperature is about 85.2°F. Based on the performance of the plant cooling system, this would produce blowdown with a discharge temperature of about 97.7°F, which is 8.2°F above the maximum river temperature. It should be noted that this discharge temperature is the maximum calculated value, and it lasted for only one hour out of a record of 33 years.

Case 4. Reverse River Flow — Periodically, reverse river flow occurs in the vicinity of the BLN site. These events are caused by variations in reservoir releases at Nickajack Dam and Guntersville Dam and are highly unsteady. The primary concern for reverse river flow is decreased diffuser performance and the possibility that the discharge may become entrained in the withdrawal zone for the plant intake. For this case, the analyses focused on conditions producing a maximum temperature rise in the river. Thus, the ambient river temperature and blowdown discharge temperature were the same as those for Case 1, 41°F and 86.4°F, respectively, and occurred in March. To be consistent with the steady flow aspects of CORMIX, the average flow over the largest reverse flow event for March was examined. Based on the operating policy for the TVA river system, such an event is expected to last between five and six hours and contain an average river flow in the upstream direction of about 9,160 cfs.

It should be emphasized that for the geometry of the BLN diffuser summarized above, the CORMIX model is unable to predict the behavior of the thermal effluent for a river flow in the reverse (upstream) direction. As such, for Case 4, the simulations were made with the diffuser ports pointing upward in a vertical direction. This will bound the impact of the thermal effluent because the mixing for this geometry will be reduced compared to that with the ports pointing downstream in opposition to the reverse river flow. Reduced mixing would result in higher (bounding) temperature than would actually occur.

Model results for all four cases are summarized in Appendix E, Table E-1. Included are simulations for a B&W unit and an AP1000 unit, both for operation of the 36-inch diffuser pipe and 42-inch diffuser pipe. It is emphasized that for a single BLN unit, the operation of the diffuser would be limited to one or the other, but not both, of the diffuser pipes.

For both a B&W and an AP1000, and for both diffuser pipes, Cases 1, 2, and 4 all meet the thermal criteria by not exceeding the 92°F monthly average and 95°F daily maximum blowdown temperatures and not exceeding the 5°F limit for instream temperature rise.

Case 3 produced a 97.7°F blowdown discharge temperature lasting one hour for both alternatives and both diffuser pipes. This exceeds the daily maximum blowdown discharge temperature limit of 95°F. However, the conditions producing this worst-case scenario included a combination of three factors that are unlikely to occur simultaneously: (1) the most extreme one-hour period of meteorology, (2) the highest 24-hour average ambient river temperature, and (3) the lowest monthly average river flow, each from periods of record exceeding 30 years of data. In fact, in these records, all three factors never occur simultaneously. Hence, based on historical data, the probability of the blowdown temperature approaching 97.7°F is considered very low. For example, a frequency analysis of the plant cooling tower operation based on these data indicates that the duration of the blowdown discharge temperature approaching the 95°F thermal limit is of magnitude 0.04 percent of the time, an average of about four hours per year. During such occurrences, plant derates would be required to prevent a violation of the NPDES permit.

Given that derates would be used in the rare events that the blowdown discharge temperature approaches 95°F, the results in Table E-1 (Appendix E) also indicate that the temperature at the edge of the mixing zone is not expected to exceed 90°F, the temperature that has been determined to be protective of aquatic life (ADEM 1998; TVA 1982a). In this manner, the CORMIX computations confirm that enforcement of a 95°F limit at the blowdown discharge preserves the veracity of a 90°F limit at the edge of the mixing zone. The maximum width (758 feet vs. a full channel width of about 1,600 feet) and thickness (10 feet vs. a channel depth of about 25 feet) of the thermal plume at the edge of the mixing zone allows an adequate zone for passage of aquatic life and protection of bottom-dwelling species.

An analysis of the data for expected river operating conditions suggests that reverse flows at BLN would typically last less than six hours. As summarized in Appendix E, Table E-1 (Case 4), the diffuser performance with reverse flows produced good dilution of the blowdown for both diffuser pipes and for both the B&W and AP1000 alternatives. The maximum computed temperature rise for the edge of the mixing zone was 3.4°F for the B&W and the 36-inch diffuser pipe. It is emphasized that these results are consistent with the results from the physical model study of the diffuser pipes that was conducted as part of the design of the original plant (TVA 1977b). In the model, the diffuser was tested with a reverse flow of about 24,000 cfs and a blowdown temperature equivalent to a wintertime increase of 36°F above the ambient river conditions. The resulting temperature rise at the edge of the mixing zone measured in the model was about 3°F.

For extreme reverse flow events, effluent from the diffuser pipes could potentially travel upstream and reach the intake channel. In terms of the impact on the diffuser performance, such conditions are not expected to be significant due to two factors. First, the diffuser is designed and constructed to mix the thermal effluent across the river where it would tend to move upstream along the opposite side (TVA 1977c). Second, the duration of extreme reverse flow events are brief (i.e., of magnitude six hours) compared to the time required for the volume of diffuser effluent to significantly impact the temperature of ambient water in the river. CORMIX simulations suggest that any thermal effluent reaching the region of the plant intake channel would reside primarily in the surface layer of the river (e.g., upper 3 feet), making it unlikely to have a significant impact on the temperature of the water at the pump intakes, which are constructed to withdraw water from the bottom layer of the river. However, given the fact that some of the diluted diffuser effluent could possibly reach the plant intake withdrawal zone, future administrative controls may be necessary for the operation of the plant and/or the operation of the river system should other nonthermal

constituents of the blowdown occur in high enough concentrations to create an unacceptable impact on the plant and/or environment (TVA 2008a).

CE-QUAL-W2 was used to assess potential far-field impacts to water quality in Guntersville Reservoir. The two-dimensional model segments the reservoir longitudinally and vertically into computational elements. The water in each element is assumed to be fully mixed with uniform water quality. Input for the model includes meteorology, hydrology, and inflow water quality. The model assumes a seasonal pattern of flows, temperatures, and water quality parameters throughout the reservoir.

The reservoir model was calibrated for 1999 (a typical flow year) and 2007 (the driest year of record and containing above normal temperatures). Four cases were simulated: (1) a reference case without the WCF and without a BLN plant; (2) a base case with only WCF; (3) a case with WCF and a B&W unit at BLN; and (4) a case with WCF and an AP1000 unit at BLN.

The model results, shown in Appendix E, Tables E-2 and E-3, provide an estimate of thermal effects on reservoir water temperatures (i.e., beyond the diffuser mixing zone), DO concentrations, and algae biomass. Results are shown for four reservoir segments:

1. Upstream of WCF intake (TRMs 409.5-410.7).
2. Upstream of BLN intake (TRMs 393.0-393.9).
3. Downstream of BLN discharge (TRMs 389.0-390.0).
4. Guntersville Reservoir forebay (TRMs 349.8-350.5).

Comparing the reference case (no plant at WCF or BLN) with the base case (a plant at WCF but no plant at BLN) indicates a thermal effect from the WCF plant. The mean temperature increase in the 2007 April-September time period ranges from 1.6°F upstream of the BLN intake to 0.1°F at the Guntersville forebay. In comparing the two proposed alternatives for operating a single unit at the BLN site with having no unit at BLN (base case), there is essentially no change in the 1999 or 2007 downstream temperatures, DO concentrations, or algae biomass. This is primarily because the volume of blowdown from a BLN unit for the two alternatives is small compared to the natural volume of water flowing down the river. The only observed differences are (1) a 1999 maximum day temperature increase of 0.1°F for each alternative upstream of the BLN intake and in the reservoir forebay for 1999 and 2007, and (2) a DO decrease of 0.1 milligrams per liter for an AP1000 on the maximum day in 1999 at the reservoir forebay. There were no changes in seasonal mean values for temperature, DO, or algae biomass.

As discussed in Subsection 3.16.3, TVA has studied the sensitivity of the river and power systems to extreme meteorology and climate variations (Miller et al. 1993). In terms of water temperature, the studies evaluated the response to changes in meteorology for a typical mainstream reservoir like Guntersville Reservoir. The results found that based solely on changes in air temperature, the average (April through October) natural water temperature in a mainstream reservoir could increase between 0.3°F and 0.5°F for every 1°F increase in air temperature. An assessment of potential climate change in the Tennessee Valley suggests that air temperatures could increase 0.8°C/1.4°F by 2020 and up to 4°C/7.2°F by 2100 (EPRI 2009b). For an increase in air temperatures of 2°C/3.6°F during the first 30 years of operation of a BLN unit, the potential increase in water temperatures in Guntersville Reservoir could be from 0.5°C/1.0°F to 1.1°C/2.0°F. Such a temperature rise would impact the operation of a BLN generating unit. For example, the frequency of events where the blowdown discharge temperature approaches the NPDES

limit of 95°F would increase, and the number of unit derates necessary to maintain compliance would increase.

3.1.3.2. Environmental Consequences

Alternative A
No changes in the plant facilities or operations would occur under this alternative. Consequently, there would be no impacts or changes in current surface water conditions.

Alternative B
Under this alternative, one B&W unit would be completed and operated. The following conclusions are based on the near-field and far-field model assessments of thermal discharges from the BLN outfall DSN003 diffusers. The CORMIX near-field model assessed compliance with the current Alabama NPDES and water quality criteria (i.e., discharge temperatures not to exceed limits of 92°F monthly average, 95°F daily maximum, or 5°F increase over ambient conditions). The CE-QUAL-W2 far-field model assessed potential cumulative effects on Guntersville Reservoir.

- The CORMIX near-field results indicate that thermal effluent requirements would be met at full load, except during infrequent hydrological and meteorological conditions. A frequency analysis of available data and cooling tower operation suggests that a daily maximum blowdown discharge temperature approaching the 95°F thermal limit would be expected about 0.04 percent of the time (an average of about four hours per year). Potential increases in river water temperatures of 0.5°C/1.0°F to 1.1°C/2.0°F, due to future climate changes, could increase this occurrence from about 0.04 percent of the time to about 0.56 percent of the time (an average of about 50 hours per year). During such events, measures up to and including plant derates would be taken to prevent a violation of the NPDES permit.

- The CORMIX results confirm that enforcement of the 95°F thermal limit for the blowdown discharge would ensure the temperature at the edge of the 250-foot mixing zone would not exceed 90°F, the temperature considered protective of aquatic life (ADEM 1998; TVA 1982a). The maximum width (758 feet) and thickness (10 feet) of the thermal plume at the edge of the mixing zone is less than half of the river width and depth, thus, allowing an adequate zone for passage of aquatic life and protection of bottom-dwelling species.

- The CORMIX results suggest sufficient dilution of the blowdown for reverse river flow. Based on the expected operation of Nickajack Dam and Guntersville Dam, it is considered possible for the diffuser effluent to reach the region of the plant intake withdrawal zone, especially for extreme reverse river flow events. The impact of this on water temperature is not expected to be significant; however, future administrative controls on the operation of the plant and/or the river may be necessary if other nonthermal constituents of the blowdown (see Subsection 3.1.4) occur in unacceptable amounts in the plant withdrawal zone.

- The CE-QUAL-W2 far-field model assessment of potential impacts to water quality indicates that the effects on reservoir temperatures, DO concentrations, and algae biomass would not be significant. This analysis included cumulative effects from solar activity and WCF, the latter being the only other significant source of waste heat in Guntersville Reservoir.

In summary, the near-field and far-field (e.g., cumulative) hydrothermal effects on Guntersville Reservoir are not expected to be significant. By virtue of the fact that the plant would be operated to comply with thermal limits (even with potential climate changes), the heated effluent is not expected to have a significant impact on near-field conditions. Far-field modeling indicates that the impacts to temperatures, DO concentrations, and algal biomass in Guntersville Reservoir would not be significant.

Alternative C
Under this alternative, one AP1000 unit would be constructed and operated. Direct and cumulative hydrothermal impacts associated with this alternative are expected to be similar to Alternative B, but slightly reduced because less water is required for blowdown and less water would be discharged to the river (i.e., the Alternative C withdrawal and discharge would be 72 percent and 36 percent, respectively, of that associated with Alternative B).

3.1.4. Chemical Additives for Plant Operation

3.1.4.1. Affected Environment

A primary area of concern for surface water quality relates to the chemicals added to treat water used for condenser circulating water, equipment cooling, fire protection, and potable water in nuclear plant operations, which result in chemical discharges.

The sources of chemical discharges from a B&W plant would include cooling tower blowdown, cooling tower makeup and essential raw cooling water systems, wastes from various makeup water and condensate demineralizers, component-cooling system, reactor coolant system, and yard drainage systems and various sumps (TVA 1974a). Sources of chemical discharge from an AP1000 plant would include the circulating water system, service water system, demineralized water treatment system, steam generator blowdown system, and yard drainage systems and various sumps (TVA 2008a).

The source of fire protection water for a B&W plant would be the raw cooling water system. For an AP1000 plant, the makeup water for the fire protection system would be provided by the Jackson County Water Authority. Treatment of the B&W raw cooling water system is described below under Proposed Schemes for Cooling Water Treatment for B&W and AP1000 Units. The water supplied by the Jackson County Water Authority is treated off site in accordance with applicable drinking water standards, and no further treatment would be performed on site. The source of potable water for either a B&W plant or an AP1000 plant would be the Jackson County Water Authority. The water supplied by this water system is treated off site in accordance with applicable drinking water standards, and no further treatment would be performed on site. Sanitary waste would be routed to the sanitary drainage system, which would be discharged off site to the Jackson County Water Authority's County Road 33 wastewater treatment plant.

Chemical additives are used in plant cooling water systems for two primary purposes:

1. To inhibit the chemical process of corrosion (rust formation) on metal piping and other plant equipment surfaces.

2. To maintain efficient heat transfer through all plant heat exchangers for heat removal from the reactor. Optimal heat transfer cannot be achieved unless heat transfer surfaces are clean. Surfaces that have deposits of metal oxides (rust), scale (such as lime deposits), biological fouling (zebra mussel and Asiatic clam), or

bacterial coatings experience lower heat transfer efficiency. In addition, certain types of bacteria can accelerate the chemical oxidation or corrosion of surfaces through various waste products such as sulfate, which certain bacteria produce. This phenomenon is referred to as microbiologically influenced corrosion.

A discussion of heat transfer-related (cooling) systems for a PWR nuclear plant is provided below. As explained in Section 2.2 and 2.3 of this SEIS both the B&W and the AP1000 are PWRs. The discussion is followed by a description of the types of chemicals that are added to the plant cooling water systems.

Overview of PWR Plant Cooling Systems for Reactor Heat Removal
Two major systems are used to convert the heat generated in the reactor's nuclear fuel assemblies into electrical power. The primary system, also called the reactor coolant system, is composed of the reactor vessel, steam generators, reactor coolant pumps, pressurizer, and connecting pipes. The main function of the primary system is to carry heat away from the reactor's nuclear fuel assemblies to the steam generators.

The major secondary systems of the PWR are the main feedwater system, the condensate system, and main steam system, which are physically separated from the primary system. These secondary systems are designed to heat and pressurize cooler water to produce feedwater for the steam generators. The main steam system then routes steam from the steam generators to the plant turbines for power generation. The condensate system receives exhausted steam from the turbine discharge to repeat the cycle.

The PWR has three layers of plant water systems, referred to as cooling water systems, which provide cooling water to the primary and secondary systems described above.

The first layer of cooling, the primary water system, or "primary loop" is in contact with the nuclear fuel assemblies inside of the reactor pressure vessel, or core, and carries the heat away from the fuel assemblies. The primary coolant carries with it not only significant heat, but also significant quantities of radioactive isotopes of various atoms, or radioisotopes.

The second layer of cooling water is referred to as the "secondary loop." For the PWR, the interface of the first and second layers of cooling is at the steam generators, which are very large, vertical heat exchangers. The steam generators contain hundreds of metal tubes, which are attached to a circular, horizontally mounted metal plate. The reactor coolant flows through the inside of the tubes, while the clean, normally nonradioactive secondary coolant flows past the outside of the tubes. The heat is transferred through the metal tubes to the cooler secondary-side cooling water. This arrangement keeps the steam dryer and other components within the upper portion of the steam generator relatively free of radioactive contamination. Secondary-side contamination only occurs in minor amounts in the event of a small leak in one or more of the tubes.

From the upper head of the steam generator, the steam is directed to the plant turbine, where the massive internal blades spin on a shaft that is connected to a motor to produce electricity. At the outlet end of the turbine, steam is directed to the main plant condenser.

The third layer of cooling and heat transfer occurs at the main plant condenser, where the steam is directed over hundreds of horizontal tubes through which cooling water flows. The source of cooling water for the main plant condenser is the large water retention basin of the plant and is referred to as the heat rejection system (B&W) or circulating water system (AP1000).

Additional "secondary systems" include the service water system (AP1000), and component cooling water system (B&W and AP1000), which are used to provide cooling for plant auxiliary systems during normal operation and during shutdown conditions. Note that the service water and component cooling water systems operate continuously and not only during periods of cooling associated with reactor shutdown.

The secondary-side cooling water includes water treatment systems necessary to maintain water purity. These include the steam generator blowdown system, which continuously treats a portion of the total flow running through the steam generators. In addition, PWRs feature partial and sometimes full-flow condensate treatment systems to treat either a portion or the entire flow of water coming from the main condenser en route to the feedwater system.

Other B&W and AP1000 plant systems to which chemicals are added include the chilled water systems, turbine building heating system, auxiliary boilers, and diesel jacket cooling systems (B&W only).

Chemicals Added To Plant Water Cooling Systems
The types of chemicals currently used in operating plant cooling water systems are described as follows:

Scale Inhibitors – Also called anti-scalants, these chemicals inhibit the formation of lime (calcium oxide) deposits, which would otherwise tend to form on the high temperature surfaces of the heat exchanger tubes, and limit the deposition of other chemical forms of oxide scale upon the heat exchanger tubes. Anti-scalants are organic (carbon-based) polymers containing phosphate attachments on the molecule.

Corrosion Inhibitors – These are also organic polymers, which contain phosphonate rather than phosphate. The chemical (molecular) structure of the phosphonate-based corrosion inhibitors are similar, but not identical to the scale inhibitors, in that they both include phosphorus, but they behave differently because of the oxidation state of the phosphorus in the two compounds. Corrosion inhibitors behave as "oxygen scavengers," and tend to draw up and chemically bind available oxygen, which makes less oxygen locally available to form rust compounds, which are metal oxides.

Oxidizing Biocide – Sodium hypochlorite (at a 12 percent by weight concentration) is conventionally used to control microbiological activity, including slime formation and microbiologically influenced corrosion. Dependent upon microbiological activity, additional sodium hypochlorite may be applied to the circulating water system at the suction side of the circulating water pumps. A maximum limit for total residual chlorine is typically stated in the site NPDES permit.

Molluscicide – Ammonium chloride or a quaternary amine can be used for zebra mussel and Asiatic clam control.

Algaecide – Chemical that can be either basic ammonium chloride, NH_4Cl, or a quarternary amine compound similar to the molluscicide chemical described above. The algaecides are used to inhibit the formation of algae inside of the plant cooling water towers.

Dehalogenation Agent – Sodium bisulfite may be utilized to ensure that the oxidizing biocide (total residual oxidant) discharge limit as it pertains to the total residual halogen, usually chloride, is not exceeded.

Detoxification Agent – Bentonite clay may be required to detoxify the molluscicide chemical from the water through absorption at a ratio of 5:1 to the quaternary amine.

Biopenetrant – Non-ionic surfactant (a simple soap) may be applied to increase the efficacy of the oxidizing biocide, by cleaning off the surfaces of the biota in order to make the chlorine-based (or other halogen such as bromine-based) biocide or molluscicide chemical penetrate more effectively into the biological material, or biota.

Brief descriptions of plant cooling treatments discussed in earlier environmental reviews for the BLN site are provided in the following paragraphs.

Prior Environmental Reviews of Plant Cooling Water Chemical Treatments
Previous environmental reviews for proposed projects at the BLN site (TVA 1974a; AEC 1974; DOE 1999; TVA 2008a) analyzed potential impacts to surface water and water quality, including the addition of chemicals to treat plant cooling water systems. An examination of the prior environmental reviews as they described proposed plant cooling water chemical applications found that chemical treatments for plant cooling water systems have improved and discharge limits for chemicals have become more restrictive than how they were described in the earlier reviews. These earlier analyses adequately bound the potential for effects but require update to reflect changes in environmental regulations, improvements in chemical additives, and proposed raw water treatment.

For example, in 1974, the principal organism that created macrofouling in the Tennessee Valley was the Asiatic clam (*Corbicula manilensis*). Since 1991, another invasive species, the zebra mussel (*Dreissena polymorpha*), has also caused fouling problems at the TVA plants. TVA's 1974 FES (TVA 1974a), Section 2.5, recommended using the product *acrolein* to address macrofouling. However, the product is no longer used in the industry, because in the past decade, more effective chemicals that control both species have become available. The chemical presently in use at TVA plants is generically known as a quaternary amine.

In its 1974 FES (TVA 1974a), Section 2.5, TVA determined that a biocide would likely be used in the condenser cooling water system or the essential raw cooling water system, if faunal or floral populations developed in either of the systems. It has been TVA's experience that microbiological activity has been the cause of microbiologically influenced corrosion, and oxidizing biocides have been routinely used in raw service water systems to control this mechanism.

The 1980 BLN FSAR (TVA 1980a), Subsection 10.4.5.2, discussed the periodic injection of sodium hypochlorite into the heat rejection system to prevent organic fouling, noting that the injection points would be at the suction side of the circulating water pumps and immediately upstream of the cooling towers. TVA concluded, however, that no corrosion inhibitor or other chemical additives would be needed in the heat rejection system, based on Guntersville Reservoir water quality and TVA's operating experience at other power plants. This earlier statement is still generally true. However, under the currently proposed treatment scheme for a B&W unit discussed below, chemicals would be applied to the essential raw cooling water (source of makeup for the B&W heat rejection system).

The CLWR FEIS (DOE 1999), Subsection 5.2.3.4, described the sources of chemical discharges from a B&W plant and summarized chemical discharges from operation of BLN Unit 1 and BLN Units 1&2 in Tables 5-28 and 5-29 of that document. Expected inorganic chemicals and observed and expected trace metal concentrations are listed. The CLWR

FEIS concluded that even under adverse conditions, chemical discharges from BLN 1&2 would be small, and the change in average concentrations in the reservoir after mixing would represent a small increase over the observed background concentrations. The CLWR FEIS also concluded that actual discharges and concentrations should meet the limitations of the NPDES permit and ADEM drinking water standards.

The COLA ER described anticipated nonradioactive, liquid-waste chemical and biocide discharge concentrations for the AP1000 in ER Section 3.6. The impact of chemical additives on surface water is summarized in the following paragraph.

Biocides are added in very low concentrations (in the low parts per million) and consumed, leaving very small concentrations by the time they are discharged. The NPDES permit issued by ADEM imposes monitoring and concentration limits on releases. The current NPDES permit takes biocide and chlorine concentrations into account, and the associated discharge limits are established to protect receiving waters. Because biocides and chemicals used for water treatment are added in low parts per million (ppm) concentrations and are largely consumed serving their purposes, and the NPDES permit takes into consideration the potential for these substances being in the discharge by establishing requirements for appropriate chemical parameter monitoring and acceptable limits, the impact from these discharges is considered minor.

Proposed Schemes for Cooling Water Treatment for B&W and AP1000 Units
As discussed in Section 2.7, the B&W and AP1000 reactor coolant systems and power conversion systems are functionally similar and would use similar chemicals and processes for water treatment. Chemical treatments for either the B&W or the AP1000 design would follow the EPRI guidelines that are in effect at the time of the treatment.

TVA currently treats cooling water systems in a manner different from the treatment applications discussed in the earlier environmental reviews. The treatment scheme that has evolved at TVA's operating nuclear plants, and would be used for either a B&W unit or an AP1000 unit, is injection of specific chemicals to control corrosion and micro- and macrofouling.

For the B&W, the treatment chemicals used would be injected into the raw water system that serves as makeup to the heat rejection system and as a source for fire protection water, consisting of the circulating water pumps, conduits, main condenser, and cooling towers. As a result, the chemicals applied to the essential raw cooling water for a B&W unit would be carried over and slightly concentrated in the heat rejection system. Sodium hypochlorite would also be periodically injected into the heat rejection system to prevent organic fouling. Based on the water quality in the Guntersville Reservoir and TVA's operating experience at its other power plants, there would be no need for a corrosion inhibitor or other chemical additives in the heat rejection system. No adverse environmental effect is anticipated from the blowdown water or the tower evaporation. Because the water discharged into the heat rejection system, including initial filling and makeup, comes from the Tennessee River via the essential raw cooling water system, provisions are made in the essential raw cooling water system to restrict the introduction of Asiatic clams or their larvae into the heat rejection system (TVA 1980a).

As discussed in COLA ER Chapter 3, the AP1000, circulating water system chemistry is maintained by a local chemical feed skid at the circulating water system cooling tower. Biocide and water treatment chemicals are injected to maintain a noncorrosive, nonscale-forming condition and limit the biological film formation and are adjusted as required.

Biocide application may vary with seasons, and algaecide is applied, as necessary, to control algae formation on the natural draft cooling tower. Chemical concentrations are measured through analysis of grab samples from the circulating water system. Residual chlorine is measured to monitor the effectiveness of the biocide treatment (TVA 2008a).

The AP1000 service water system chemistry is maintained by the turbine island chemical feed system as discussed in the COLA FSAR (TVA 2009a). Biocide and water treatment chemicals are injected to maintain a noncorrosive, nonscale-forming condition and limit the biological film formation and are adjusted as required. Specific chemicals used within the system, other than the biocide, are determined by the site water conditions. Biocide application may vary with seasons, and algaecide is applied, as necessary, to control algae formation on the natural draft cooling tower. Chemical concentrations are measured through analysis of grab samples from the circulating water system. Residual chlorine is measured to monitor the effectiveness of the biocide treatment (TVA 2008a).

The AP1000 demineralized water treatment system receives water from the raw water system and filters and processes this water to remove ionic impurities. A pH adjustment chemical is added upstream of the filtration units to adjust the pH of the reverse osmosis influent, which is maintained within the operating range of the reverse osmosis membranes. A dilute antiscalant, chemically compatible with the pH adjustment chemical, is used to increase the solubility of salts and decrease scale formation on the membranes. Both the pH adjustment chemical and the antiscalant are injected into the demineralized system from the turbine island chemical feed system (TVA 2008a).

The AP1000 steam generator blowdown system assists in maintaining acceptable secondary coolant water chemistry during normal operation and during anticipated operational occurrences of main condenser inleakage. It does this by removing impurities that are concentrated in the steam generator. The system extracts blowdown water from each steam generator and processes the water as required. Chemicals needed to maintain proper operation of the system are injected by the turbine island chemical feed system on an as-needed basis, and are not dependent on the modes of operation of the plant (TVA 2008a).

As discussed earlier, TVA presently uses a chemical generically known as a quaternary amine to control macrofouling, which is effectively applied at a minimum of 1.5 ppm of active product (3.0 ppm total product). Typically, the quaternary amine is applied to the systems three to five times per season for 24 or 72 hours. During the application process, bioboxes of healthy specimens are typically utilized to monitor for mortality of both species. Quaternary amines lose their effectiveness by dilution or may be detoxified by adding bentonite clay.

While oxidizing biocides have been routinely used in raw service water systems to control faunal and floral populations, chemical biocides have not been routinely used in TVA nuclear plant condenser cooling water systems. Instead, cleanliness of condensers has generally been maintained mechanically by a continuous tube-cleaning system, such as the Amertap system, which would be applicable to a B&W unit or an AP1000 unit. However, some chemical biocides may be used, if needed for biological control.

Another difference between the proposed scheme for the B&W and the treatment process described in the 1980 FSAR (TVA 1980a), Subsection 10.4.5.2, relates to additional makeup water for the B&W condenser cooling water system. In the 1980 FSAR discussion, a small amount of additional makeup for the condenser circulating water system was to be

supplied by BLN sewage treatment plant effluent. Under the proposed scheme, it is expected that the essential raw cooling water system would provide all makeup water for a B&W unit. No on-site sewage treatment plant is planned for either a B&W unit or an AP1000 unit. BLN sanitary waste would be discharged to the Jackson County Water Authority's wastewater treatment facility, as discussed earlier in this section.

TVA's operational philosophy regarding chemical additives for plant operation reflects minimization of chemical use through an optimization program. The optimization program includes (1) monitoring operating plant parameters, (2) continually evaluating water chemistry, and (3) inspecting equipment to minimize the total amount of chemicals added. Under both Alternatives B and C, the treatment plan would include treatment of intake or process waters with biocides, dispersants, corrosion-inhibiting chemicals, and detoxification chemicals. Prior to use in TVA plants, chemicals undergo an extensive toxicological review and comparison with maximum instream wastewater concentrations to ensure water quality standards are met.

Under either Alterative B or C, water treatment processes would be controlled to comply with state water quality criteria and applicable NPDES permit conditions to ensure protection of the receiving water body. The standards and criteria applied by the state in establishing NPDES permit limits and requirements are to protect public health and water resources, as well as to maintain the designated uses for the receiving water body.

The amounts of the various chemicals injected for the B&W reactor versus an AP1000 reactor are very comparable, but somewhat lower in the AP1000. The differences are based on plant thermal cycle efficiency. Additional heat "recovery and reuse" features of the AP1000 reactor translate into lower overall rates of cooling water flow. With lower daily volumes of cooling water flowing through the plant systems, less chemicals are needed to treat cooling water.

Secondary system chemistry specifications would be based on the recommendations in the version of the EPRI PWR Secondary Water Chemistry Guidelines that are current at that time. For component cooling water, both a B&W and an AP1000 unit would use chemistry-control specifications consistent with the version of the EPRI Closed Cooling Water Chemistry Guideline that is current at that time. For the emergency diesel jacket water cooling system (B&W only), an industry-standard-approved corrosion inhibitor to control corrosion in the emergency diesel jacket water cooling system would be used.

Acceptance criteria for each monitored parameter would be established and described in approved plant procedures. In the event the acceptance criteria are not met, specific corrective actions would be implemented in accordance with TVA's corrective action program. Any releases to the environment would be governed by the NPDES permit.

3.1.4.2. Environmental Consequences

Alternative A
Under this alternative, no construction or nuclear plant operation would occur at BLN. Therefore, selection of this alternative would not result in direct, indirect, or cumulative effects from chemical additives to surface water.

Alternatives B and C
Based on average estimated daily streamflow of 37,300 cfs, blowdown for the B&W and AP1000 alternatives as a percentage of average flow is approximately 0.130 percent (B&W)

and 0.046 percent (AP1000) of the average flow of the Tennessee River. Of the estimated more conservative 7Q10 flow of 5,130 cfs calculated for the BLN site (one unit only), the percent of Tennessee River flow would be 0.970 percent (B&W) and 0.350 percent (AP1000). Concentrations of solids and residual water treatment chemicals in the cooling tower blowdown would quickly dissipate in the river, because the blowdown volume is insignificant relative to the river flow. The impact of chemical additives would be further reduced through the use of bisulfite chemicals and chemical-absorbing media.

Although the volume of the cooling tower blowdown is anticipated to be small when compared to the river flow and the treatment chemicals added are largely consumed leaving very small concentrations by the time they are discharged, the discharge is regulated by an Alabama state NPDES permit and would comply with applicable water quality standards and criteria. Therefore, for either Alternative B or C, the direct, indirect and cumulative effects of chemical discharges would be minor.

3.2. Groundwater Resources

3.2.1. Affected Environment

Groundwater conditions at the BLN site have been documented in several reports over time, beginning with TVA’s 1974 FES through the COLA ER (TVA 2008a) and COLA FSAR (TVA 2009a). A summary of that groundwater information is provided below.

Groundwater Hydrology

In and near the plant area, the principal water-bearing formations are the Knox Dolomite of Cambrian and Ordovician age and the Fort Payne Chert of Mississippian age. The Knox crops out approximately 3,200 feet northwest of the plant site and dips to the southeast, so it is about 1,000 feet below the land surface in the site area. The Fort Payne crops out about 3,000 feet southeast of the plant site and dips southeastward away from the plant (TVA 1986). The Chickamauga Formation, the (uppermost) bedrock at the main plant site, is a poor water-bearing formation in this region (TVA 1986). More recently, with the reclassification of the regional stratigraphy (Osborne et al. 1988), the main site is said to be underlain instead by the Stones River Group Limestone (TVA 2008a). The physical properties of the formation remain unchanged by the reclassification.

Groundwater at the BLN site occurs under unconfined conditions, as reflected by the water table. The water table conforms closely to topography and ranges in depth below ground surface from zero along Town Creek embayment to a maximum of about 22 feet (TVA 1986) or more (Julian 1996; TVA 2008a; 2009a) at the plant site. The water table occurs primarily in soil composed of residual silts and clays derived from in-place weathering of the underlying rock and also in the upper fractured, weathered zones of the bedrock. Recharge is provided by precipitation, mostly as rain, which averages about 50 inches annually, of which about 8 inches goes into groundwater storage (TVA 1986).

Historic potentiometric plots of groundwater levels (TVA 1986) and later data in the 1980s and 1990s all show the direction of groundwater flow from the plant site toward Town Creek on the northwest for the most part. For some shorter periods of the year, some flow goes to the Tennessee River (Guntersville Reservoir) (TVA 2008a; 2009a). Subsurface testing at BLN using a network of test observation wells installed in 2006 was conducted in support of the COLA (TVA 2008a; 2009a).

Groundwater Use and Trends
There are no groundwater supply wells on site at BLN. Previous TVA reports have documented the use of groundwater supply wells by the town of Hollywood and city of Scottsboro, both of which are within 3 and 7 miles (respectively) of BLN, and by the city of Stevenson, which is about 12 miles from BLN (Julian 1996). A recent communication with ADEM (M. Browman, TVA, personal communication, August 2009) verified that Hollywood and Scottsboro no longer use groundwater supply wells to meet their water needs. Stevenson and Pisgah (located on the east side of Guntersville Reservoir) are the only two municipal or industrial entities in Jackson County, Alabama, that have groundwater supply wells. Groundwater is not used as a municipal or industrial water source within a 2-mile radius of BLN (TVA 2008a; 2009a).

Private groundwater sources were identified early on (1961) within a 2-mile radius (see Figure 3-8 and Table 3-5) (TVA 1986) and more recently within a 1-mile radius (Figure 3-9) (TVA 1997) of the BLN site. A coarse visual comparison indicated that within the zone of overlap, there was a doubling of wells from the first to the second survey. The overwhelming predominance of these wells is northwest of the BLN site and separated from the site by Town Creek embayment, which provides a hydraulic barrier between the wells and the plant. A survey conducted by TVA in 2009 for private wells within an arc 2 miles from the plant, southwest along the peninsula to the plant, revealed two private wells. One has been capped off and unused for 20 years, and the other is used for nonpotable purposes.

Groundwater Quality
Groundwater quality at BLN has been monitored over the years to obtain background concentrations, to examine the effect of on-site disposal practices, and in response to specific incidents. Monitored parameters included radionuclides, organics, and inorganics (TVA 1978c; 1979; 1980b; 1981b; 1982b; 1983a; 1984).

The locations of the TVA monitoring wells installed on site between 1973 and 1996 (Julian 1999), and in 2006 (TVA 2008a) in support of the COLA are shown in Figure 3-10.

Background levels of selected radionuclides (gamma-emitting and tritium) were monitored from 1977 through 1983 in six bedrock wells (TVA 1978c; 1979; 1980b; 1981b; 1982b; 1983a; 1984). Results were spatially and temporally variable.

Monitoring through 1990 of the effects of trisodium phosphate waste/wastewater disposal on site in the early to mid-1980s indicated that the associated metals and phosphorus concentrations had returned to background or near-background levels. The same was true for sodium, except at one well, which continued to show elevated concentrations (Lindquist 1990).

Background sampling by TVA across the site from 1981 to 1991 for total concentrations of inorganics, except for nickel, showed very few constituents in excess of the Drinking Water Standards. Exceedances for iron, manganese, and aluminum were attributed to colloidal mineral material (TVA 1997). Sampling conducted in support of the COLA ER for a similar array of parameters yielded generally similar results. Monitoring in response to diesel spills on site in the 1980s and early 1990s, indicated that, by 2004, the levels of critical contaminants had decreased to regulatory acceptable values (C. Spiegel, ADEM, personal communication, February 2006; A. Nix, TVA, personal communication, July 2006).

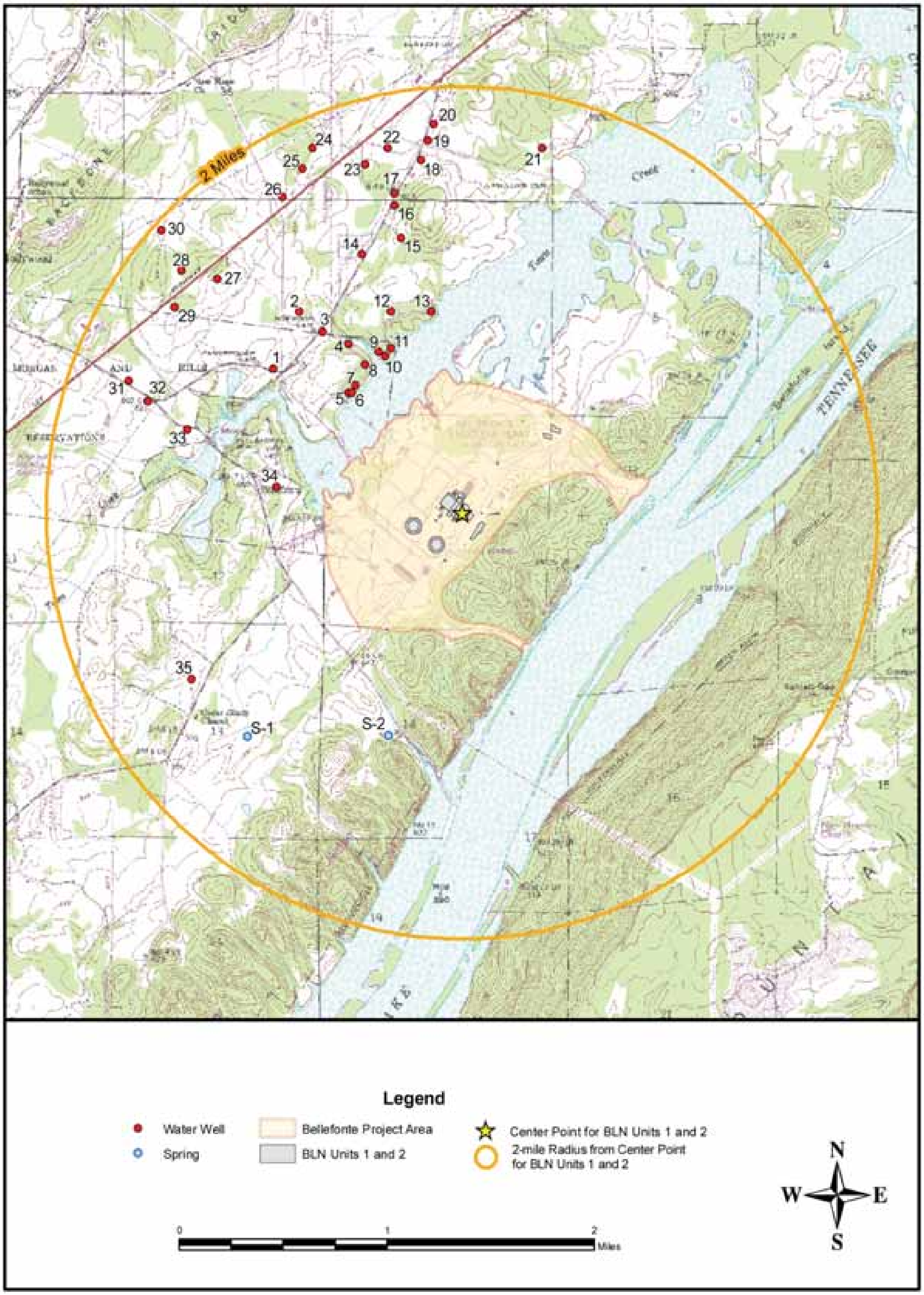


Figure 3-8. Water Wells and Springs Within 2-Mile Radius of BLN

Table 3-5. Inventory of Private Wells and Springs Located Within 2-Mile Radius of BLN, 1961 Data[(a)]

Well Number[(b)]	Year Installed	Elevation[(c)] (feet msl)	Well Depth (feet)	Completion Zone	Comments
1	U	611	20	U	Private residential well
2	U	621	U	U	Private residential well
3	U	609	72	U	Private residential well
4	U	602	U	U	Private residential well
5	U	610	U	U	Private residential well
6	U	600	U	U	Private residential well
7	U	605	U	U	Private residential well
8	U	608	U	U	Private residential well
9	U	605	U	U	Private residential well
10	U	605	U	U	Private residential well
11	U	605	U	U	Private residential well
12	U	629	172	U	Private residential well
13	U	610	39	U	Private residential well
14	U	623	33	U	Private residential well
15	U	670	72	U	Private residential well
16	U	629	102	U	Private residential well
17	U	619	34	U	Private residential well
18	U	621	97	U	Private residential well
19	U	637	70	U	Private residential well
20	U	630	77	U	Private residential well
21	U	620	70	U	Private residential well
22	U	635	U	U	Private residential well
23	U	617	55	U	Private residential well
24	U	640	135	U	Private residential well
25	U	630	131	U	Private residential well
26	U	640	48	U	Private residential well
27	U	640	200	U	Private residential well
28	U	634	68	U	Private residential well
29	U	630	72	U	Private residential well
30	U	638	52	U	Private residential well
31	U	615	U	U	Private residential well
32	U	620	125	U	Private residential well
33	U	604	72	U	Private residential well
34	U	639	116	U	Private residential well
35	U	645	U	U	Private residential well
S-1	N/A	637	Spring	N/A	Intermittent spring[(d)]
S-2	N/A	600	Spring	N/A	Intermittent spring[(d)]

(a) This table may include wells that have been abandoned or installed since the original survey from 1961.
(b) See Figure 3-8 for locations.
(c) Elevation at the ground surface (wells 1-35, springs S-1, and S-2) or top of well casing. Elevations were either obtained by reference or estimated from topographic maps.
(d) Flow was observed from the two intermittent springs in January 2009.

msl = Above mean sea level
U = Unknown
N/A = Not applicable

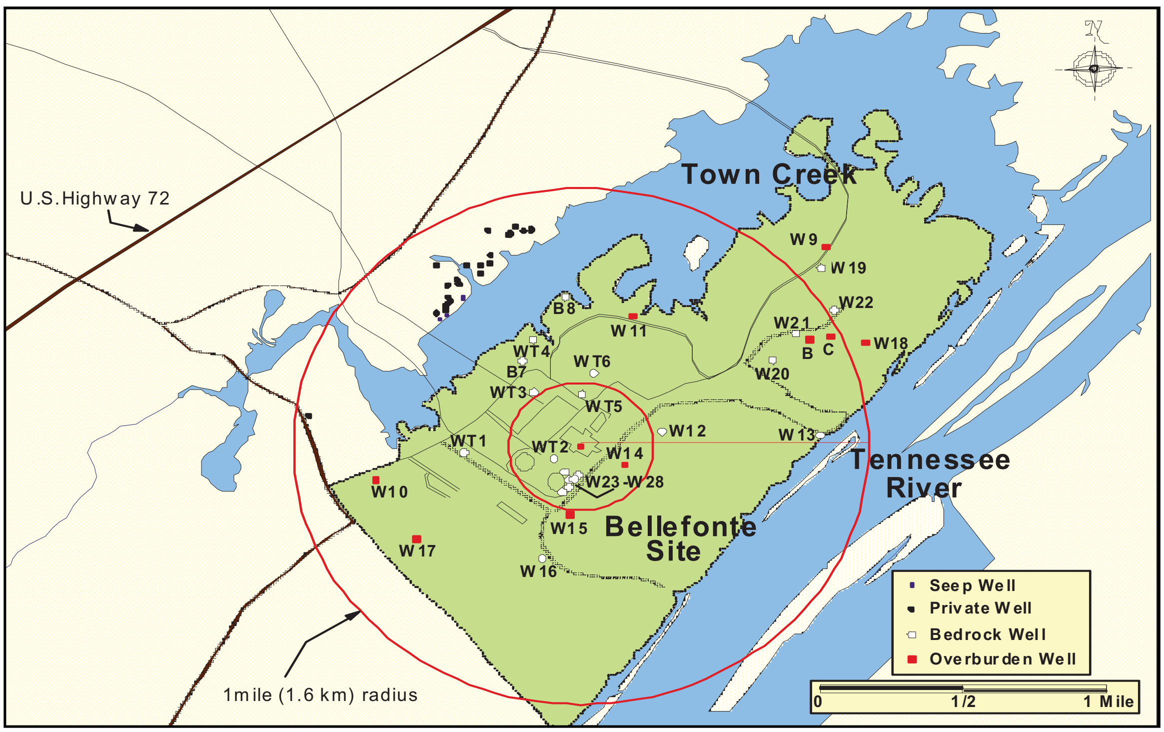


Figure 3-9. Groundwater Wells Within 1-Mile Radius of the BLN Site - 1990

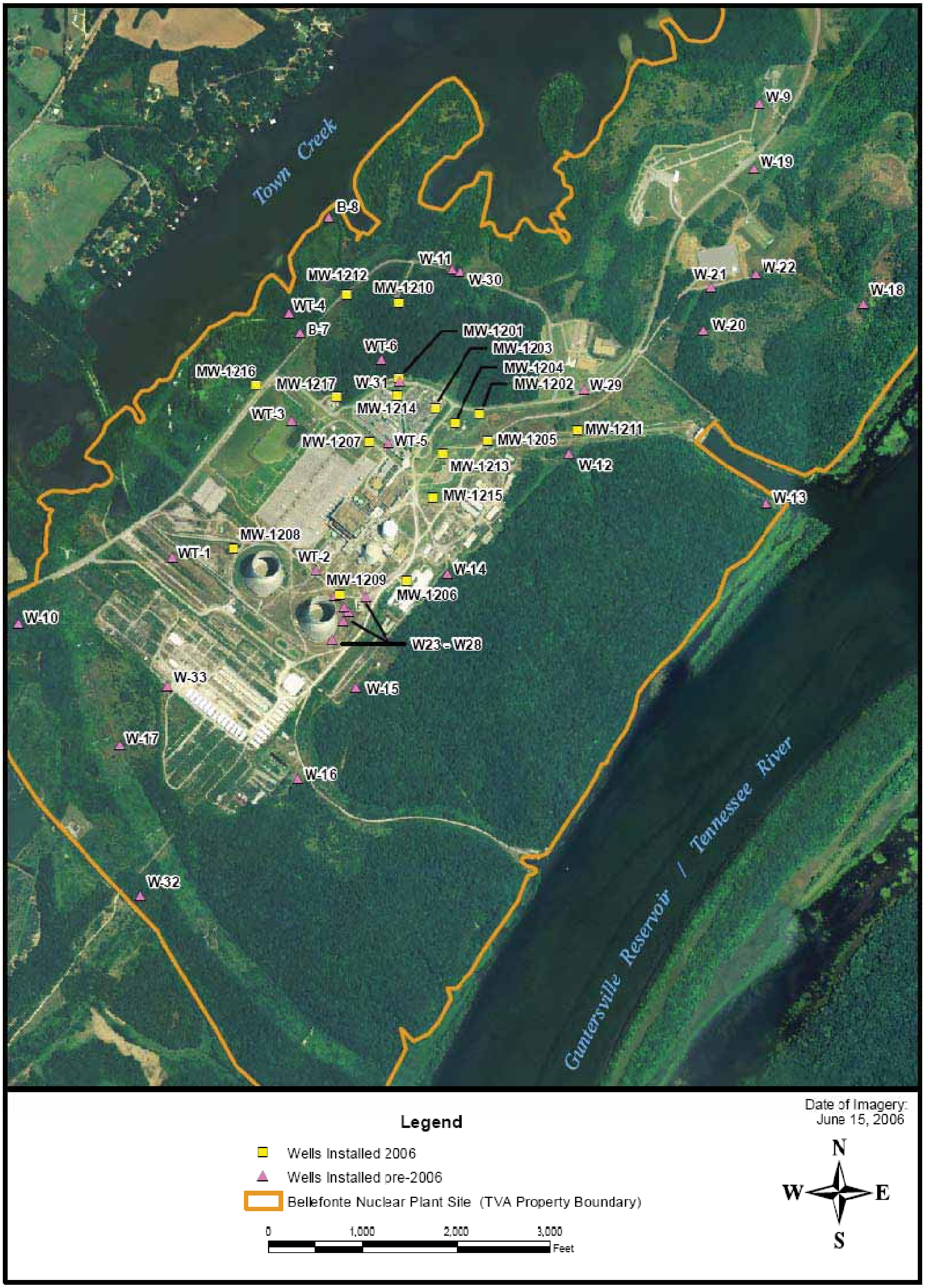


Figure 3-10. BLN B&W Groundwater Wells

3.2.2. Environmental Consequences

Alternative A

Under the No Action Alternative, there would be no effects to the groundwater hydrology, groundwater use, or groundwater quality. The current much-reduced activity and equipment inventory at the site favor the lack of effect on most aspects of groundwater and on groundwater quality in particular. The current use of BMPs for the handling of chemicals, together with the adherence to the site SPCC plan for the management and cleanup of oils, limit likelihood that oil or chemicals would reach groundwater. There is currently no groundwater use on site. Under the No Action Alternative, the quality of groundwater may actually improve. Residual chemicals from past spills and from industrial practices that have been discontinued would decrease over time, leading to the improvement in water quality.

Alternatives B and C

Nonradiological. The completion of one B&W unit or the construction of one AP1000 unit would have no impact on the groundwater hydrology or groundwater use, either on site or locally. Potable water would be supplied by the Jackson County Water Authority. The source of fire protection water for a B&W unit would be the raw water cooling system. For an AP1000, the makeup water for the fire protection system would be provided by the Jackson County Water Authority. Water for concrete batching (if necessary) and other construction uses would be withdrawn from the Tennessee River/Guntersville Reservoir. TVA does not anticipate the use of groundwater as either a safety-related source of water for a BLN unit or its source of water supply for any purpose during operation.

With the adoption of either alternative, nonradiological impacts on groundwater quality are expected to be minor and insignificant. Under both alternatives, chemicals used during construction would be managed using BMPs, thereby limiting the likelihood of chemical contamination of surface water as well as groundwater. In addition, BLN and similar sites that store oil in volumes above a certain threshold and in containers meeting certain size specifications are required to have an SPCC plan (EPA 2008a) applicable to gasoline, diesel fuel, lubricating oil, insulating oil, and other oils. An SPCC plan reduces the likelihood that oil spills will occur on site and provides measures for the expeditious control and cleanup of such spills if they do occur. Implementation of the SPCC plan and the BMPs would help keep oils and chemicals out of surface waters as well as groundwater. With these controls in place, and with the gradual decrease in concentration of existing residual chemicals from historic on-site spills and practices, it is expected there would be an improvement in groundwater quality over time as stated for Alternative A.

Over the past 12 years, several instances of nuclear plants inadvertently releasing tritium contamination to the soil and/or groundwater have been documented. A recent NRC (2010) fact sheet concluded that although the leaks do not present a risk to the public, enhanced efforts are being focused on proper monitoring and repair of pipes by plant operators. Because no radioactive waste has been produced at the BLN site, either of the proposed nuclear units can benefit from the experience gained at operating plants and from the recent industry guidance from the NRC and Nuclear Energy Institute (NEI).

Radiological. With the adoption of either alternative, impacts on groundwater quality from radiological sources are expected to be minor and insignificant. Under both alternatives, TVA would comply with the NEI's groundwater protection initiative, NEI 07-07 (NEI 2007). This initiative identifies actions to improve utilities management and response to instances

where the inadvertent release of radioactive substances may result in low, but detectible, levels of plant-related radioactive materials in subsurface soils and water. Aspects addressed by the initiative include site hydrology and geology, site risk assessment, on-site groundwater monitoring, and remediation. The placement and distribution of monitoring wells would be determined by a qualified hydrogeologist. Further discussion of the groundwater monitoring program is provided in COLA FSAR Subsection 12AA.5.4.14, Groundwater Monitoring Program.

An AP1000 unit at BLN would be compliant with NEI 08-08 (NEI 2008), which offers guidance for new plant design and operation, in terms of engineering and administrative controls that would minimize the occurrence of and provide for the management of inadvertent releases of licensed materials, including tritium, to groundwater. Aspects addressed include design of systems, structures, and components, leak detection, and review of operational practices. The B&W unit would comply with specific requirements of NEI 08-08 (NEI 2008) regarding protection of newly installed buried piping.

A detailed technical evaluation (TVA 2010a) was performed on the existing B&W unit to identify possible sources of radioactive substances that could potentially leak into the groundwater, and specific actions are provided to prevent and monitor leaks, including replacement of the existing plant discharge line, installation of additional monitoring wells, and development of a monitoring program. Specific engineering features that preclude the leakage of radioactive discharge to the environment for an AP1000 unit are discussed in the COLA FSAR Subsection 11.2.1.2.4. These include visual inspection points, piping designs that preclude inadvertent or unidentified releases to the environment, and location of all valves and fittings inside of buildings. Further discussion of the groundwater monitoring program for the AP1000 is provided in COLA FSAR Subsection 12AA.5.4.14. For both Alternatives B and C, the exterior radwaste discharge piping would be enclosed within a guard pipe (secondary containment) and monitored for leakage (see COLA FSAR Subsection 11.2.1.2.4)

Because the direct and indirect effects of the proposed Action Alternatives are expected to be insignificant and TVA is not aware of other activities planned or underway in the vicinity of the plant that contribute to groundwater impacts, construction and operation of a BLN nuclear unit would not result in significant cumulative effects to groundwater.

3.3. Floodplain and Flood Risk

3.3.1. Affected Environment

In AEC's 1974 FES, Subsection 12.1.2 states "Plant safety aspects are considered separately as part of the Preliminary Safety Analysis Report (PSAR) prepared by TVA and the staff's evaluation contained in the Safety Evaluation Report. The AEC's criteria of design against plant site flooding are provided in 10 CFR Part 50, Appendix A (Criterion 2)." The BLN COLA FSAR Section 2.4 (TVA 2010b) contains information related to potential flooding of the BLN site from the Tennessee River and local Probable Maximum Precipitation[5] (PMP) site drainage. Floodplain and flood risk information for the BLN site was updated in the COLA FSAR. The Bellefonte Conversion FEIS (TVA 1997) described the floodplain and flood risk conditions at the BLN site.

[5] The Probable Maximum Precipitation is defined as the theoretically greatest depth of precipitation for a given duration that is physically possible over a particular drainage area at a certain time of year (American Meteorological Society 1959). In consideration of the limited knowledge of the complicated processes and interrelationships in storms, PMP values are identified as estimates.

The BLN site is located on a peninsula formed by Town Creek embayment and the Tennessee River on Guntersville Reservoir in Jackson County, Alabama (Figure 1-1). The proposed project area could be flooded from both the Tennessee River and Town Creek, as well as local PMP site drainage. The area impacted by the proposed project extends from about TRM 390.4 to TRM 392.3, and from about Town Creek Mile 2.1 to 3.3.
The 100-year floodplain for the Tennessee River varies from elevation 600.5 feet msl at TRM 390.4 to elevation 601.1 feet msl at TRM 392.3. The TVA Flood Risk Profile (FRP) elevations on the Tennessee River vary from elevation 601.8 feet msl at TRM 390.4 to elevation 602.6 feet msl at TRM 392.3. For Town Creek, the 100-year floodplain is the area lying below elevation 601.4 feet msl. The FRP elevation is 603.1 feet msl. The FRP is used to control flood-damageable development for TVA projects and residential and commercial development on TVA lands. At this location, the FRP elevations are equal to the 500-year flood elevations.

Jackson County, Alabama, has adopted the 100-year flood as the basis for its floodplain regulations, and all development would be consistent with these regulations. There are no floodways published for this area (TVA 1997).

The BLN drainage system was evaluated for a storm producing the PMP on the local area. The site is graded such that runoff would drain away from safety-related structures to drainage channels and subsequently to the Tennessee River. The PMP flood analysis assumes that all discharge structures are nonfunctioning. The highest PMP water surface elevation in the vicinity of safety-related structures would be 627.53 feet msl (TVA 2009a).

Based on the 2009 reverification of the Probable Maximum Flood[6] (PMF), the controlling PMF elevation at the BLN site would be 625.7 feet msl with dam safety modifications that were made to Watts Bar and Nickajack dams. The effects of coincident wind wave activity are estimated to be 1.3 feet high. Therefore, the PMF and coincident wind wave activity results in a flood elevation of 627.0 feet msl (TVA 2010b).

The floodplains and flood risk assessment involves ensuring that facilities would be sited to provide a reasonable level of protection from flooding. In doing so, the requirements of EO 11988 (Floodplain Management) would be fulfilled. For nonrepetitive actions, EO 11988 states that all proposed facilities must be located outside the limits of the 100-year floodplain unless alternatives are evaluated, which either would identify a better option or support and document a determination of “no practicable alternative” to siting within the floodplain. If this determination can be made, adverse floodplain impacts would be minimized during design of the project (TVA 1997).

For a “critical action,” facilities must be protected to the 500-year flood elevation where there is no practicable alternative. A “critical action” is defined in the Water Resource Council Floodplain Management Guidelines as any activity for which even a slight chance of flooding would be too great. One of the criteria used in determining if an activity is a critical action is whether essential and irreplaceable records, utilities, and/or emergency services would be lost or become inoperable if flooded. Based on this criterion, construction activities associated with this project would be considered as “critical actions”

[6] The Probable Maximum Flood is defined as the most severe flood that can reasonably be predicted to occur at a site as a result of hydrometeorological conditions. It assumes an occurrence of PMP critically centered on the watershed and a sequence of related meteorologic and hydrologic factors typical of extreme storms.

because flooding of these facilities would render them inoperable. All facilities that would force the shutdown or curtailment of power generation if flooded, would either be located above or flood-proofed to the 500-year flood elevation at that location. Many of the support facilities that would not impact power generation if flooded would only be subject to evaluation using the 100-year flood (TVA 1997). Because the proposed project involves a nuclear generating facility, the NRC also requires a flood risk evaluation of possible impacts from the Tennessee River PMF and local PMP site drainage for all alternatives.

Because the activities evaluated in 1997 are different from those proposed for this project, the description of environmental consequences has been newly developed to address completion or construction and operation of a single-unit nuclear plant.

3.3.2. Environmental Consequences

Alternative A
Under the No Action Alternative, no new construction or dredging would occur at the BLN site; therefore, no actions inconsistent with EO 11988 would occur.

Alternative B
Because the existing nuclear-related structures would be utilized, only minor additional physical disturbance of the site from new construction would occur. The majority of work would take place within the existing structures. Minor upgrades to the existing switchyard and transmission line system would be needed. When the final site plans are developed, these activities would be further reviewed to confirm that the work is consistent with EO 11988.

Dredging would occur in the intake channel. However, consistent with EO 11988, dredging is a repetitive action that would result in minor impacts because the dredged material would be disposed of in an on-site spoils area above the 500-year flood elevation.

Section 2.4 of the BLN FSAR (TVA 1986) describes the plant grade of safety-related structures, other than the intake pumping station, as varying between elevations 628 and 646 msl and lists key plant structures and their elevations. The existing safety-related structures where work would take place are either located above the 100-year and FRP elevations or are flood-proofed to that flood level, so the project would be consistent with EO 11988. In addition, all safety-related structures are either located above or flood-proofed to the Tennessee River PMF and coincident wind wave elevation of 627.0 feet msl and above the local PMP site drainage elevation of 627.53 feet msl.

Construction and operation of the B&W unit would not increase the flood risk in the Guntersville Reservoir watershed because the plant would not impact upstream flood elevations. Therefore, there would be no cumulative effects to flood risk associated with the implementation of Alternative B.

Alternative C
Based on the site plan (Figure 2-12), all of the proposed construction activities would occur outside of the 100-year floodplain, which would be consistent with EO 11988. The only activity planned below the FRP elevation would be the construction of site parking. Every effort would be made to reduce the quantity of fill associated with this activity to ensure compliance with the TVA Flood Control Storage Loss Guideline.

Dredging would occur in the intake channel and barge unloading dock. However, consistent with EO 11988, dredging is a repetitive action that should result in minor impacts, because the dredged material would be disposed of in an on-site spoils area above the 500-year flood elevation.

An AP1000 would be constructed at a grade elevation of 628.6 feet msl, which would be above the Tennessee River PMF and coincident wind wave elevation of 627.0 feet msl and above the PMP site drainage elevation of 627.53 feet msl. All safety-related structures would either be located above or floodproofed to the resulting flood levels. The new administration building would be located well above the 100-year and FRP elevations.

As with Alternative B, there would be no cumulative effects to flood risk associated with implementation of Alternative C.

3.4. Wetlands

3.4.1. Affected Environment

Wetlands are areas inundated or saturated with surface water or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas (Environmental Laboratory 1987).

Wetlands are regulated under Sections 404 and 401 of the CWA and addressed under EO 11990. To conduct certain activities in the “waters of the U.S.” that may affect wetlands, authorization under a Section 404 permit from the USACE is required. Section 401 gives states the authority to certify whether activities permitted under Section 404 are in accordance with state water quality standards. ADEM is responsible for Section 401 water quality certifications in Alabama. EO 11990 requires all federal agencies to minimize to the extent practicable the destruction, loss, or degradation of wetlands, and to preserve and enhance the natural and beneficial values of wetlands in carrying out the agency’s responsibilities.

Vegetation communities, including bottomland areas, were assessed during the initial environmental review for the construction of BLN 1&2 (TVA 1974a). Wetland habitat was specifically addressed during subsequent proposals for associated on-site operations (TVA 1997; 2008a; DOE 1999). Wetlands are located along the 12.5-mile shoreline of Guntersville Reservoir and Town Creek embayment fronting the BLN site, but are outside the BLN project area or on the opposite side of Perimeter Road from the BLN plant facilities (Figure 3-11). These wetland areas consist of bottomland/riparian forest, shoreline emergent habitat, and floating aquatic beds. Throughout and following the construction of the existing BLN 1&2 structures, these shoreline wetland areas experienced very little impact (TVA 2008a).

A wetland assessment completed by TVA in 2006 indicated six forested wetlands were located between the perimeter road and the existing parking area. An interagency field review with USACE in 2009 resulted in the inclusion of one additional small forested wetland and wetland connectivity channels between the previously delineated areas. These seven forested wetlands ranged in size from 0.02 to 4.52 acres and totaled approximately 12.2 acres. In 2009, TVA wetland biologists also mapped two created scrub-shrub wetland areas upstream of the intake channel connecting to Guntersville Reservoir

via ephemeral conveyance. These wetlands totaled approximately 1 acre and met the USFWS wetland definition but did not exhibit all criteria required for wetland determination and USACE jurisdiction. One linear wetland feature was also mapped during the 2009 field reconnaissance along the west side of the road leading to the barge terminal. This wide, linear, forested wetland is located in a natural ravine and receives water via precipitation and runoff that empties into a culvert connecting to Guntersville Reservoir. On a 3-level functionality scale, the wetlands rank in Category 2 (moderate condition and provision of wetland function) and Category 3 (superior condition and provision of wetland function).

Wetland determinations were performed according to USACE standards (Environmental Laboratory 1987), which require documentation of hydrophytic vegetation (USFWS 1996), hydric soil, and wetland hydrology. Broader definitions of wetlands, such as the definition provided in EO 11990 (Protection of Wetlands), Alabama state regulatory definitions, and the USFWS definition (Cowardin et al. 1979) were also considered in making their delineations. Field delineation and habitat assessment forms are included in Appendix F.

3.4.2. Environmental Consequences

Alternative A
Under the No Action alternative, no alterations or improvements would be made to the existing facilities for the purpose of nuclear power generation. Therefore, selection of this alternative would not result in direct, indirect, or cumulative effects to wetlands.

Alternative B
Under Alternative B, completion of and improvements to existing facilities and continued operation of the plant would take place. Construction proposed under Alternative B would not directly affect wetlands (Figure 3-11). Proposed parking areas would be sited greater than 50 feet from any delineated wetland boundary to provide a buffer and avoid or minimize indirect impacts to wetlands. During operation, the impact of the thermal plume on emergent, floating-leaved, and submerged vegetation that composes much of the shoreline wetlands would be minimal due to the small temperature change predicted.

Some localized enhancement of macrophyte growth could occur along portions of the mainstream east bank and the adjacent shallow area (DOE 1999). No indirect effects to wetlands are anticipated from runoff or sedimentation during construction or initial or long-term operation of a B&W reactor at the BLN site. Therefore, because there are no wetlands within the construction footprint and the wetlands on or adjacent to the site would not experience significant ecological changes resulting from construction or power generation at the BLN site, no direct, indirect, or cumulative wetland impacts would occur under this alternative.

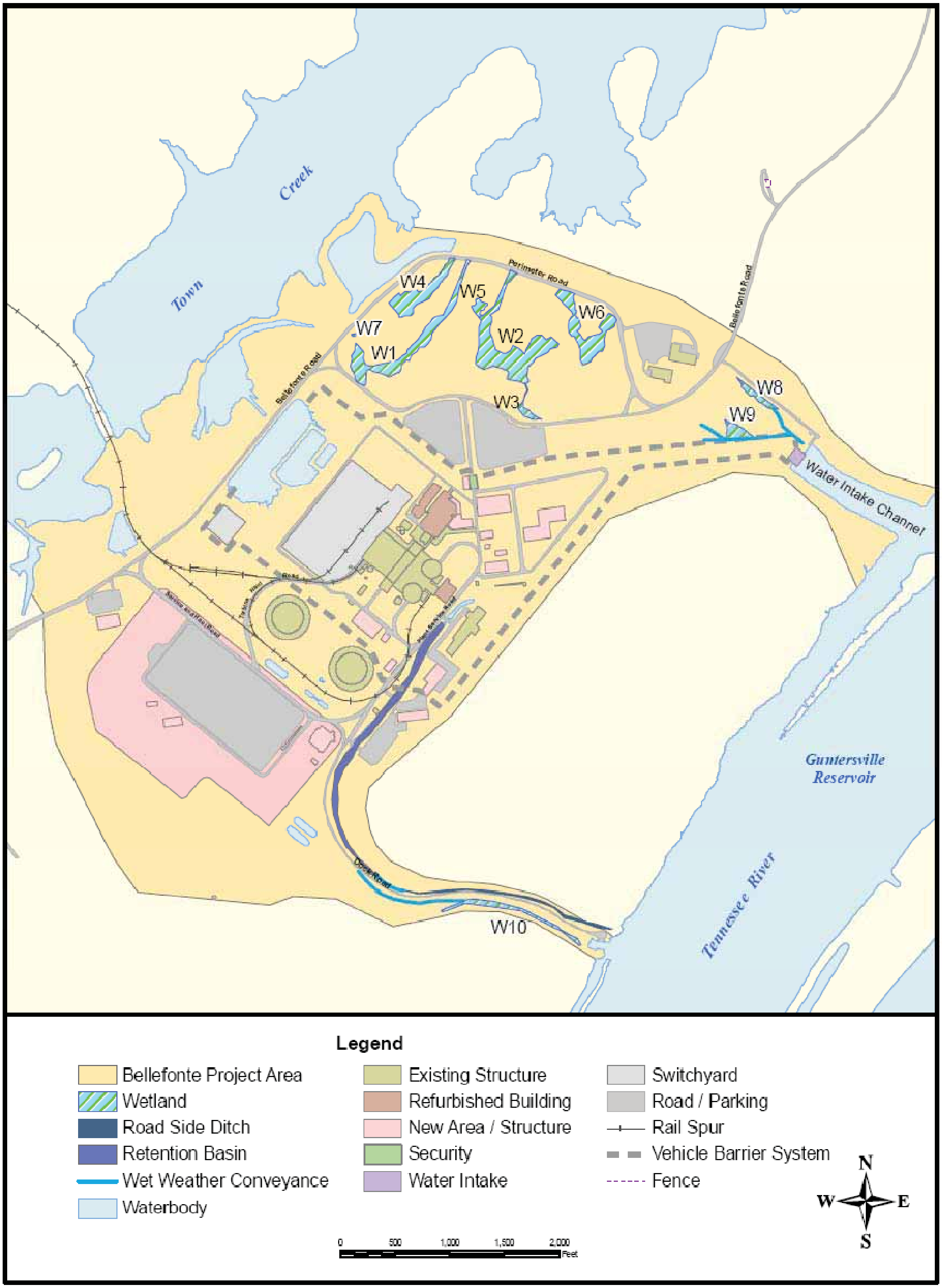


Figure 3-11. Wetlands Shown in Relation to the B&W Site Plan (Alternative B)

Alternative C

Under Alternative C, the new reactor facility would be constructed on and between the Perimeter Road and the existing parking area. The construction footprint for this alternative would result in direct and/or indirect impacts to the 12.2 acres of forested wetland located in that area (Figure 3-12). In compliance with the CWA, TVA would obtain a Section 404 permit and Section 401 certification for the wetland fill associated with the construction footprint for the new facility. Compensation for wetland impacts would be provided through purchasing wetland mitigation credits at the USACE approved wetland mitigation ratio from Robinson Spring Wetland Mitigation Bank, located within the same watershed as the proposed impacts. The impact of the thermal plume on wetland vegetation along the shoreline due to operation of an AP1000 unit on site would be minimal due to the small temperature change predicted.

Some enhancement of macrophyte growth could occur along portions of the mainstream east bank and the adjacent shallow area (DOE 1999). BMPs would be used to avoid or minimize indirect wetland impacts. Therefore, no significant wetland impacts are anticipated from runoff or sedimentation during the construction or operation of one AP1000 unit at BLN. Because TVA would mitigate in-kind within the watershed for wetland fill resulting from construction, no net loss of wetland functions within the watershed would be anticipated, resulting in no cumulative wetland impacts under Alternative C.

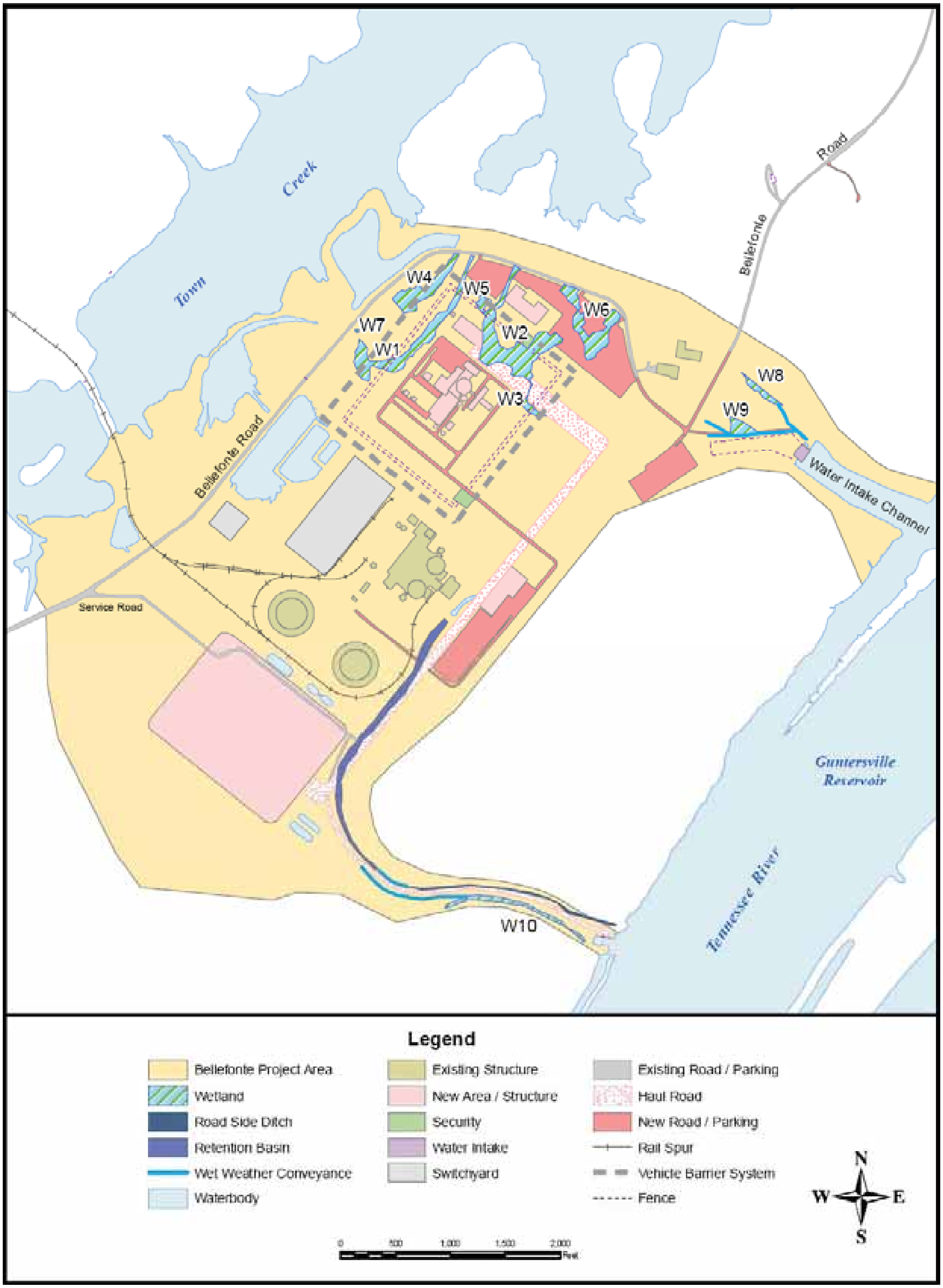


Figure 3-12. Wetlands Shown in Relation to the AP1000 Site Plan (Alternative C)

3.5. Aquatic Ecology

3.5.1. Affected Environment

To support the evaluation of the viability of licensing an additional nuclear reactor at the BLN site, TVA conducted one year of preoperational monitoring in Guntersville Reservoir. During 2009, sampling was conducted upstream and downstream of BLN to characterize site-specific conditions. Sampling at these sites was in addition to TVA's routine VS monitoring program. The VS program, supplemented with additional fish and benthic macroinvertebrate community monitoring upstream and downstream of fossil and nuclear power plants, is used to evaluate effects of thermal discharges to aquatic communities in the receiving water body.

The VS monitoring program in the Tennessee River system began in 1990. This program was implemented to evaluate ecological health conditions in major reservoirs as part of TVA's stewardship role. One of five indicators used in the VS program is the Reservoir Fish Assemblage Index (RFAI). RFAI has been thoroughly tested on TVA and other reservoirs and published in peer-reviewed literature (Jennings et al. 1995; Hickman and McDonough 1996; McDonough and Hickman 1999). The measures used in this methodology are indexed metrics, and not absolute measures of community diversity (number of species) or abundance (number of individuals of each species).

Fish communities are used to evaluate ecological conditions because of their importance in the aquatic food web and because fish life cycles are long enough to adapt to conditions over time. Benthic macroinvertebrate populations are assessed using the Reservoir Benthic Index (RBI) methodology. The RBI is an indexed measure that is used to compare reservoir sites within the Tennessee River system. Because benthic macroinvertebrates are relatively immobile, negative impacts to aquatic ecosystems can be detected earlier in benthic macroinvertebrate communities than in fish communities. RBI data are used to supplement RFAI results to provide a more thorough examination of differences in aquatic communities upstream and downstream of thermal discharges. Results of the 2009 preoperational monitoring near BLN are summarized below.

Fish Community

Data collected in 2009 indicate RFAI scores from sites sampled downstream from BLN were similar to those sampled upstream (Table 3-6; Appendix G, Tables 1-3).

Table 3-6. RFAI Scores Upstream and Downstream of BLN During 2009[1]

Season (2009)	Upstream From BLN			Downstream From BLN		
	Score	Rating	Percent[2]	Score	Rating	Percent[2]
Spring	34	Fair	56	35	Fair	58
Summer	35	Fair	58	30	Poor	50
Autumn	40	Fair	67	34	Fair	57

[1] Summarized from Simmons and Walton 2009
[2] Percent of highest attainable score

Although the scores reached only between 50 and 67 percent of the highest attainable score between spring and autumn, the variation between upstream and downstream scores during any season were within the acceptable six-point range of variation, which indicates no difference in the RFAI between upstream and downstream sites.

Average RFAI scores from established VS monitoring sites on Guntersville Reservoir, farther upstream and 15 river miles downstream of BLN range from 33 (Fair) to 39 (Fair),

which is similar to the average scores for the preoperational monitoring sites upstream and downstream of BLN during spring, summer, and autumn 2009 (Appendix G , Table 4).

TVA has conducted extensive fish sampling in Guntersville Reservoir between 1949 and 2009 using a variety of sampling methodologies. Surveys were conducted prior to 1949, but those data are not consolidated or easily accessible (e.g., specimens cataloged at various museums throughout the United States). A summary of the collection efforts and methods employed from 1949 to 2009 is presented below.

- Rotenone sampling. Between 1949 and 1993, selected coves in Guntersville Reservoir were blocked off and treated with rotenone, killing the fish in the cove so that species occurrence and abundance could be assessed. Rotenone sampling declined sharply in the mid-1980s due to changes in pesticide regulations, and TVA stopped using rotenone as a sampling method in 1993.

- Impingement mortality (number of fish impinged on trash screen at power plant cooling water intakes) sampling. These studies were conducted during 1974 -1975 and during 2005-2007 at WCF upstream of BLN on Guntersville Reservoir (TVA 1975b; 2007b).

- Electrofishing, gill nets, and hoop nets. These sampling methods were used in addition to the cove rotenone sampling during special studies conducted by TVA in Guntersville Reservoir from 1974 to 1984 (TVA 1974b; 1983c; 1985b).

- TVA did not conduct intensive reservoir monitoring from 1984 to 1993. During this time, the RFAI methodology was under development. Sampling was primarily aimed at developing these metrics, and the river system was not systematically sampled as it is under the current VS program.

- RFAI sampling. RFAI sampling is a standardized sampling protocol that uses electrofishing and gill nets only. This sampling program was initiated by TVA in 1993 and has continued until present as part of its VS monitoring program. The RFAI program replaced the cove rotenone sampling program.

- During summer 2009, TVA biologists conducted sampling in addition to the standardized preoperational RFAI monitoring in various sections of the Tennessee River, coves, and embayments of Guntersville Reservoir using boat electrofishing and small-mesh seines in shallow areas to evaluate species occurrences in areas that were not typically surveyed during RFAI sampling and to document the occurrence of species not collected by standard RFAI methodology (e.g., some small-bodied minnows and darters).

Because a variety of sampling methods was used, results must be interpreted and compared with caution. Variation in the effectiveness of the collection techniques used now (electrofishing and gill nets) as compared to the historic period (rotenone) must be considered. These collection techniques target different areas of the reservoir and tend to collect different species. Rotenone, used in coves, is effective in collecting species of all sizes. Electrofishing and gill netting, which occur in the main channel or shoreline areas, are effective in collection of larger-bodied fish species (e.g., black bass, sunfish, and suckers), but smaller-bodied species (minnows and darters) tend to be under-represented by these collection methods. Documenting the species inhabiting Guntersville Reservoir is

also complicated by the apparent misidentification of some specimens in historical collection records.

When comparing the older (1949–1984) data to more recent (1993–2009) data, some differences are apparent. Seventy-nine species are reported from historical rotenone, impingement, electrofishing, and gill net and hoop net surveys (1949 to 1989) (Appendix G, Table 13). Six species (blacktail shiner, bluntnose darter, fantail darter, redline darter, shortnose gar, and suckermouth minnow) are questionable records and likely represent historic misidentifications of other common species. Three of these species are mainly found in smaller streams and are infrequently found in reservoirs (bigeye chub, stripetail darter, creek chub) and should not be considered part of the resident fish community in the reservoir. Elimination of the erroneous identifications, and those species that are not residents, leaves a total of 70 native fish species historically present in Guntersville Reservoir.

Nineteen fish species reported from the 1949–1984 data were not collected in 1993–2009 RFAI samples. Three of these species are mainly found in smaller streams and infrequently found in reservoirs (bigeye chub, stripetail darter, and creek chub). Six species (blacktail shiner, bluntnose darter, fantail darter, redline darter, shortnose gar, and suckermouth minnow) are questionable records and likely represent historic misidentifications of other common species. Four species were collected as recent as the early 1990s in rotenone samples (ghost shiner, silver chub, pugnose minnow, and stripetail darter) but were not present in RFAI samples. Two species were collected from 2005 to 2009 WCF impingement samples (orangespotted sunfish) or in recent seining in the reservoir (whitetail shiner) but were not observed in RFAI samples. Of the 19 species "missing," only four have not been collected from the reservoir or the nearby watershed in recent times (highfin carpsucker, quillback, river carpsucker, and smallmouth redhorse) (Appendix G, Table 5). All four of these species are uncommon in the reservoir and are only collected sporadically.

Conversely, nine species were collected in TVA electrofishing and gill net samples during 1993 to 2009 that were not encountered in historical TVA fish surveys (TVA rotenone/electrofishing/gill net/hoop net) in Guntersville Reservoir (Appendix G, Table 5). Of these, two are recent nonnative invaders to the Tennessee River system (Atlantic needlefish and inland silverside). The remaining seven species (bluntnose minnow, channel shiner, dusky darter, river redhorse, silver redhorse, rainbow darter, and snubnose darter) are native species that prefer stream habitats and are infrequently encountered in the reservoir. An additional species, river darter, was collected in impingement samples at WCF during 2005 to 2007 (Appendix G, Table 5).

Based upon results of numerous studies, 71 species (69 native species) have been collected in Guntersville Reservoir during the past approximate 20 years (Simmons and Walton 2009). This number is based upon the following:

- 64 species collected in RFAI samples while electrofishing and gill netting from 1993 to 2009
- Three species collected during rotenone surveys from 1990 to 1993 (ghost shiner, pugnose minnow, silver chub)

- Two species collected from impingement samples at WCF during 2005 to 2007 (orangespotted sunfish and river darter)

- Two species collected while boat electrofishing (rainbow darter) and seining (whitetail shiner) in Guntersville Reservoir during summer 2009

The stripetail darter is not included in this total because it primarily inhabits streams, and two species that invaded the Tennessee River system during the past 15 years (Atlantic needlefish and inland silverside) are excluded from the comparison.

Comparing recent data to historical data, 69 native species of fish have been collected in Guntersville Reservoir between 1990 and 2009, and 70 native fish species were collected during historical surveys (1949 to 1984) (Appendix G, Table 13). Therefore, the differences between the historical reported fish community and the current reported fish community in Guntersville Reservoir are likely a consequence of sampling methods and species natural history and in errors in the historically reported data, rather than a substantial decline in the number of species inhabiting Guntersville Reservoir.

Some changes in fish community composition and abundance have occurred over the period from 1949 to the present, but these are well within the natural variation seen in fish communities throughout the Tennessee River drainage. These changes do not represent a declining trend in the fish community of Guntersville Reservoir. Population densities of individual species likely vary greatly from year to year due to climate and water quality conditions, but the number of species present in Guntersville Reservoir and the relative health of this community are fairly stable.

Benthic Macroinvertebrate Community
Benthic macroinvertebrate (bottom-dwelling organisms) data collected during spring 2009 from TRM 393.7 (upstream of BLN) and from TRM 389 (downstream of BLN) resulted in an RBI score of 25 (good) (Appendix G, Table 6). Appendix G, Table 7, provides estimated mean density per square meter by taxon at these sites. Results from samples taken downstream from BLN were very similar to those taken upstream. Both upstream and downstream sites received similar overall scores.

All VS sites on Guntersville Reservoir have averaged a “good” to “excellent” RBI score from 1993 to the present (Appendix G, Table 8). Results of preoperational RBI monitoring conducted near BLN during spring 2009 were similar to results of VS monitoring calculated in 2008, indicating conditions near BLN are similar to other sites on Guntersville Reservoir.

Although the RBI is a good index of overall reservoir health, it is not a measure of the freshwater mussel community composition or health. Conversion from a free-flowing river to an impoundment has affected the freshwater mussel community in the Guntersville Reservoir. Since closure of Guntersville Dam, the mussel community in this portion of the river has undergone a conversion from a diverse community typical of a large, free-flowing river to a community composed of relatively few species that are tolerant of reservoir conditions. RBI is used to compare sites within and among TVA’s reservoir system.

Ichthyoplankton
Data on fish communities, including density of fish eggs and larvae adjacent to BLN, were collected. The ichthyoplankton (fish eggs and larvae suspended in the water column) assessment results during 2009 in the vicinity of BLN are similar to historical assessments

during 1977 through 1983 (TVA 2009c). Taxonomic composition and abundance of ichthyoplankton during the 2009 study validated the historical ichthyoplankton data collected several years earlier. Mandated minimum flows generated from Chickamauga and Nickajack dams provide favorable spawning habitat and water quality conditions in Guntersville Reservoir to support spawning success of fish. Additionally, there has not been any significant change in the reservoir fish assemblage in upper Guntersville Reservoir since the TVA VS program was initiated in 1993, which suggests no major changes to spawning success.

3.5.2. Environmental Consequences

Alternative A

Because no construction or nuclear plant operation would occur at BLN, there would be no impacts to aquatic habitat or species under the No Action Alternative.

Alternative B

Under Alternative B, work would be conducted to complete a single B&W unit and bring it to full operational capacity. Because intake and discharge structures are already in place, new construction is not expected to occur near the banks of the reservoir, and accidental discharge and storm water runoff is limited under the construction storm water pollution prevention plan (SWPPP) and a site-specific SPCC plan, which are implemented prior to construction initiation. Refurbishment of the barge unloading dock would take place and would be performed in compliance with ADEM and applicable Alabama Department of Conservation and Natural Resources (ADCNR) and USACE permits.

Dredging 1,960 feet of the intake channel between the intake structure and the main river channel would be performed in compliance with applicable ADEM and USACE requirements. The intake channel was surveyed for native mussels and snails in 2009. Only common species were encountered within the intake channel. Densities of these species were very low compared to areas in the main channel of the Tennessee River. Predredge conditions should return as benthic communities recolonize the area and suspended solids settle out of the water column. Dredging would have only minor direct and indirect effects on aquatic communities. No cumulative effects to the benthic macroinvertebrate community are anticipated.

Operational impacts on aquatic communities could occur through the release of thermal, chemical, or radioactive discharges to the atmosphere or river. Operation of a BLN unit would be in compliance with the NPDES discharge limits, as outlined in the 2009 permit (#AL0024635). Thermal effects on the aquatic communities in the vicinity are anticipated to be minimal due to the relatively small amount of heat involved. Modeling indicates that the area of the river bottom directly contacted by the discharge plume is extremely small. Only minor effects on benthic organisms are anticipated. Because the plume does not affect the entire cross section of the river, there would be adequate room for fish passage around the affected area.

Potential chemical or radioactive releases could affect aquatic species near the site and in the reservoir downstream of the site, either directly or indirectly through the food chain. However, any potential uptake of excessive toxins would be incidental and localized, resulting in minimal impacts to aquatic life (AEC 1974; TVA 1991; DOE 1999). No adverse direct, indirect, or cumulative effects on aquatic communities are expected to result from plant releases (i.e., thermal, chemical, and radiological releases). Impacts on aquatic life

from chemical or radiological releases would be minor (Subsections 3.1.4 and 3.17.3, respectively).

Impingement and entrainment associated with operating plant intake structures have potential to affect aquatic organisms. Impingement occurs when aquatic organisms too large to pass through the screens of a water intake structure become pinned against screens and are unable to escape. Entrainment is the involuntary capture and inclusion of organisms in streams of flowing water, such as plant cooling water systems. Impingement and entrainment are regulated under Section 316(b) of the CWA. The effects of plant operation are unique to the aquatic community conditions and the physical characteristics of the withdrawal at each facility. However, impingement and entrainment monitoring can only occur when a plant becomes operational. For this SEIS analysis, TVA used two reference plants (WCF and WBN) and preoperational monitoring results to estimate the magnitude of these effects.

The known impingement and entrainment at WCF is used to estimate the maximum potential impingement and entrainment effects at BLN. Located approximately 16 river miles upstream of BLN on Guntersville Reservoir, WCF uses “once-through” cooling and withdraws significantly more water (approximately 1,476 MGD at WCF compared to a projected 48 MGD for the B&W and 36 MGD for the AP1000) from the river than would be used at BLN. TVA has monitored impingement at the WCF site and has determined that the WCF intake does not have a significant effect on fish communities in Guntersville Reservoir due to impingement (TVA 2008a). Both impingement and entrainment rates at WCF are small. Because BLN is equipped with a closed-cycle cooling system that minimizes the intake flow, the impingement and entrainment effects at BLN would be even smaller than the effects at WCF.

The impingement and entrainment rates at WBN are much lower than those documented at WCF primarily due to the use of closed-cycle cooling at WBN. WBN’s maximum intake pumping flow rate is 103.4 MGD. Entrainment estimates from Watts Bar, a similar one-unit nuclear plant with closed-cycle cooling, located upstream on Chickamauga Reservoir at TRM 528, were low, and it is expected that BLN entrainment estimate would also be low and would not adversely impact the fish community of Guntersville Reservoir. TVA's evaluation of the historical entrainment data supports the conclusion that the impact of entrainment of ichthyoplankton from the intake system at BLN when the plant becomes operational would be small, and no adverse environmental impact is expected.

Operation of BLN would result in some impingement and entrainment of fish. However, these effects would be minor, and would not result in direct or indirect adverse effects on fish communities in Guntersville Reservoir. These effects, even when considered as part of the cumulative effects of operation of the BLN and WCF facilities on Guntersville Reservoir, would not have a cumulative adverse effect on fish communities in Guntersville Reservoir.

Should one of the Action Alternatives be selected, TVA would perform impingement and entrainment monitoring necessary to comply with Section 316(b) of the CWA once the BLN facility is in operation to validate the projected low impingement and entrainment rates.

Alternative C

Under Alternative C, construction and operational activities, and measures implemented to minimize effects on aquatic organisms would be similar to those described under Alternative B with two exceptions.

Under both Action Alternatives, the intake channel would be dredged prior to initiating nuclear plant operations. However, under Alternative C, only the area between the intake structure and the shoreline (1,200 feet) would be dredged, reducing the volume of dredged material by approximately 1,100 cubic yards as compared to Alternative B.

Secondly, approximately 240 cubic yards of dredged material at the barge unloading dock would be removed if TVA were to implement Alternative C. During dredging, loss of the benthic community adjacent to the barge terminal and temporary increases in turbidity are expected. Predredge conditions should return as benthic communities recolonize the area and suspended solids settle out of the water column. Dredging of the barge unloading dock would add to effects from dredging the intake channel, but still would have only minor direct and indirect effects on aquatic communities. No cumulative effects are anticipated.

3.6. Terrestrial Ecology

The BLN site, located on the west bank of the Tennessee River in Jackson County, Alabama, lies within the Sequatchie Valley, a subregion of the Southwestern Appalachian ecoregion. The Sequatchie Valley extends nearly 100 miles from the Tennessee border to the southwest into Alabama. In the north, the open, rolling, valley floor, 600 feet in elevation, is nearly 1,000 feet below the top of the Cumberland Plateau and Sand Mountain. South of Blountsville, Alabama, the topography becomes more hilly and irregular with higher elevations. The Tennessee River flows through the Sequatchie Valley until it turns west near Guntersville, where it leaves the valley. Similar to parts of the Ridge and Valley subregion, the Sequatchie Valley is an agriculturally productive region, with areas of pasture, hay, soybeans, small grain, corn, and tobacco (Griffith et al. 2001).

Vegetation on the BLN site and adjacent lands has been continuously disturbed by decades of timber harvest and agricultural activities. Initial construction of BLN 1&2 in the 1970s disturbed approximately 400 acres of the 1,600-acre BLN site. The section summarizes previous site assessments, relays any changes since those assessments occurred, characterizes existing on-site terrestrial habitat, and states all potential impacts resulting from implementation of the three alternatives described in Chapter 2. Because extensive information previously was collected and analyzed (TVA 1974a; AEC 1974; TVA 1997; 2008a; DOE 1999), no new quantitative field data were collected for this supplemental review.

3.6.1. Plants

3.6.1.1. Affected Environment

Terrestrial plant communities were assessed during the initial environmental review for the construction of BLN 1&2 (TVA 1974a), during the Bellefonte Conversion FEIS (TVA 1997), and in support of the COLA ER (TVA 2008a). For the 1974 FES, vegetation analyses were based on statistical values for data obtained from systematic vegetation plot samples. Vegetation community boundaries were determined subjectively and plot data from those communities were analyzed for species importance values using frequency, density, and basal area (for trees). Five major plant community types were described: cultivated fields; elm-ash-soft maple forests; oak-hickory forests; mixed conifer and hardwood forests; and broomsedge-lespedeza fields. The majority of BLN construction occurred on previously disturbed young forest and agricultural fields (TVA 1974a) within the BLN site. A 1997 ecological assessment was completed for the remaining natural habitat of the BLN site. Five terrestrial vegetative communities were described: lawns and grassy fields;

bottomland/riparian hardwood forests; mixed hardwood forests; pine-hardwood forests; and scrub-shrub thickets.

During field reconnaissance in 2007 and 2008, vegetation sampling confirmed that previous habitat data are consistent with current conditions. Vegetative cover on the BLN site is primarily mixed hardwood forest and mixed improved and native grass fields (Table 3-7). Approximately 5 percent of the ground cover on the BLN site consists of roads and structures (Figure 3-13) (TVA 2008a). These vegetation communities are common and representative within the Sequatchie Valley. No globally rare or uncommon terrestrial plant communities are known to occur on site, nor are there any USFWS-designated critical habitats for plant species' protection within, on, or adjacent to the BLN site.

Table 3-7. Percent Cover of Major Habitat Types on the BLN Site

Habitat Type	Description	Percent Cover
Mixed improved and native grass fields	Introduced species including broomsedge, oat grass, orchard grass, sericea lespedeza, and tall fescue	24
Bottomland/riparian forests	Green ash, red maple, sweet gum, and various oak species such as cherrybark oak, overcup oak, water oak and willow oak; invasive species include Chinese privet, Japanese honeysuckle, and multiflora rose	11
Mixed hardwood forests	Mixed-mesophytic and oak-hickory forest vegetation typically dominated by American beech, mockernut hickory, red oak, sugar maple, and white oak	43
Pine-hardwood forests	Oak-pine or oak-hickory-pine communities commonly found in evergreen-deciduous forests; dominant species are loblolly pine and shortleaf pine, with black oak, southern red oak, and sweetgum also present	3
Scrub-shrub thickets	Early succession to forests; comprised of saplings of ash species (green and white), black locust, pine, sweetgum, and sumacs; these areas also contain various varieties of blackberries and catbriars	12

Most lands in and around the TVA power service area have been affected by introduced nonnative plant species. Nonnative plants occur across Southern Appalachian forests, accounting for 15 to 20 percent of the documented flora (U.S. Forest Service [USFS] 2008). According to NatureServe (2009), invasive nonnative species are the second-leading threat to imperiled native species. Not all nonnative species pose threats to our native ecosystems. Many species introduced by European settlers are naturalized additions to our flora and considered to be nonnative noninvasive species. These "weeds" have very little negative impacts to native vegetation. Examples of these are Queen Anne's lace and dandelion. However, other nonnative species are considered to be exotic invasive species and do pose threats to the natural environment. EO 13112 defines an invasive species as any species, including its seeds, eggs, spores, or other biological material capable of propagating that species, that is not native to that ecosystem, and whose introduction does or is likely to cause economic or environmental harm or harm to human health (USDA 2007).

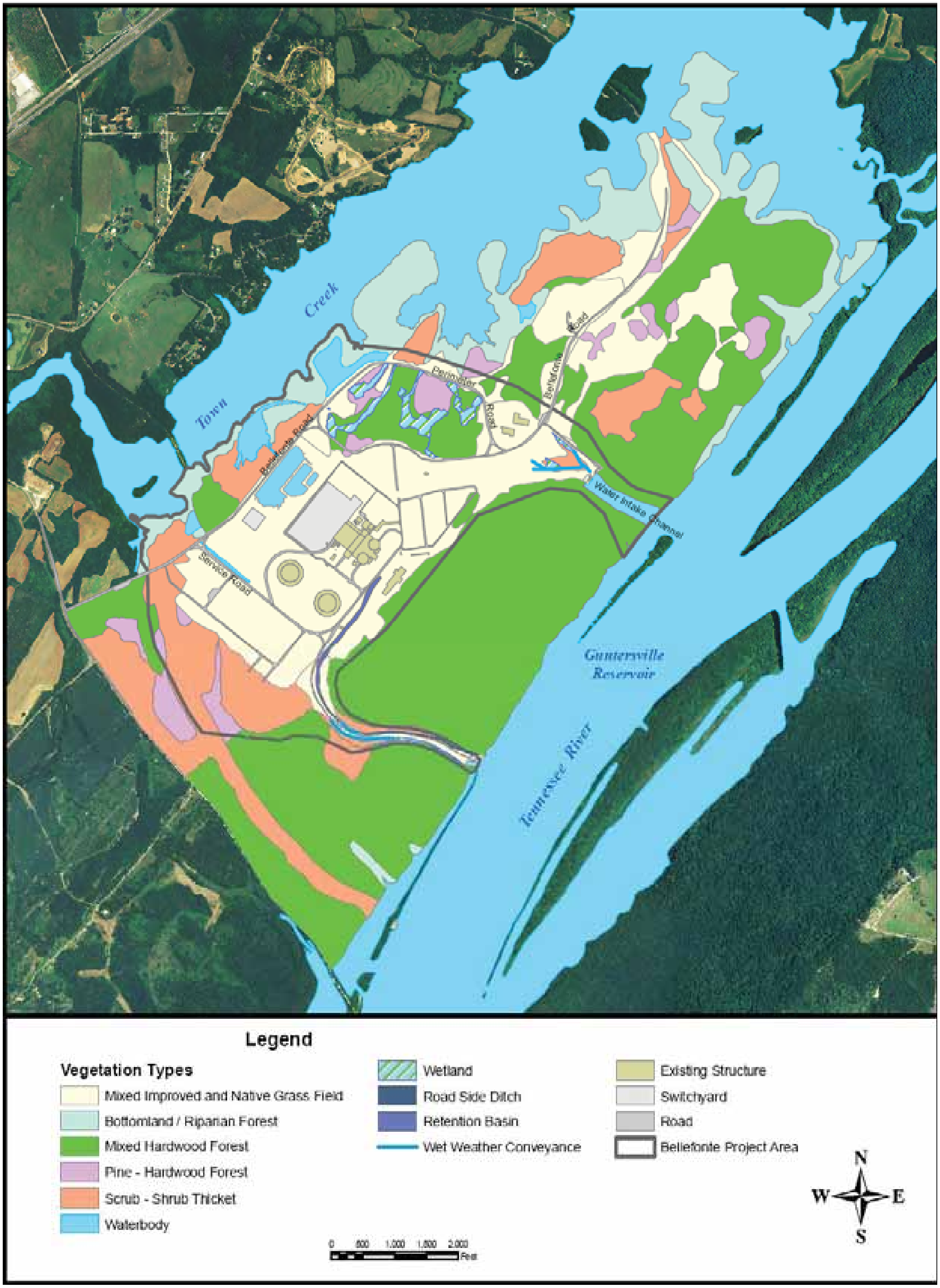


Figure 3-13. Vegetation Cover Types on the Bellefonte TVA Property

The Alabama Invasive Plant Council (2006) reports six of the top 10 Alabama worst weeds as occurring in Jackson County, and two additional species are found in DeKalb County. These exotic weeds, which pose a severe threat to native ecosystems, are alligator weed, Eurasian water milfoil, cogongrass, Chinese privet, hydrilla, kudzu, multiflora rose, and tropical soda apple. Cogongrass, hydrilla, and tropical soda apple are also on the Federal Noxious Weed List (USDA 2007). Field observations within the BLN site noted an abundance of Chinese privet and Japanese honeysuckle along with dandelion, multiflora rose, sericea lespedeza, and tall fescue.

The most effective, economical, and ecologically sound approach to managing invasive plants is to prevent them from invading (Center for Invasive Plant Management 2009). Land managers often concentrate on fighting well-established infestations, at which point management is expensive, and eradication is unlikely. Infestations must be managed to limit the spread of invasive plants, but weed management that controls existing infestations while focusing on prevention and early detection of new invasions can be far more cost-effective.

Weed prevention depends on the following:

- Limiting the introduction of weed seeds
- Early detection and eradication of small patches of weeds
- Minimizing the disturbance of desirable plants along trails, roads, and waterways
- Maintaining desired plant communities through good management
- Monitoring high-risk areas such as transportation corridors and bare ground
- Revegetating disturbed sites with desired plants
- Evaluating the effectiveness of prevention efforts and adapting plans for the following year

3.6.1.2. Environmental Consequences

Alternative A

Under the No Action Alternative, upgrades to existing units or construction of new units would not be undertaken. Because the terrestrial communities present on and around the BLN site are common and representative of the region, no impacts to the terrestrial plant ecology of the area are expected under this alternative. In addition, invasive plant species present on site will not be disturbed; therefore, this alternative would not contribute to the spread or introduction of exotic invasive plant species on or near the BLN site.

Alternative B

Under Alternative B, construction activities would occur within previously disturbed areas, resulting in very minor clearing of some terrestrial vegetation. Any clearing would take place in accordance with an SPCC plan and BMPs designed to minimize impacts to the adjacent land (TVA 1992). Disturbed areas would be revegetated with native or nonnative noninvasive plant species to reduce the introduction and spread of exotic invasive plant species associated with ground disturbance and other construction activities. Therefore, no indirect effects to terrestrial vegetation are expected. Criteria gaseous or particulate air pollutants emitted from the facility during construction or operation would meet the ambient air quality standards and would have no adverse direct, indirect, or cumulative effect on terrestrial vegetation. Because the terrestrial communities present on and around the BLN

site are common and representative of the region, no cumulative impacts to the terrestrial plant ecology of the area would be expected under this alternative.

Alternative C

Adoption of Alternative C would result in similar impacts associated with construction and operation. Under this alternative, about 50 acres of terrestrial vegetation (hardwood forest, pine-hardwood forest, mixed hardwood forested wetland, and native grass field) would be cleared, resulting in minor direct impacts to terrestrial vegetation. As with Alternative B, clearing would take place in accordance with an SPCC plan, BMPs, and revegetation plans as described under Alternative B. Therefore, no indirect effects to native terrestrial vegetation would occur under Alternative C. Because the terrestrial communities present on and around the BLN site are common and representative of the region, no cumulative impacts to the terrestrial plant ecology of the area are expected under Alternative C.

3.6.2. Wildlife

3.6.2.1. Affected Environment

The terrestrial ecology at the BLN site has changed little from that described in earlier environmental reviews (TVA 1974a; 1997; 2008a; DOE 1999). The project site, which is highly developed, includes parking areas, buildings, cooling towers, and roads. Habitat surrounding the existing facilities consists of improved and native grass fields that provide poor to moderate quality wildlife habitat. Mixed hardwood forest or scrub-shrub communities adjacent to the vegetated fields are of adequate extent for wildlife to use as movement corridors (TVA 2008a).

Wildlife using areas adjacent to the proposed B&W and AP1000 footprints include locally abundant species that are tolerant of human activity and highly modified habitats. Species associated with upland grassy areas and scrub-shrub communities surrounding existing BLN facilities include cottontail rabbit, woodchuck, hispid cotton rat, least shrew, eastern meadowlark, field sparrow, gray rat snake, eastern garter snake, and American toad. Other common species associated with the forested and emergent wetland communities include upland chorus frog, marbled salamander, and red-winged blackbird. Forested upland communities surrounding the site provide habitat for common wildlife including white-tailed deer, gray squirrel, raccoon, red-bellied woodpecker, blue jay, wood thrush, wild turkey, ring-necked snake, ground skink, and slimy salamander. Nearby embayments of Guntersville Reservoir are used by a wide variety of wildlife that favor riparian habitats. These areas are used extensively by waterfowl including gadwall, American coot, blue-winged teal, mallard, American wigeon, ruddy duck, and Canada geese. Pied-billed grebe, great blue heron, belted kingfisher, mink, muskrat, beaver, red-eared slider, false map turtles, and common musk turtles are also common in these embayments (Keiser et al. 1995).

3.6.2.2. Environmental Consequences

Alternative A

There would be no impacts from construction or operation to wildlife under the No Action Alternative. Wildlife and their habitat occurring on BLN properties would change very little in the foreseeable future as no substantive changes are expected to occur under this alternative.

Alternative B
Under Alternative B, new construction would occur in areas that previously were cleared. Criteria gaseous or particulate air pollutants emitted from the facility during construction or operation would meet the ambient air quality standards and would have no adverse direct, indirect, or cumulative effect on wildlife. In addition, previous studies conclude that small radioactive exposure relative to acceptable benchmarks, as would be the case under normal operating circumstances, are not expected to cause observable changes in terrestrial animal populations (International Atomic Energy Agency [IAEA] 1992; DOE 1999).

Potential for collisions between birds and structures, vehicles, and transmission lines exists. Many authors on the subject of avian collisions with utility structures agree that collisions are not a significant source of mortality for thriving populations of birds with good reproductive potential. NRC reviewed monitoring data concerning avian collisions with cooling towers at nuclear power plants and determined that overall avian mortality is low (NRC 1996).

Wildlife and their habitat occurring on BLN properties would change very little in the foreseeable future as no substantive changes are expected to occur to terrestrial wildlife under this alternative. No adverse direct or cumulative impacts to wildlife are expected under Alternative B.

Alternative C
Construction of an AP1000 unit would result in upgrading existing infrastructure on site and construction of new buildings and parking areas inside the perimeter road. Construction within the perimeter road would clear about 50 acres of a mixed hardwood forest, forested wetlands, native grass fields, and mixed pine-hardwood forest. Review of aerial photographs and results of field reconnaissance indicate that the existing habitat contains only a small amount of interior forest habitat favored by woodland species. Therefore, clearing approximately 50 acres would result in minor impacts to common species of wildlife inhabiting the Bellefonte project area. Potential effects on wildlife from operation of the plant would be similar to those described under Alternative B. No impacts on wildlife associated with operation are anticipated under Alternative C.

Because wildlife on the BLN property is locally abundant and no uncommon terrestrial habitats are currently known to exist within the Bellefonte project area, no cumulative impacts to terrestrial animal resources are anticipated from selection of Alternative C.

3.7. Endangered and Threatened Species

The ESA prohibits any person from taking a federally listed species. Significant habitat modification or degradation that results in death or injury of federally protected species by significantly impairing behavioral patterns such as breeding, feeding, or sheltering is also prohibited. Most of the disturbance to aquatic and terrestrial habitats associated with completion of BLN has already occurred. The following sections provide updated information on the presence of federally listed and state-listed species found on and near (as defined in each subsection) the Bellefonte project area and the potential for impacts from proposed alternatives for nuclear generation.

To evaluate effects to federally listed species from completion (or construction) and operation of a single BLN nuclear unit, TVA prepared a biological assessment (BA) pursuant to the requirements of Section 7 of the ESA (TVA 2009d). The BA examined

potential impacts of completing and operating a single B&W unit, as well as constructing and operating a single AP1000 unit and associated transmission system improvements.

Fifty-two plants and animals federally listed as endangered, threatened, candidate for listing, or protected under the *Bald and Golden Eagle Protection Act* were addressed in the BA. Only two of the 52 of these species, the pink mucket pearlymussel (*Lampsilis abrupta* - federally listed as endangered and hereafter referred to as pink mucket) and sheepnose mussel (*Plethobasus cyphyus* - federal candidate) were identified in the TVA BA as occurring in areas potentially affected by construction activities at the BLN site or by subsequent operation of the facility. Potential impacts to the pink mucket and sheepnose mussel and measures to minimize those impacts are described in Subsection 3.7.1 below. The analysis and conclusions of the BA regarding plant construction and operation are discussed in Subsections 3.7.2 and 3.7.3. BA conclusions regarding the potential to impact species in the affected transmission line ROWs are discussed in Section 4.6.

In accordance with Section 7 of the ESA, TVA has conducted formal consultation with the USFWS to determine reasonable and prudent measures designed to avoid or minimize take of the two mussel species that would occur under either Action Alternative. TVA transmitted a BA to USFWS on November 14, 2009. USFWS (Daphne, Alabama, field office) acknowledged receipt of the BA in a December 7, 2009, letter. A follow-up letter from the USFWS (Daphne, Alabama, field office) dated January 21, 2010, stated the USFWS conclusion that only the pink mucket could be affected by the project and that there would be no effect on the candidate species sheepnose mussel.

USFWS issued a biological opinion (BO) for this project by letter dated April 15, 2010. The BO contains a “take” permit that allows for impacts to the federally listed pink mucket under either Action Alternative. Due to the poor habitat quality and low densities of mussels present in the project area, and the minimal effects on pink mucket identified in the BA, TVA has committed to providing a total of $30,000 to be used for research and recovery of pink mucket. Copies of these letters, including the BO, are included in Appendix H.

3.7.1. Aquatic Animals

3.7.1.1. Affected Environment

Seven federally listed aquatic species are known to occur recently in Jackson County, Alabama. These include one fish, one snail, and five mussels. Two federal candidate mussels are also reported from Jackson County (Table 3-8). There are historic records of six other federally listed mussels in Jackson County, but those species are presumed extirpated from Guntersville Reservoir. Only one species recently occurring in Jackson County, the pink mucket, has been documented in Guntersville Reservoir in the vicinity of the BLN site. Mussel and snail surveys in Guntersville Reservoir immediately adjacent to the site in 1995, 2007, and 2009 discovered one live pink mucket and one empty pink mucket valve. No other federally listed mussel or snail species were encountered. Habitat that could support the federal candidate sheepnose mussel was identified during this survey. On this basis, it is assumed that the sheepnose mussel, as well as pink mucket, is present within areas affected by BLN site development.

Table 3-8. Federally Listed and State-Listed Aquatic Species Present in Jackson County, Alabama

Common Name	Scientific Name	Federal Status	Alabama (Status, Rank)
Insects			
A caddisfly	*Rhyacophila alabama*	-	(POTL, S1)
A glossosomatid caddisfly	*Agapetus hessi*	-	(TRKD, S1)
Hine's emerald dragonfly	*Somatochlora hineana*	LE	(PROT, SH)
Snails			
Anthony's riversnail	*Athearnia anthonyi*	LE	(PROT, S1)
Corpulent hornsnail	*Pleurocera corpulenta*	-	(TRKD, S1)
Varicose rocksnail	*Lithasia verrucosa*	-	(TRKD, S3)
Mussels			
Alabama lampmussel	*Lampsilis virescens*	LE	(PROT, S1)
Butterfly*	*Ellipsaria lineolata*	-	(TRKD, S3)
Cumberland moccasinshell	*Medionidus conradicus*	-	(PROT, S1)
Deertoe	*Truncilla truncata*	-	(TRKD, S1)
Fine-rayed pigtoe	*Fusconaia cuneolus*	LE	(PROT, S1)
Kidneyshell	*Ptychobranchus fasciolaris*	-	(TRKD, S1)
Monkeyface*	*Quadrula metanevra*	-	(TRKD, S3)
Ohio pigtoe*	*Pleurobema cordatum*	-	(TRKD, S2)
Painted creekshell	*Villosa taeniata*	-	(TRKD, S3)
Pale lilliput	*Toxolasma cylindrellus*	LE	(PROT, S1)
Pheasantshell	*Actinonaias pectorosa*	-	(TRKD, S1)
Pink mucket*	*Lampsilis abrupta*	LE	(PROT, S1)
Purple lilliput	*Toxolasma lividus*	-	(TRKD, S2)
Rabbitsfoot	*Quadrula cylindrica cylindrica*	-	(PROT, S1)
Rainbow	*Villosa iris*	-	(TRKD, S3)
Round hickorynut	*Obovaria subrotunda*	-	(TRKD, S2)
Sheepnose*	*Plethobasus cyphyus*	C	(PROT, S1)
Shiny pigtoe pearlymussel	*Fusconaia cor*	LE	(PROT, S1)
Slabside pearlymussel	*Lexingtonia dolabelloides*	C	(PROT, S1)
Slippershell mussel	*Alasmidonta viridis*	-	(PROT, S1)
Snuffbox	*Epioblasma triquetra*	-	(TRKD, S1)
Spike	*Elliptio dilatata*	-	(TRKD, S1)
Tennessee clubshell	*Pleurobema oviforme*	-	(TRKD, S1)
Tennessee heelsplitter	*Lasmigona holstonia*	-	(TRKD, S1S2)
Tennessee pigtoe	*Fusconaia barnesiana*	-	(TRKD, S1)
Wavy-rayed lampmussel	*Lampsilis fasciola*	-	(TRKD, S1S2)
Fish			
Blotched chub	*Erimystax insignis*	-	(TRKD, S2)
Blotchside logperch	*Percina burtoni*	-	(TRKD, S1)
Palezone shiner	*Notropis albizonatus*	LE	(PROT, S1)
Southern cavefish	*Typhlichthys subterraneus*	-	(PROT, S3)

*Denotes species that are known or likely to occur in Guntersville Reservoir and could be directly or indirectly affected by BLN site construction activities.
Federal status abbreviations: C = Candidate for federal listing; LE = Listed endangered
State status abbreviations: POTL = Potential candidate for state listing; PROT = Protected; TRKD = Tracked by the state natural heritage program
State rank abbreviations: S1 = Critically imperiled, often with five or fewer occurrences; S2 = Imperiled, often with <20 occurrences; S3 = Rare or uncommon, often with <80 occurrences; SH = Historical record; S#S# = Occurrence numbers are uncertain

The 1995, 2007, and 2009 surveys indicated Anthony's riversnail does not occur adjacent to the BLN site. No suitable habitat for other federally listed aquatic species known from Jackson County, Alabama, is present in streams near the BLN site or in Guntersville Reservoir adjacent to the BLN site. Three Alabama state-listed mussel species, Ohio pigtoe, butterfly, and monkeyface, were identified during the 2007 survey adjacent to the BLN site. These species are currently tracked by the state, but are not formally protected.

3.7.1.2. Environmental Consequences

Alternative A
There would be no construction or operation of a nuclear plant at BLN under Alternative A. Existing discharge to Guntersville Reservoir is in accordance with NPDES permits, which are designed to maintain water quality and aquatic habitat conditions that are suitable for aquatic life, including federally listed and state-listed species. Therefore, there would be no impacts to federally listed or state-listed aquatic species under the No Action Alternative.

Alternative B
Under Alternative B, a B&W unit would be completed and operated. The effects to listed aquatic species from site construction, dredging, towing barges, and operating the plant were evaluated.

Intake and discharge structures for the nuclear unit are already in place and new construction is not expected to occur near the banks of the reservoir. Accidental discharge and storm water runoff is limited under the construction SWPPP and a site-specific SPCC plan, which would be implemented prior to initiating construction. Refurbishment of the barge unloading dock would be performed in accordance with ADCNR and applicable ADEM and USACE permits. All site construction work would be conducted using appropriate BMPs, and no discharge-related impacts would occur. Therefore, on-site construction activities would not result in direct, indirect, or cumulative effects on the federally listed or state-listed aquatic animals in Guntersville Reservoir and its tributaries near BLN.

Dredging the intake channel may adversely affect the pink mucket and the three state-listed species present in the potentially affected areas. Due to the poor habitat quality and low densities of mussels present in the project area, few individuals would likely be directly harmed. The greatest number of mussels affected would be individuals inhabiting areas surrounding, and particularly downstream of, dredged areas in the main channel of the Tennessee River. Mussels in those areas would be indirectly affected by turbulence and the suspension and deposition of fine sediments. Although brief and temporary, turbulence and suspended silt could interfere with respiration, feeding, and reproductive activity of federally listed mussels. The use of BMPs such as silt curtains should limit the area affected by suspended sediments and sedimentation.

Mussels also may be indirectly affected by tows delivering less than 50 total barges prior to operation of BLN. Effects from tow propeller wash include brief periods of extreme turbulence, increased suspended sediments, scouring of substrate (and mussels) from the riverbed, and accumulation of fine sediments in surrounding areas. Subsequent effects could interfere with mussel respiration, feeding, and reproductive activity, including interactions with potential fish hosts; such effects may last months to years.

Discharge of chemicals needed to operate the plant is not expected to harm aquatic species. Concentrations of chemicals added to cooling tower blowdown are very small by the time they are discharged to the Tennessee River. The discharge is regulated and monitored under an NPDES permit. Results of studies at TVA's WBN show mussels and fish are not affected even if exposed to undiluted effluent.

Exposure to heated effluent may cause minor indirect effects to federally listed mussels by stressing the fish that carry larval mussels in their gills. Thermal effluent is not expected to harm mussels inhabiting the bottom of the river directly. As stated above in Section 3.5, modeling indicates that the river bottom area in Guntersville Reservoir that would be directly contacted by the thermal plume is small. Bottom contact would only occur within the mixing zone defined in Subsection 3.1.3.1. Therefore, exposure to heated discharge is minimal, and any potential thermal effects would be minor.

In addition to thermal and chemical discharges, operational effects may include impingement and entrainment of aquatic organisms (see Section 3.5 above). Impingement and entrainment could affect fish species that may serve as hosts for the pink mucket (e.g., largemouth bass, smallmouth bass, spotted bass, freshwater drum, sauger, white crappie, and walleye) and sheepnose (e.g., sauger and central stoneroller) and other state-listed species. Effects on these species are anticipated to be minor, and would not have a measurable adverse indirect or cumulative effect on the pink mucket, sheepnose, or other listed aquatic species.

In conclusion, TVA has determined that proposed dredging and barge towing proposed under Alternative B would result in adverse direct, indirect, and cumulative effects to the pink mucket and minor adverse affects to the state-listed mussels. Operation of the proposed B&W unit may have minor indirect impacts on those species. In accordance with Section 7 of the ESA, USFWS has issued a "take permit" that allows for these impacts to the federally listed as endangered pink mucket. Measures designed to minimize and/or mitigate for impacts to pink mucket identified in the USFWS BO are identified in Subsection 2.8 of this FSEIS and would become commitments in TVA's ROD. Due to the low densities of mussels present in the project area, and the minimal effects on pink mucket identified in the BA, rather than conduct an extensive mussel relocation effort for relatively few mussels, TVA has committed to providing a total of $30,000 to be used for research and recovery of the pink mucket.

Alternative C

Similar to Alternative B, proposed activities under Alternative C would use existing intake and discharge, all site construction work would be conducted using appropriate BMPs, and no discharge-related impacts would occur. On-site construction activities would not result in direct, indirect, or cumulative effects to the federally listed or state-listed aquatic species in Guntersville Reservoir or its tributaries near BLN.

As described under Alternative B, dredging may affect the pink mucket and the three state-listed species present in the potentially affected areas. As with Alternative B, due to the poor habitat quality and low densities of mussels present in the project area, few individuals would likely be directly harmed. Under Alternative C, dredging would occur in part of the intake channel and at the barge unloading dock. Because the portion of intake channel nearest the river would not be dredged, indirect impacts to the pink mucket and sheepnose mussel are about 70 percent less under Alternative C than Alternative B.

Transportation of materials by barge would occur more frequently during the site construction activities proposed under Alternative C than Alternative B. The greater number of barges would result in greater indirect effects to federally listed mussels near the barge unloading dock from turbulence, suspended sediments, and scouring, as compared to Alternative B.

Impacts from thermal and chemical discharge, as well as impingement and entrainment of potential fish hosts would be the same under Alternative C as described for Alternative B. Therefore, proposed dredging and barge towing proposed under Alternative C would result in adverse direct, indirect, and cumulative effects to the pink mucket and minor adverse effects to the state-listed mussels. Operation of the proposed AP1000 unit could have minor indirect impacts on those species. As with Alternative B, the USFWS has issued a take permit that allows for these impacts to the federally listed as endangered pink mucket, and TVA has committed to providing a total of $30,000 to be used for research and recovery of the pink mucket. Measures designed to minimize and/or mitigate for impacts to the pink mucket identified in the USFWS BO are identified in Subsection 2.8 of this FSEIS and would become commitments in TVA's ROD.

3.7.2. Plants

3.7.2.1. Affected Environment

A review of the TVA Natural Heritage database indicated no federally listed plants and 25 state-listed plant species occur within 5 miles of BLN (Table 3-9). No critical habitat has been designated for plant species within or near the BLN site. Four federally listed plant species and one candidate for federal listing are reported from greater than 5 miles from BLN but within Jackson County, Alabama. These include: American hart's-tongue fern, green pitcher plant, Morefield's leather-flower, Price's potato bean, and monkey-face orchid. The USFWS recommended that surveys be conducted to investigate presence of the green pitcher plant, monkey-face orchid, Morefield's leather flower, and Price's potato bean (TVA 2008a). Subsequent surveys conducted during winter 2007 and summer 2008 indicated no habitat suitable for any of the five federally listed or candidate plant species exists within the TVA property boundary at BLN. In addition, no state-listed species were identified during several field surveys within the TVA property boundary.

3.7.2.2. Environmental Consequences

Alternatives A, B, and C

Because no federally listed, candidate for federal listing, or state-listed threatened or endangered species are known to occur within the TVA property boundary at BLN, and no habitat suitable to support those species is present, no adverse impacts to federally listed or state-listed plant species would occur under any of the alternatives.

Table 3-9. State-Listed Plants Found Within 5 Miles of the BLN Site and Federally Listed Species Documented in Jackson County, Alabama

Common Name	Scientific Name	Federal Status	State Rank/Status
Alabama snow-wreath	*Neviusia alabamensis*	--	S2/SLNS
American hart's-tongue fern*	*Asplenium scolopendrium var. americanum*	LT	S1/SLNS
American smoke-tree	*Cotinus obovatus*	--	S2/SLNS
Appalachian quillwort	*Isoetes engelmannii*	--	S3/SLNS
Butler's quillwort	*Isoetes butleri*	--	S2/SLNS
Canada violet	*Viola canadensis*	--	S2/SLNS
Carolina silverbell	*Halesia carolina*	--	S2/SLNS
Creeping aster	*Eurybia surculosa*	--	S1/SLNS
Cumberland rosinweed	*Silphium brachiatum*	--	S2/SLNS
Goldenseal	*Hydrastis canadensis*	--	S2/SLNS
Green pitcher plant*	*Sarracenia oreophila*	LE	S2/SLNS
Harper's dodder	*Cuscuta harperi*	--	S2/SLNS
Horse-gentian	*Triosteum angustifolium*	--	S1/SLNS
Michaux leavenworthia	*Leavenworthia uniflora*	--	S2/SLNS
Monkey-face orchid (white fringeless orchid)*	*Platanthera integrilabia*	C	S2/SLNS
Morefield's leather-flower*	*Clematis morefieldii*	LE	S1S2/SLNS
Nuttall's rayless golden-rod	*Bigelowia nuttallii*	--	S3/SLNS
One-flowered broomrape	*Orobanche uniflora*	--	S2/SLNS
Price's potato bean*	*Apios priceana*	LT	S2/SLNS
Sedge	*Carex purpurifera*	--	S2/SLNS
Spotted mandarin	*Disporum maculatum*	--	S1/SLNS
Sunnybell	*Schoenolirion croceum*	--	S2/SLNS
Tennessee bladderfern	*Cystopteris tennesseensis*	--	S2/SLNS
Tennessee leafcup	*Polymnia laevigata*	--	S2S3/SLNS
Twinleaf	*Jeffersonia diphylla*	--	S2/SLNS
Wahoo	*Euonymus atropurpureus*	--	S3/SLNS
White-leaved sunflower	*Helianthus glaucophyllus*	--	SH/SLNS
Wister coral-root	*Corallorhiza wisteriana*	--	S2/SLNS
Woodland tickseed	*Coreopsis pulchra*	--	S2/SLNS
Yellowwood	*Cladrastis kentukea*	--	S3/SLNS

* Denotes known from the county but not from within 5 miles of the project area
Federal status abbreviations: C = Candidate; LE = Listed endangered; LT = Listed threatened
State rank abbreviations: S1 = Critically imperiled, often with five or fewer occurrences; S2 = Imperiled, often with <20 occurrences; S3 = Rare or uncommon, often with <80 occurrences; S4 = Apparently secure in the state with many occurrences; SH = Historical record; S#S# = Occurrence numbers are uncertain
State status: Alabama does not give status to state-listed species; SLNS = No state status

3.7.3. Wildlife

3.7.3.1. Affected Environment

No populations of terrestrial animal species federally listed as threatened or endangered (or species that are proposed or candidates for federal listing) are reported within 3 miles of BLN. Populations of two federally listed as endangered species, the gray bat (*Myotis grisescens*) and the Indiana bat (*Myotis sodalis*), are reported from the region but have not been documented on or within 3 miles of the Bellefonte project area. Gray bats roost in several caves in the county and routinely forage over Guntersville Reservoir near the BLN

facility (Thomas and Best 2000; Best et al. 1995). No suitable roosting habitat for this species (caves) exists on the BLN property.

Small colonies of Indiana bats hibernate in caves in Jackson County. No caves occur within the project boundary; however, suitable summer roosting habitat exists in forested portions of the property within the Bellefonte project area. Suitable habitat in the project area was examined in 2008 to assess the quality of this potential habitat for Indiana bats (TVA 2008a). Although a few moderate-quality roost trees were present, the overall habitat quality for Indiana bats was low because the subcanopy is relatively dense, and the site lacks multiple trees suitable for Indiana bat roosts. Indiana bat habitats typically roost in multiple trees having varying exposure to sunlight (Miller et al. 2002).

Additionally, bald eagles (*Haliaeetus leucocephalus*), which are federally protected under the *Bald and Golden Eagle Protection Act*, occur near BLN. Prior to 2009, the species was reported nesting approximately 1.4 miles east of the Bellefonte project area.

Several Alabama state-listed species are reported from Jackson County (TVA 2008a). Of these, ospreys (*Pandion haliaetus*) are the only state-listed terrestrial animal species known from the BLN project area. Osprey nests are present on transmission line structures within the proposed Bellefonte project area.

Eastern big-eared bats (*Corynorhinus rafinesquii*) are reported from Jackson County. The species has rarely been observed in recent years despite numerous cave and bat surveys performed by TVA and the ADCNR. Forested habitat within the Bellefonte project area was examined in 2008 (TVA 2008a). No potential roost trees suitable for big-eared bats (large hollow trees) were found on the site. Because big-eared bats often roost in man-made structures, an old water storage and pump facility on the property was examined for signs of bat use; no evidence of bats was identified. The closest suitable habitat for this species exists at wetlands on Bellefonte Island (mature hollow trees) in the Tennessee River and along the extensive sandstone escarpment of Sand Mountain located south and across the river from BLN.

3.7.3.2. Environmental Consequences

Alternative A
There would be no impacts to federally listed or state-listed wildlife under the No Action Alternative. Habitat suitable for these species, including foraging areas used by gray bats and low- to moderate-quality roosting habitat for Indiana bats would not be affected under this alternative.

Alternative B
Construction and operation activities proposed under Alternative B are not expected to negatively affect federally listed or state-listed wildlife. No suitable roosting habitat for gray bats exists on the BLN property. The proposed actions would not result in adverse impacts to roosting or foraging gray bats. Because construction would occur in nonforested areas, habitat potentially suitable for roosting Indiana bats would not be affected.

Given the overall lack of suitable roost trees, caves, or sandstone outcrops and no evidence of bat use at the water pump facility, eastern big-eared bats are unlikely to be present, and no impacts to that species are expected.

The distance between the Bellefonte project area and the single known bald eagle nest is greater than the recommended nesting buffer zone (660 feet) established by National Bald Eagle Management Guidelines to protect bald eagles. Therefore, construction activities at BLN are not expected to result in adverse impacts to bald eagles.

Operational impacts on threatened and endangered terrestrial animals could occur through the release of thermal, chemical, or radioactive discharges to the atmosphere or river. These releases could affect listed species near the site and in the reservoir downstream of the site, either directly or indirectly through the food chain. However, any potential uptake of excessive toxins would be incidental and localized, resulting in minimal impacts to protected species' populations. Noise associated with regular on-site operations is not expected to carry to nearby forested tracts that contain potential foraging habitat for some species. Infrequent activities occurring near these forested areas may cause species to leave the area temporarily, but no long-term effects on individuals or populations nearby are anticipated.

The use of habitats at BLN by federally listed and state-listed terrestrial animals is limited. Construction and operation activities proposed under Alternative B are not expected to result in adverse direct, indirect, or cumulative impacts to federally listed or state-listed species or their habitats.

Alternative C

Under Alternative C, potential effects from construction and operation of the AP1000 unit are the same as described for the B&W unit with one exception. Construction proposed under Alternative C involves removal of approximately 50 acres of forest within the perimeter road. Some potential roost trees of moderate quality exist in this area. Prior to clearing forest within the BLN site, TVA would conduct a survey for Indiana bats using methods approved by the USFWS. If Indiana bats are not detected, trees may be removed. If Indiana bats are detected, TVA would coordinate with the USFWS to establish methods to avoid or minimize effects to Indiana bats. In either instance, impacts to Indiana bats under Alternative C would be minor.

All other construction and operation activities proposed at BLN are not expected to result in adverse direct, indirect, or cumulative impacts to federally listed or state-listed species or their habitats.

3.8. Natural Areas

3.8.1.1. Affected Environment

Natural areas include managed areas, ecologically significant sites, and Nationwide Rivers Inventory (NRI) streams. This section addresses natural areas that are on, immediately adjacent to, or within 3 miles of BLN. No ecologically significant sites or NRI streams occur within that area.

Changes since the 1974 FES (TVA 1974a) concerning natural areas and the environmental impact on natural areas within 3 miles of BLN are assessed below for the purpose of updating previous documentation to current conditions.

Mud Creek State Wildlife Management Area (WMA), Bellefonte Island TVA Small Wild Area (SWA), Coon Gulf TVA SWA, and Section Bluff TVA SWA are the four natural areas currently listed in the TVA Natural Heritage database within 3 miles of BLN property

boundaries. Mud Creek State WMA and Bellefonte Island TVA SWA are within 1 mile of the BLN site. The remaining two areas are between 1 and 3 miles of BLN.

Mud Creek State WMA is located in Jackson County, Alabama, approximately 0.2 mile northeast of BLN property boundaries. Mud Creek WMA comprises approximately 8,273 acres owned by TVA and managed by ADCNR for waterfowl and small and big game hunting.

Bellefonte Island TVA SWA is located in Jackson County, Alabama, approximately 0.2 mile east of BLN property boundaries, within the midchannel of the Tennessee River between TRM 392.5 and TRM 394. Bellefonte Island TVA SWA comprises approximately 100 acres of property managed by TVA and features a naturally occurring stand of tupelo gum swamp that is suitable habitat for numerous species of waterfowl.

Coon Gulf TVA SWA is located in Jackson County, Alabama, approximately 1 mile northeast of BLN property boundaries. Coon Gulf TVA SWA comprises approximately 2,366 acres managed by TVA, features a forested cove on Guntersville Reservoir, and provides habitat for federally listed and state-listed species.

Section Bluff TVA SWA is located in Jackson County, Alabama, approximately 2.6 miles south of and across the river from BLN property boundaries. Section Bluff comprises approximately 600 acres managed by TVA and features extensive sandstone outcrops and mature hardwoods that provide habitat for federally listed and state-listed species.

3.8.1.2. Environmental Consequences

Alternative A

Under the No Action Alternative, no alterations or improvements would be made to existing facilities for the purpose of nuclear power generation. Therefore, no natural areas would be directly or indirectly affected, and no cumulative effects would result from adoption of this alternative.

Alternatives B and C

Under the Action Alternatives, improvements to existing facilities and continued operation of the plant would take place. Construction associated with completion of existing facilities would not directly or indirectly affect natural areas in the vicinity, because construction-related activities would be confined to land already previously altered due to the initial BLN construction. The distance between these areas and the BLN site provides ample buffer from any construction noise originating from the BLN site. Emissions of gaseous and particulate air pollutants from operation of combustion sources on site would result in small increases in air pollutant concentrations. However, the resulting concentrations of the pollutants in the vicinity would meet the ambient standards and would have no adverse effect on people or wildlife using these areas. In addition, previous studies conclude that small radioactive exposure relative to acceptable benchmarks, as would be the case under normal operating circumstances, are not expected to cause changes in terrestrial animal populations (IAEA 1992; DOE 1999). Therefore, potential for cumulative impacts to these areas resulting from the initial construction and long-term operation of either a single B&W unit or a single AP1000 unit are anticipated to be minor.

3.9. Recreation

3.9.1.1. Affected Environment

As documented in previous environmental assessments of the BLN site, the area within a 50-mile radius of BLN is well suited to a variety of outdoor recreation pursuits. There are several major parks and recreation resources within this region including Chattahoochee National Forest, Wheeler National Wildlife Refuge, Little River Canyon National Preserve, and several state parks. Guntersville Reservoir, which has 69,000 surface acres and approximately 80 developed public, commercial, or quasi-public recreation areas around its shoreline, is also one of the region's major recreation resources. The waters of this reservoir provide opportunities for a variety of recreation activities including power and nonpower boating, swimming, fishing, and waterfowl hunting. The surrounding shorelines offer accommodations for camping, hiking, hunting and wildlife observation, golfing, and vacationing.

While most of the recreation areas on Guntersville Reservoir, including major areas such as Lake Guntersville State Park, Buck's Pocket State Park, Goose Pond Colony, and most commercial recreation facilities, are more than 10 miles away from the BLN site, there are six areas within the 6-mile radius of the BLN. Figure 3-14 shows the location of these areas, as well as three additional reservoir recreation areas situated within 10 miles of the BLN site.

3.9.1.2. Environmental Consequences

Alternative A
Under this alternative, because no nuclear plant would be built or operated, no impact on recreational facilities or activities is anticipated.

Alternatives B and C
As indicated in earlier NEPA assessments (TVA 1974a; 2008a), plant construction and operation under either alternative would generate some noise and would also result in the removal and use of a small amount of water from Guntersville Reservoir.

As discussed in Section 3.12, some activities conducted during the construction of either of the alternatives would generate noise that could be an annoyance to recreationists and others in the vicinity of the plant site. Because such noise levels would occur over a short period of time, impacts on recreation would be negligible. Under either alternative, plant operation noise is expected to be attenuated to near ambient levels beyond the site boundary. Consequently, noise from plant operation would have a minor impact, and no mitigation would be required. No cumulative effects would be expected.

Plant water use would represent a minimal amount relative to total water flow in the waterways around BLN (Subsection 3.1.2). River level associated with consumptive water losses resulting from plant operations would not affect recreational boating in summer, when river use is at its highest, even during extreme low-flow conditions (TVA 2008a). Therefore, impacts on water-based recreation would be minor, and no mitigation would be required. No cumulative effects would be expected.

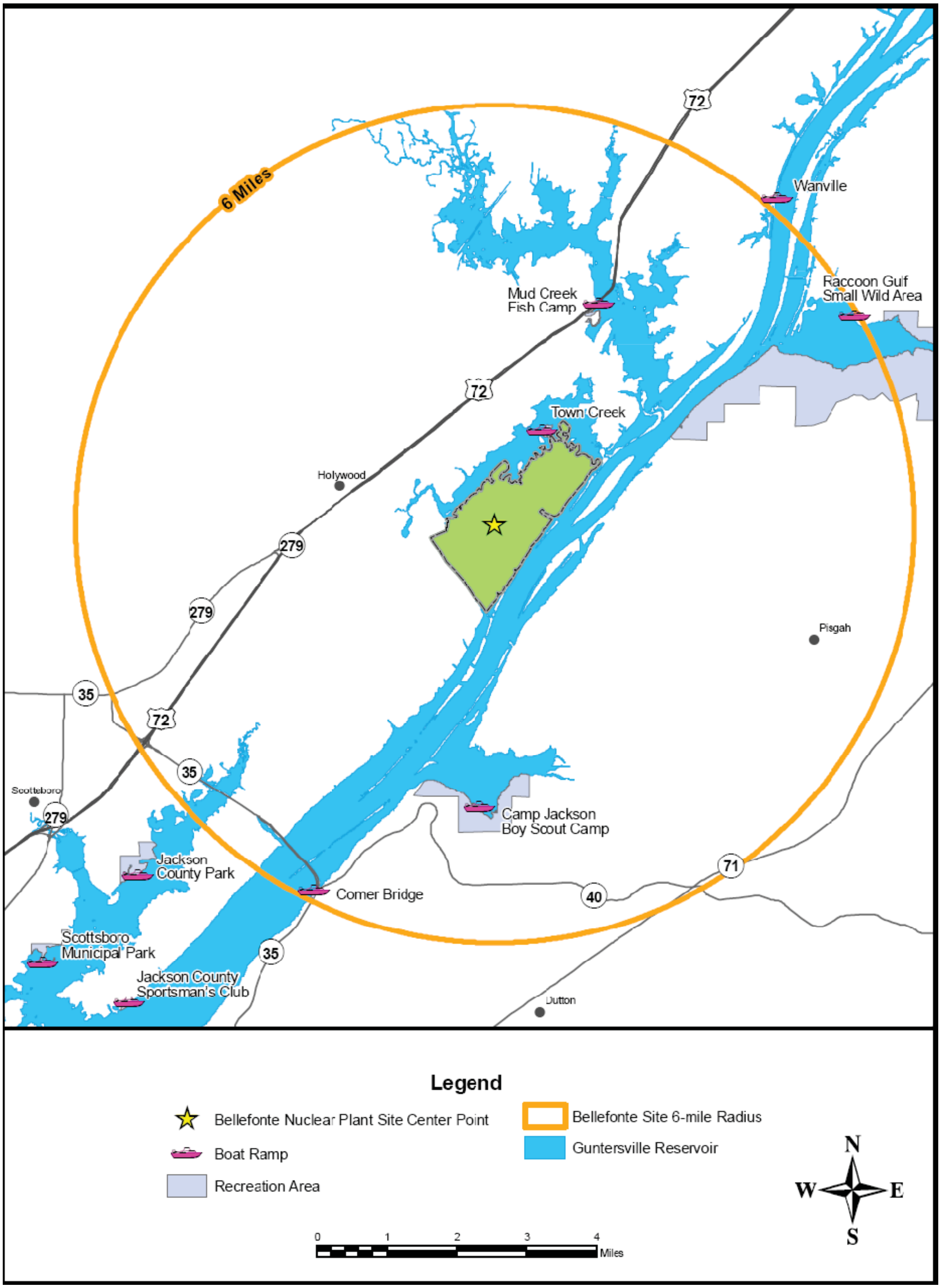


Figure 3-14. BLN Recreation Instream Use

3.10. Archaeological Resources and Historic Structures

3.10.1. Affected Environment

As noted in previous environmental reviews, the area surrounding the BLN property has been occupied by humans for more than 15,000 years. The archaeological record of the Tennessee River Valley has documented four major prehistoric occupational periods that began with the Paleo-Indian (14,000-8000 B.C.), the Archaic Period (8000-900 B.C.), the Woodland Period (900 B.C-A.D. 1100), and the Mississippian Culture (A.D. 1100-1630). Although the earliest European contact in the region severely impacted the Native American cultures, occupation by Cherokees continued through the early 19th century, when they were removed along the Trail of Tears. European settlers soon began to occupy the region, and Jackson County was established in 1819.

Previous undertakings associated with this area have documented the archaeology within the BLN site. A summary of these earlier investigations is included in the COLA ER. TVA determined the area of potential effects (APE), shown on Figure 2-1, for both Action Alternatives to be the approximate 606 acres surrounding the proposed construction and its associated infrastructure for archaeological resources and the 1-mile viewshed for historic structures, due to similarity of areas needed for construction and operation. This 606-acre APE is the same APE determined with concurrence of the Alabama SHPO for evaluating BLN 3&4. The archaeological APE is identified on Figure 2-1 (B&W site plan) and Figure 2-12 (AP1000 site plan) as "Bellefonte Project Area."

Previous archaeological surveys conducted within the archaeological APE identified four sites (1JA111, 1JA113, 1JA300, and 1JA301). Only two of these sites were recommended for additional archaeological investigations (1JA300 and 1JA301) (Oakley 1972). Excavations were conducted at site 1JA300 prior to construction of the original plant.

When TVA began developing a demonstration COLA for new nuclear generation at BLN, it was determined that a more systematic survey would be necessary to ensure that no historic properties (which includes prehistoric and historic sites, buildings, structures, and objects) would be affected. Two new surveys were subsequently conducted within the APE to identify archaeological sites or historic structures that may be impacted by this undertaking (Deter-Wolf 2007; Jenkins 2008).

Results of the new archaeological survey concluded that sites 1JA300 and 1JA301 were completely destroyed during construction of the intake. Site 1JA111 was determined to be potentially eligible for listing in the National Register of Historic Places (NRHP). One new site (1JA1103) was identified that was considered, along with 1JA113, to be ineligible for listing in the NRHP.

Five historic structures had been previously recorded within the visual APE for this project (Jenkins 2008). The new survey for historic structures conducted in 2008 revisited these sites and identified 10 new properties, for a total of 15 historic properties (Jenkins 2008). Only two of these properties (Bellefonte Cemetery and the African-American Bellefonte Cemetery) were determined to meet the criteria of eligibility for the NRHP. Both cemeteries are nearly 1 mile from the BLN cooling towers.

3.10.2. Environmental Consequences

Alternative A
The No Action Alternative would result in no new construction and therefore would have no effect on historic properties.

Alternative B
Site 1JA111 was identified within the archaeological APE and was recommended as potentially eligible for listing in the NRHP. TVA has determined that 1JA111 would be fenced off, marked on the BLN site drawings, and avoided by any future planned construction should Alternative B be selected. Any future modification to current project plans that have a potential to affect this site would require TVA to conduct further testing of 1JA111 to determine its NRHP-eligibility status.

Two historic resources eligible for listing in the NRHP were identified within the historic viewshed (visual APE) of the proposed construction site. The Bellefonte Cemetery and the African-American Bellefonte Cemetery are both protected by dense vegetative buffers and would not be affected by Alternative B.

With the avoidance of archaeological site 1JA111 and the presence of vegetative buffers surrounding the cemeteries, TVA has determined that Alternative B would have no direct or indirect effect on historic properties. In a letter dated September 9, 2009, the Alabama SHPO concurred with TVA's findings that proposed completion of the BLN site would have no effect on historic properties (see Appendix H). Because no effects are anticipated, there are no cumulative effects to historic properties from B&W completion and operation.

Alternative C
Effects to historic properties under Alternative C would be the same as those anticipated under Alternative B. Although the construction of a new reactor would result in slightly more ground disturbance than under Alternative B, the construction area was surveyed and no historic properties were identified within this area. As with Alternative B, 1JA111 would be fenced off, marked on the BLN site drawings, and avoided by any future planned construction. Any future modification to current project plans for a single AP1000 that would have a potential to affect this site would require TVA to conduct further testing of 1JA111 to determine its NRHP-eligibility status.

With the avoidance of archaeological site 1JA111 and the vegetative buffers surrounding the cemeteries, TVA has determined that the implementation of Alternative C would have no direct or indirect effect on historic properties. Because no effects are anticipated, there would be no cumulative effects to historic properties from AP1000 construction and operation. As with Alternative B, TVA consulted with the Alabama SHPO, who concurred with TVA's no effects finding in the September 9, 2009, letter (see Appendix H).

3.11. Visual Resources

3.11.1. Affected Environment

The BLN site is buffered from the main river channel by a wooded ridgeline that rises approximately 200 feet above the lake surface. Only distant views of the existing cooling towers are experienced by passing river traffic as a result of the close proximity of the ridgeline to the lake shoreline. The plant site is situated on level to gently rolling bottomland formerly used for agricultural purposes. Pasture and crop land still extend southwesterly

from the plant site toward Scottsboro, Alabama. Scattered residential development can be seen along county roads ranging from abandoned farmhouses to new subdivisions. The terrain is generally open with occasional stands of bottomland hardwoods dotted with patches of pine and cedar.

The existing plant site is most visible to more than 50 cabins, second homes, and primary residences located along the north shore of Town Creek embayment, an area known as Creeks Edge development (see Figure 3-15). The embayment, which bounds the west side of the BLN site, is only accessible to small boat traffic as passage is limited by a box culvert under the BLN site's secondary entrance road. Fishermen and pleasure boaters using other portions of Town Creek and Mud Creek to the northeast of BLN have direct views into the plant site.

The town of Hollywood is located approximately 3 miles to the northwest of BLN. Its location to the north of U.S. Highway 72 is screened somewhat from a view of the plant by Backbone Ridge.

The BLN site is seen most frequently by passing motorists from various points along U.S. Highway 72. The plant facilities such as roads, parking, and administration-type buildings are screened for the most part by low rolling terrain in the foreground. Distant views of the 474-foot cooling towers and the reactor domes can be seen in excess of 5 miles away. The cooling towers along with the multiple high-voltage transmission lines associated with the BLN site are the dominant man-made visual features in the surrounding landscape.

Sand Mountain stretches in either direction from the plant site as it forms the eastern shoreline of Guntersville Reservoir. While it is the most dominant natural feature in the landscape, it provides background to easterly views of BLN. Views of the existing plant facilities appear as focal points when one looks west off the rim of the mountain. No public viewing areas appear along the mountain's edge, but a few residences have spectacular views of the valley below. A different visual/aesthetic character of landscape can be experienced in the coves and hollows along the Sand Mountain rim. Laurel and rhododendron line the creeks that cascade over limestone creek beds on their descent to the Tennessee River. Distant glimpses of the plant site can be seen from these mountainside vantage points. Additional views can be seen by highway travelers traversing the mountain on Alabama State Routes 35 and 40, as well as by those crossing the lake on the Comer Bridge.

As described in Section 3.8, Natural Areas, Bellefonte Island and the Mud Creek State WMAs, adjacent to and just upstream of the BLN site also provide a visual quality protector to the scenic environment. A heron rookery can be seen by boaters at the tip of the peninsula between the Town and Mud creek's confluence with the Guntersville Reservoir. Coon Gulf TVA SWA, approximately 1.0 mile upstream on the opposite bank, also contributes to the visual quality. Section Bluff TVA SWA is approximately 2.5 miles downstream on the opposite bank.

In summary, the BLN site is located in a valley setting partially screened from the passing Tennessee River and overlooked by Sand Mountain. The existing plant facilities, in particular the cooling towers, and the associated transmission lines currently present the most noticeable visual/aesthetic change in character to an area generally within a 5- to 7-mile radius.

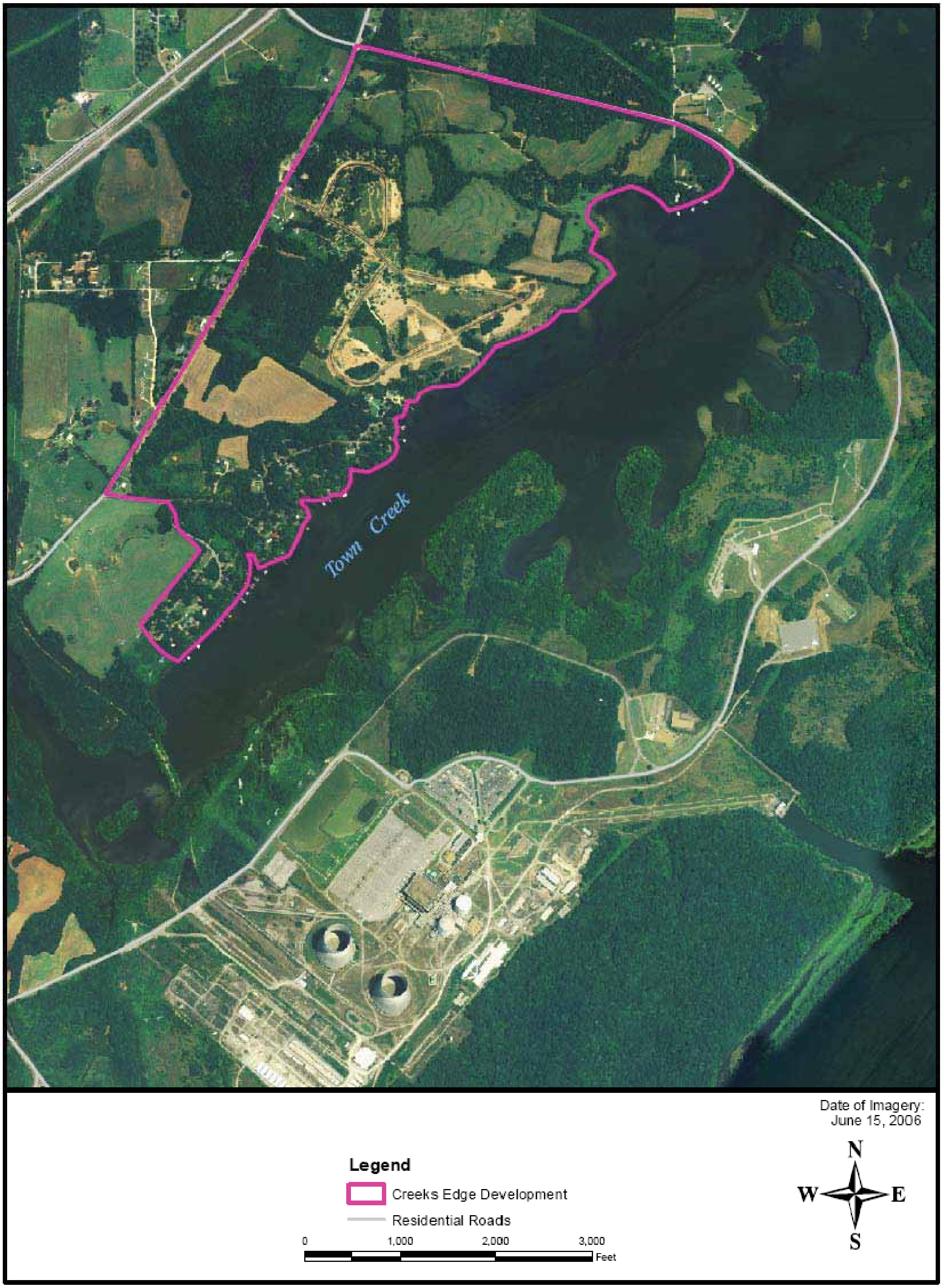


Figure 3-15. Creeks Edge Development Near BLN

3.11.2. Environmental Consequences

Alternative A
Under this alternative, TVA would not complete or operate one partially completed B&W unit or construct and operate an AP1000 unit. Visual resources would not be affected.

Alternative B
Under this alternative, TVA would refurbish the existing 161-kV and 500-kV switchyards, construct a new laydown area southwest of the existing BLN 1&2 cooling towers and reconfigure the northern parking areas. The new laydown area would be visually similar to the industrial buildings and storage yards in the area now. There would likely be associated support structures constructed throughout the plant site area. These support structures would add to the number of discordantly contrasting elements seen at the plant site, but would be visually insignificant in the industrial environment.

Visual impacts during construction would be minor and insignificant. Motorists along U.S. Highway 72 to the west would likely not have views of construction activities at the plant site. Residents along County Road 33 entering the plant site would notice a small increase in traffic for plant site deliveries and an increase in the number of employees and contractors entering and leaving the site. This would be temporary until construction activities are complete.

During operation of the B&W, residents along Town Creek and motorists along U.S. Highway 72 would notice a water vapor plume from one of the existing 474-foot cooling towers on the plant site. The visibility of the plume would vary with atmospheric conditions. The plume would be most discernible during the winter months following leaf drop and the differences between the temperature and humidity of the plume and ambient conditions are the greatest; under these conditions it can be visible for many miles in all directions. Plumes would be less visible during the summer months when temperature and humidity are higher, hazy conditions persist, and morning fog is more common. Visual presence of these fog/plume conditions would be similar to those currently associated with the operation of the Smurfit Stone Plant and WCF located upstream.

The new plume seen in the landscape would have a potential minor cumulative impact on visual resources. Increasing the number of adversely contrasting elements would contribute to reducing visual harmony and coherence of the rural landscape. The visual impact of incremental changes may not be individually significant, but when additions are seen in combination with similar existing features, the impact continues to grow. This would cause a cumulative minor change in the visible landscape and the aesthetic sense of place.

Alternative C
Under this alternative, visual impacts would be similar to those described for Alternative B. However, the AP1000 would require construction of a new turbine and reactor building on the north side of the existing employee and visitor parking lot. This structure would likely be visible to residents along Town Creek, and while it would add a new broadly horizontal element to the industrial landscape, the new structure would be visually similar to other structures seen on the plant site now. In addition, the overall plant arrangement for an AP1000 unit is designed to minimize the building volumes and quantities of bulk materials consistent with safety, operational, maintenance, and structural needs to provide an aesthetically pleasing effect. Natural features of the site would be preserved as much as possible and utilized to reduce the plant’s impact on the environment, and landscaping for

the site, areas adjacent to the structures, and the parking areas would blend with the natural surroundings to reduce visual impacts. Visual impacts would be minor.

3.12. Noise

3.12.1. Affected Environment

At high levels, noise can cause hearing loss and at moderate levels noise can interfere with communication, disrupt sleep, and cause stress. Even at relatively low levels, noise can cause annoyance. Noise is measured in decibels (dB), a logarithmic unit, so an increase of 3 dB is just noticeable and an increase of 10 dB is perceived as a doubling of sound level. Because not all noise frequencies are perceptible to the human ear, A-weighted decibels (dBA), which filters out sound in frequencies above and below human hearing, were used for this assessment. Ambient environmental noise is usually assessed using the day-night noise level (Ldn). The day-night noise level is a weighted logarithmic 24-hour average with a 10 dB penalty added to noise between 10 p.m. and 7 a.m. to account for the potential for sleep disruption.

Community noise impacts are typically judged based on the magnitude of the increase above existing background sound levels. There are no federal, state, or local industrial noise statutes for the communities surrounding the BLN site. EPA recommends an Ldn less than 55 dBA to protect the health and well-being of the public with an adequate margin of safety. The U.S. Department of Housing and Urban Development (HUD) considers areas with an upper limit Ldn of 65 dBA to be acceptable for residential development. In addition, the Federal Interagency Committee on Noise (1992) recommends that a 3 dB increase indicates a possible impact requiring further analysis when the existing Ldn is 65 dBA or less.

BLN is located in a rural area along the Tennessee River in northeast Alabama. The nearest residence, situated across Town Creek, is located 0.75 mile from the Unit 1 steam generators and 0.66 mile from the Unit 1 cooling tower. There are approximately 50 cabins, second homes, and primary residences located along the north shore of Town Creek embayment in the Creeks Edge development. The homes most likely to be impacted by noise are clustered in the southwestern portion of the development (see Figure 3-15).

Background ambient sound levels were measured in 2006 at BLN fenceline locations with values ranging from 47 to 55 dBA, which is typical of a rural community (TVA 2008a). Noise sources in the vicinity of the BLN site include barge traffic, road traffic, dogs barking, insects, power boats, plant equipment at BLN (fans, transformers, compressors), and power line hum.

3.12.2. Environmental Consequences

Alternative A

Because there would be no construction/completion and operation of a nuclear plant, implementation of this alternative would have no impact on noise levels near BLN.

Alternative B

During completion of a B&W unit, the largest source of noise would be the hydrodemolition to access the steam generators. Hydrodemolition can be very loud, with noise levels often exceeding 110 dBA. However, all hydrodemolition work would be done inside the containment walls, which would greatly decrease the potential for off-site impacts.

Hydrodemolition would take place 24 hours a day, seven days a week, for up to 12 days. While limiting most of the construction activities to daytime hours can reduce potential noise impacts, hydrodemolition would not be limited to daylight hours. Any noise impacts of hydrodemolition at nearby residences would be temporary and would last for no more than 12 days.

Other phases of construction would require the use of cranes, forklifts, man lifts, compressors, backhoes, dump trucks, and pier driller and portable welding machines. This type of equipment would generate noise levels up to 91 dB at 50 feet (EPA 1971). Construction noise of 91 dBA at 50 feet would be about 56 dBA at the nearest residence approximately 0.75 mile away. Most construction activites would be limited to daylight hours and would not exceed either EPA's recommendation or HUD's guideline for residential areas. Noise from construction equipment is expected to be audible over background noise levels, but it is not expected to cause a significant adverse impact. Based on the projected noise levels and the duration of construction activities, noise impacts from construction activities associated with Alternative B are expected to be minor for the surrounding communities, and minor to moderate for the nearest residents of Creeks Edge development (Figure 3-15).

The major noise source in the operation of a B&W unit is the cooling tower. Noise from the cooling tower is expected to be 85 dBA near the tower and approximately 55 dBA 1,000 feet from the tower. At the nearest residence, noise from the cooling tower is expected to be approximately 48 dBA, which is similar to background noise levels in the area. Considering that the cooling towers would operate 24 hours per day when the plant is in operation, the Ldn at the nearest residence would be 54.6 dBA, which is an increase of 1.8 dBA over background levels. If the cooling tower were operated less frequently, the increase in noise levels would be even less. These levels would not exceed EPA's recommendation or HUD's guideline for residential areas. Based on the projected noise levels, noise impacts associated with operation of a B&W unit are expected to be minor, for both the surrounding communities and for the nearest residents of Creeks Edge development.

Alternative C

As shown in Figure 2-12, construction of an AP1000 would be slightly closer to the nearest residences across Town Creek. Most activities necessary to construct an AP1000 unit would be similar to those implemented under Alternative B and would have similar impacts on noise levels in the vicinity of BLN. Although no hydrodemolition work on the steam generator would be necessary under this alternative, site preparation for the construction of an AP1000 unit would require blasting, which would cause temporary noise impacts. Peak instantaneous A-weighted noise levels from blasting are predicted to be 75 dBA at the source and approximately 40 dBA at the nearest residence. Blasting is expected to occur intermittently over the course of one year, though there would likely be several weeks when blasting would occur daily. When blasting does occur, there would likely be two or three detonations per day, each lasting less than one second. Potential mitigation measures include, but are not limited to, the use of blasting blankets, notification of the surrounding receptors prior to blasting, and limiting blasting activities to daylight hours. Based on the projected noise levels and the duration of construction activities, noise impacts from construction activities associated with Alternative C are expected to be minor for the surrounding communities and minor to moderate for the nearest residents of Creeks Edge development.

The major noise source in the operation of an AP1000 is the cooling tower and the impacts of operation of an AP1000 unit on noise levels in the vicinity of BLN are identical to the impacts anticipated under Alternative B. Based on the projected noise levels, noise impacts from the operation of Alternative C are expected to be minor for both the surrounding communities and for the nearest residents of Creeks Edge development.

3.13. Socioeconomics

The direct and indirect effects of 10 aspects of the socioeconomic environment are described in the following subsections. Environmental consequences are described for both construction and operation. The cumulative effects on socioeconomics of TVA's proposed action in concert with other past, present, and future projects known from a 50-mile radius around the BLN site are included in Subsection 3.13.11

3.13.1. Population

3.13.1.1. Affected Environment

The BLN site is located in Jackson County, Alabama, in the northeast corner of the state (Figure 1-1). Population of the area was described in TVA's 1974 FES, Section 1.2; the 1999 CLWR FEIS, Subsection 4.2.3.8; and the 1997 BLN Fossil Conversion FEIS, Subsection 3.1.12.1. Since that time, the population of the county has increased.

The 2000 Census of Population count for Jackson County was 53,926 (Census 2000a). Population and demographic characteristics were discussed in the COLA ER, Subsection 2.5.1. Population was estimated from the proposed reactor location. The basic geographic unit was block groups; as necessary, individual blocks were used to divide block groups that crossed the 5-mile boundary. As cited, the U.S. Census of Population, 2000, SF1 was used. Estimated population by direction and distance from the site are provided in COLA ER, Figures 2.5-2 and 2.5-3. These include 16 compass directions with concentric circles at 2, 4, 6, 8, 10, 16, 40, 60, and 80 kilometers.

The U.S. Census Bureau estimate for 2009 shows a small decline in population to 52,838 (Census 2009). The estimated population living within 10 miles of the site is approximately 25,500; of these, about 4,600 live within 5 miles. Except for a small area in DeKalb County, southeast of the site, all of the area within 10 miles of the BLN site is in Jackson County.

Scottsboro, Alabama, is the principal economic center closest to the site. The closest incorporated place is Hollywood, a small town of slightly fewer than 1,000 residents.

In addition to the residential population surrounding the site, there are substantial transient populations within 50 miles of the site due to the following major nearby attractions: Lake Guntersville Park; a campground that can host as many as about 650 campers daily; the Unclaimed Baggage Center in Scottsboro, with over a million visitors per year; and the Goose Pond Colony Golf Course, the second-largest attractor of transient population in the area with more than 100,000 visitors per year. Transient populations are discussed in detail in the COLA ER, Subsection 2.5.1.3.

3.13.1.2. Environmental Consequences

Alternative A
Under Alternative A, the No Action Alternative, no completion or construction and operation of a plant would occur, and therefore there would be no impacts from construction or operation.

Alternatives B and C
Completion of Alternative B is expected to take about 4.7 years (56 months), with a peak on-site workforce of approximately 3,000. About 1,900 of these would be construction employees, and the remainder (approximately 1,100) would be engineering operations, testing, and security workforce. If Alternative C were selected, construction is expected to take about 6.5 years (two years site preparation and 54 months construction), with a peak on-site workforce of approximately 3,000. About 2,200 of these would be construction workers, and the remainder (approximately 800) would be engineering operations, testing, and security workforce. Impacts from a temporary increase in population due to construction are discussed in TVA's 1974 FES, Section 2.8; the CLWR FEIS, Subsection 5.2.3.8; and the BLN Conversion FEIS, Subsection 4.2.12.1. Under either Alternative B or Alternative C, according to Subsection 4.4.2.1 of the COLA ER, construction-phase workers and their families would represent a small percentage of the existing county population, and the impact of in-migration is anticipated to be small. The impacts to the communities within the 6-mile vicinity (Scottsboro, and the area along its major transportation routes) are expected to be moderate.

During operation, under Alternative B, the BLN site is expected to employ approximately 800 operations workers at the new unit. Under Alternative C, operations employment is expected to be approximately 650. However, some of those would already be working at the site during construction. Therefore, not all operations workers would be additions to the local population after completion of the construction phase. The impacts of plant operation would be similar to those discussed in the CLWR FEIS (Subsection 5.2.3.8) and probably somewhat greater than those anticipated in the Bellefonte Conversion FEIS (Subsection 4.2.12.2) or the 1974 FES (Section 2.8). Under either Alternative B or Alternative C, the impacts are expected to be minor, similar to those discussed in the COLA ER, Subsection 5.8.2.1., where the percent of increase in population is below 1 percent for Jackson County. Because a number of operations workers (including security personnel) would have moved into the area during the construction phase, the remaining operations workers would represent a very small long-term increase in the existing population. Within the communities in the 6-mile vicinity, the influx of operations workers during scheduled outages helps reduce the effect of population decline caused by the departure of construction workers. Impacts under Alternative C would be slightly less than under Alternative B, because operations employment would be lower for the AP1000.

3.13.2. Employment and Income

3.13.2.1. Affected Environment

Employment and income in the area were not discussed in TVA's 1974 FES. They were discussed in the 1997 BLN Conversion FEIS, Subsection 3.1.12.2, and in the 1999 CLWR FEIS, Subsection 4.2.3.8. Employment and income in Jackson County have increased since these earlier studies were prepared (U.S. Department of Commerce, Bureau of Economic Analysis [BEA] 2010a). In 2008, total employment in Jackson County averaged 25,841, compared to 25,999 in 2007 (BEA 2010b). However in 2009, the county

unemployment rate rose to 11.7 percent, more than double the 5.7 percent rate in 2008 (Alabama Department of Industrial Relations 2010), and more than the Alabama rate of 10.1 and the U.S. rate of 9.3 percent (U.S. Department of Labor, Bureau of Labor Statistics 2010). Per capita personal income in Jackson County in 2008 averaged $28,842, about 86 percent of the state average and 72 percent of the national average (BEA 2010c) (see Table 3-10).

In Jackson County, the largest employer is the manufacturing sector with 22.8 percent of total jobs (Table 3-10), followed by government (16.9 percent) and retail trade (12.5 percent). Farming, manufacturing, retail trade, and government account for a greater share of employment in Jackson County than they do at either the state or national level (see Table 3-10). The private service sector accounts for a smaller share. While the production of textile products dominates, other industries in Jackson County include paper products, machinery, and furniture and related products. Industries based in the town of Hollywood include structural steel fabrication, sheet metal works, automotive interior carpeting, and specialty signs. Both employment and income are discussed in the COLA ER, Subsection 2.5.2.1.

Table 3-10. Employment and Income in 2008

Category	Percent by Region		
	Jackson County	Alabama	United States
Farming	5.7	1.9	1.5
Mining	0.4	0.4	0.6
Construction	6.4	6.9	6.1
Manufacturing	22.8	11.1	7.8
Wholesale Trade	3.1	3.4	3.6
Retail Trade	12.5	11.0	10.4
Finance, Insurance, and Real Estate	4.6	7.7	9.6
Government	16.9	15.6	13.5
Other	27.5	42.0	46.9
Total Employment	25,841	2,640,717	181,755,100
Per Capita Personal Income	$28,842	$33,655	$40,166

Source: BEA 2010c

The manufacturing sector accounts for about 29 percent of total earnings in the county, considerably more than in the state as a whole (15 percent) and the nation (11 percent). Farm earnings accounted for almost 5 percent of total earnings in the county, compared to less than 1 percent in the state and less than 1 percent in the nation. (BEA 2010c)

3.13.2.2. Environmental Consequences

Alternative A

Under Alternative A, the No Action Alternative, no completion or construction and operation of a new plant would occur, and therefore there would be no impacts.

Alternatives B and C

Employment and income impacts of the employment increases are discussed in TVA's 1974 FES, Section 2.8; the CLWR FEIS, Subsection 5.2.3.8; and the Bellefonte Conversion

FEIS, Subsection 4.2.12. Under either Alternative B or Alternative C, the increase in employment for completion or construction of a single nuclear unit at BLN could result in creation of some new temporary secondary jobs, especially during and near peak employment. Many of these jobs would be temporary in nature, and the number of such jobs would vary depending on the level of employment. These impacts would be beneficial. Impacts from Alternative B are expected to be similar to, but somewhat smaller than, those discussed for the AP1000 in the COLA ER, Subsection 4.4.2.2. For both Action Alternatives, these beneficial impacts are considered to be moderate to significant in the county and minor regionally.

Impacts on employment and income in Jackson County were assessed using the BEA, Economics and Statistics Division's multipliers for industry jobs, earnings, and expenditures. The economic model is called regional input-output modeling system (RIMS II) and incorporates buying and selling linkages among regional industries creating multipliers for both jobs and monetary expenditures. The multiplier from RIMS II analysis for construction jobs is 1.4218. Thus, for every newly created construction job, an estimated additional 0.422 jobs are created in the region. The RIMS II (utilities) multiplier for operations jobs is 1.759. Thus, for every operations job, an estimated additional 0.759 jobs are created in the region. Operations jobs occur as the construction jobs approach the end of the construction phase, with some overlap.

Expenditures within the region for goods and services during construction of the BLN site would also have a small beneficial impact on income in the region under either Alternative B or Alternative C. This increase could be noticeable in the local area, especially for establishments providing frequently purchased items such as food, and would be considered moderate and beneficial.

Operation of the plant would result in creation of permanent jobs from the hiring of employees to supervise, operate, and maintain the plant. Impacts from the presence of operations employees are discussed in the TVA 1974 FEIS, Section 2.8; however, the expected number of employees estimated for that project was well below the approximately 800 (for Alternative B) or 650 (for Alternative C) workers that are currently anticipated during operation. The impacts likely would be more similar to the operations impacts discussed in the CLWR FEIS, Subsection 5.2.3.8, and similar to the upper end of the range discussed in the BLN Conversion FEIS, Subsection 4.2.12.2. The impacts should also be less than those discussed in the COLA ER, Subsection 5.8.2.2, because the employment level would be about 15 percent lower under Alternative B and 35 percent lower under Alternative C. The impacts would generally be beneficial, resulting in a small increase in the average income in the county, small increases in sales at retail and service establishments, and a temporary increase in home sales or rentals. These impacts could lead to some additional hiring, particularly at retail and service establishments, causing a small decrease in unemployment. Overall impacts on employment and income are expected to be small and beneficial in the region and moderate and beneficial in the county.

3.13.3. Low-Income and Minority Populations

3.13.3.1. Affected Environment

The minority population in Jackson County as of the 2000 Census was 8.8 percent of the total Jackson County population, well below the state average of 29.7 percent and the national average of 30.9 percent. The BLN site is located in Census Tract 9509, Block

Group 1. This block group had a minority population of 15.0 percent in 2000, higher than the county average but still well below the state and national averages (Census 2000b).

An in-depth analysis of the low-income and minority populations was conducted in 2008 in response to NRC sufficiency review comments on the COLA ER. In a letter to the NRC dated May 2, 2008, TVA responded and referred the reviewers to a paper titled “Bellefonte Nuclear Plant Environmental Justice Impact Assessment Methodology and Findings,” dated April 2008 (TVA 2008f). That paper further discussed the methodology used to identify low-income and minority populations located on or near the BLN site, identified the agencies and other parties contacted to assist in identifying these populations, and provided an explanation of the environmental justice impacts assessments. The paper describes the method of assessment used to analyze possible pathways or vulnerabilities pertaining to the identified minority and low-income census blocks and block groups, and it includes two tables, one for construction and one for operation, which summarize impacts described in the ER that could potentially be associated with environmental justice. Each impact includes an assessment of potential pathways between the impact and the identified low-income or minority census block and block groups. The analysis results, which include degree and significance, are recorded in the “EJ Impact'” column of the tables.

In its May 2, 2008, letter, TVA noted that the BLN population analysis for the COLA ER was performed using the current decade U.S. Census Bureau data (2000 data) in conformance with NUREG-1555 guidance, and guidance provided by the Council on Environmental Quality. Eight years had passed since the 2000 Census, and TVA acknowledged that a substantial increase in area Hispanic population may have occurred, as noted by the NRC reviewers. However, given the qualitative nature of the available information about this increase, it was not incorporated into the statistical population analysis conducted for the COLA ER in conformance with NUREG-1555 guidance.

However, as discussed in the 2008 paper (TVA 2008f), during the development of the COLA ER, various organizations were contacted to help locate and assess uniquely vulnerable minority and low-income populations that do not rely on the mainstream economy for all of their income and can be more difficult to find. In addition, local and county services and resources were contacted because managers of these services and resources are closest to the communities and may have knowledge about cultural practices that help identify these populations in ways that federal databases and current literature do not. Research was further extended to contacting local sporting goods and bait and tackle shops in an effort to help identify low-income or subsistence populations that historically obtain or supplement their food supply through hunting and fishing.

Based on the demographic and environmental justice analyses set forth above, TVA is not aware of any subsistence resource dependencies, practices, or other circumstances that could result in disproportionate impacts to minority or low-income populations. Specifically, TVA identified no low-income populations within 2 miles of the BLN center point where potential plant-related impacts would be expected to be most significant. Four minority census blocks located within 2 miles of the BLN site center point were identified in COLA ER, (Figures 2.5-9 through 2.5-26). Subsection 2.5.4.3 of the COLA ER describes these census blocks and their demography. In brief, the sizes of populations in the census blocks are equivalent to single families, and each of these identified blocks are dispersed within a collection of nonminority census blocks.

As reflected in COLA ER, Figures 2.5-27 and 2.5-28, low-income populations identified within the BLN 50-mile region are located primarily within urban areas, where subsistence dependence on natural resources (e.g., fish, game, agricultural products, and natural water sources) is difficult to identify or quantify. To the extent that fishing, hunting, or gardening occur in the BLN vicinity or region, it is difficult to differentiate between those activities that are recreational in nature, as opposed to those that are subsistence practices. No quantifiable data have been identified that associates subsistence practices with any TVA-identified minority or low-income groups.

Estimates of minority population in 2008 indicate an increase in the national minority share to 34.4 percent, the state share to 31.6 percent, and the county share to 9.7 percent (Census 2008a). Estimates are not available for smaller areas. However, it is highly likely that any local increase would still result in the block group share remaining below the state and national averages. Should the number of blocks containing minorities increase, there is no evidence suggesting that this distribution trend would be any different from what was found with the 2000 Census.

The latest estimates for number of persons below poverty level indicate that in 2008, 13.2 percent of the population was below the poverty level nationally, compared to 15.9 percent in the state of Alabama and 16.9 percent in Jackson County (Census 2008b). These estimates are not available for smaller areas. However, the 2000 Census showed a poverty level in Census Tract 9509, Block Group 1, of 3.4 percent. This was below the 5.1 percent level in Census Tract 9509 and well below the 13.7 percent level in Jackson County, the 16.1 percent in Alabama, and the 12.4 percent nationally (Census 2000c). As described in Subsection 4.4.3 of the COLA ER, the nearest low-income population is in Scottsboro, 6 miles away from the BLN site.

3.13.3.2. Environmental Consequences

Alternative A

Under Alternative A, the No Action Alternative, no completion or construction and operation of a plant would occur, and therefore there would be no impacts from construction or operation.

Alternatives B and C

Environmental justice impacts were not evaluated in TVA's 1974 FES. However, they were evaluated in the BLN Conversion EIS, Section 4.9, and in the CLWR FEIS, Subsection 5.2.3.10, and in Appendix G. The COLA ER evaluated potential environmental justice impacts from construction in Subsection 4.4.3. It was determined that socioeconomic impacts other than transportation, housing, and education would be small, and due to the spatial distribution of minorities and low-income population in the region, the potential for disproportionate socioeconomic impacts in these categories on minority and low-income populations would be small. Transportation, housing, and education were identified as the socioeconomic impact categories with the greatest potential to affect minorities and low-income populations disproportionately during construction.

Although there are two minority populations identified on the opposite side of Town Creek, none are located adjacent to site access roads. Thus, the minority populations are not expected to be impacted adversely by the construction traffic. The May 2, 2008, environmental justice impact assessment paper (TVA 2008f) identified one pathway that showed a potential relationship between housing costs during construction and the

identified low-income block groups. Subsection 4.4.3.2 of the COLA ER described the potential housing impact on low-income populations from construction. The COLA ER determined that because available housing in the vicinity is limited, there is a potential for increased demand from the influx of plant construction workers to result in rental rate and housing cost increases. Any such increases would affect the low-income population in the vicinity disproportionately to higher income groups, which could better absorb the increased costs. However, with mitigation measures, such as those described in the COLA ER, Subsection 4.4.2.4, and Subsection 3.13.4.2 of this SEIS, this impact could be reduced to small to moderate. TVA would review the availability of housing prior to the construction phase to assess the need for mitigation.

During construction, the impacts on the local education system are expected to be moderate to large, but the effects are also expected to be temporary. Because education impacts would affect every school in Jackson County, there would be no disproportionate impact on minority or low-income populations.

Beneficial socioeconomic impacts from construction of a nuclear unit at the BLN site were described in the COLA ER, Subsection 4.4.2. They are principally applicable to the counties in the region and include increased employment opportunities, potentially greater income, both directly and indirectly related to plant construction. These beneficial impacts also would be realized by minority and low-income populations and would not be disproportionate to minority and low-income populations in the vicinity and region.

Environmental justice impacts from operation were not evaluated in TVA's 1974 FES but were evaluated in the BLN Conversion EIS, Section 4.9, and in the CLWR FEIS, Subsection 5.2.3.10, and in Appendix G. The COLA ER evaluated operational and socioeconomic impacts on low-income and minority populations in Subsection 5.8.3 and concluded that, overall, impacts would be minor, and given the distribution of minority and low-income populations, the potential for disproportionate impacts to those populations would be small.

TVA did not identify any location-dependent, disproportionate high and adverse impacts to minority and low-income populations. Overall, socioeconomic impacts other than education impacts would be minor, and given the distribution of minority and low-income populations, the potential for disproportionate impacts to those populations would be small. Based on the analysis in the COLA ER, Subsection 2.5.4, no significant natural resource dependencies in any population were identified in the 50-mile region.

Beneficial impacts from the operation of a nuclear unit at the BLN site to the surrounding vicinity and region include the addition of new jobs, revenues paid by TVA, and taxes paid by BLN workers, which in turn benefit local public services and the local education systems. These beneficial impacts also would be realized by minority and low-income populations, and would not be disproportionate to minority and low-income populations in the vicinity and region.

3.13.4. Housing

3.13.4.1. Affected Environment

Housing is discussed in TVA's 1974 FES, Section 2.8. It also is discussed in the CLWR FEIS, Subsection 4.2.3.8, and in the BLN Conversion FEIS, Subsection 3.1.12. Based on prior TVA evaluations, no more than half of the BLN construction workers are expected to

need housing in the area (TVA 1985a; 2008a). For most movers, Jackson County is expected to be the preferred location if accommodations are available, for both construction and operations workers. As of the 2000 Census, Jackson County had 2,553 vacant housing units, with 894 housing units available, either for sale or for rent (Census 2000d). Temporary housing is also available at local hotels/motels in the Scottsboro area, and other temporary housing is available at local campgrounds and recreational vehicle (RV) parks. The Census Bureau 2006-2008 estimates indicate 3,831 housing units are available in Jackson County, but the estimate does not provide the percent available for rent or sale (Census 2010). As described in Subsection 4.4.2.4 of the COLA ER, as of July 2008, there were approximately 330 hotel guest rooms. However, the addition of two recently opened hotels in Scottsboro brings the total number of guest rooms to approximately 470. There are also 320 campsites in Jackson County. Housing is discussed in greater detail in the COLA ER, Subsection 2.5.2.6.

As described in the COLA ER, the real estate market in Jackson County, Alabama, remained fairly steady between 2000 and 2007, and in April 2008, 141 houses in Jackson County were listed by realtors. Approximately 12 properties were available near the Mud Creek embayment, and the Creeks Edge development had 73 lots available for purchase. A new subdivision called Riverside, located in Scottsboro, was in the first phase of development, with 45 lots available. Riverside is a 200-acre planned residential development with many amenities, and seven phases of development are planned.

In addition, the COLA ER identified Goose Pond Island as a lake community (housing development) on the northern end of the 2,700-acre wooded island in the Tennessee River at Scottsboro, with more than 250 home sites. More than 75 percent of the home sites are sold. The City of Scottsboro still owns the remaining 1,500 acres on the island and plans to develop the acreage as a complement to the housing on the north side of the island.

3.13.4.2. Environmental Consequences

Alternative A
Under the No Action Alternative, there would be no construction and no new plant and, therefore, no impacts.

Alternatives B and C
During construction under either Alternative B or C, the majority of the BLN employees are expected to live in Jackson County. Workers who do not find acceptable facilities in Jackson County would likely locate to the west in Madison County, south or east in Marshall or DeKalb counties, or to the north in Tennessee. Impacts of in-migration are discussed in TVA's 1974 FES, Section 2.8, and have been updated in the BLN Conversion FEIS, Subsection 4.2.12.1; the CLWR FEIS, Subsection 5.2.3.8; and Subsection 4.4.2.4 of the COLA ER. The impacts of Alternative B or C are expected to be similar to those described in the COLA ER, Subsection 4.4.2.4. That analysis concluded that the impacts in Jackson County are expected to be moderate to large, but that mitigation could reduce these impacts to a small to moderate range. If either Action Alternative were implemented, TVA would review the availability of housing prior to the construction phase to assess the need for mitigation, which could include housing assistance for employees, transportation assistance for commuting employees, or remote parking areas with shuttles. No known changes in the amount of available housing or expectations of in-migration would lead TVA to modify this conclusion under either Alternative B or Alternative C.

Housing impacts during operations are discussed in TVA's 1974 FES, Section 2.8. They are also discussed in the BLN Conversion FEIS, Subsection 4.2.12.2, and in the CLWR FEIS, Subsection 5.2.3.8. The impacts of either proposed action are expected to be similar to those discussed in the COLA ER, Subsection 5.8.2.3.2, where a number of operations workers moving into Jackson County were accounted for during the construction phase. Based on availability of housing units and rental units in Jackson County in relation to the number of remaining operations workers expected to arrive after construction, the analysis concludes that the impact on housing would be minor and insignificant in the 50-mile region and in the county. There are no known changes that would modify this conclusion under either Alternative B or Alternative C.

3.13.5. Water Supply and Wastewater

3.13.5.1. Affected Environment

There are several water systems in Jackson County, including the Scottsboro Municipal Water System, the Stevenson Water System, the Bridgeport Water System, and the Section/Dutton Water System. Wastewater is treated by a combination of wastewater treatment facilities and septic tanks. Industrial and public water supply, but not wastewater, was discussed in TVA's 1974 FES, Section 1.2. Water supply and quality were also discussed in the CLWR FEIS in Subsection 4.2.3.4. Water supply and usage, but not wastewater, were described in the BLN Conversion FEIS (Subsections 3.1.6 and 3.1.8). Water supply and wastewater treatment are also described in the COLA ER, Subsections 2.3.2 and 2.5.2.7.1. Subsection 3.1.2 of this SEIS updates the surface water use and trends for the Guntersville watershed. Table 3-2 identifies the water users, the supply source, and water demands in 2005 and projections for 2030. The COLA ER, Subsection 4.2.1.3, provides a discussion on the supply of water for construction activities, such as concrete batching and dust suppression.

Potable water at the BLN site is currently supplied by the Jackson County Water Authority. Wastewater (sanitary waste) treatment is currently provided by the Jackson County Water Authority at the County Road 33 wastewater treatment plant. This plant has a capacity of 125,000 gallons per day (Robert Hill, Jackson County Water Authority, personal communication, January 2010). Under normal conditions, the County Road 33 plant treats approximately 30,000 gallons per day.

During construction of either a B&W or an AP1000 unit, the construction field workforce would use portable toilets, which would be supplied by vendors licensed by the Alabama Onsite Wastewater Board. There would be no sanitary system discharge from the portable toilets at the construction site into the effluent stream. Sanitary waste from the construction administration and office buildings (used by plant personnel) would be routed to the County Road 33 treatment plant. As construction is completed, sanitary waste from new buildings, such as the maintenance building, would also be routed to the County Road 33 treatment plant.

During operation of either Alternative B or C, potable water would be supplied by the Jackson County Water Authority, which receives 100 percent of its water supply from the Scottsboro Municipal Water System (TVA 2008a). Sanitary waste treatment would be supplied by the Jackson County Water Authority, using the County Road 33 treatment plant. Plant staff for one unit would contribute an additional approximate 40,000 gallons per day to the County Road 33 wastewater treatment plant's daily load. Even with some local

growth, the County Road 33 treatment plant should have adequate capacity to handle the increase from TVA's operations workforce.

Currently, Jackson County Water Authority reports water infiltration problems at the County Road 33 wastewater treatment plant during wet weather. The county reported it will repair this problem in the near future. Should capacity at the County Road 33 plant become an issue prior to BLN operation, TVA has the option of connecting to the Scottsboro Wastewater Treatment Facility. As described in Subsection 2.5.2.7.1 of the COLA ER, the Scottsboro Wastewater Treatment Facility has a maximum capacity of 5 MGD and is currently operating at approximately 4 MGD. The facility is permitted for up to 15 MGD, but there are no current plans to expand the facility.

3.13.5.2. Environmental Consequences

Alternative A
Under the No Action Alternative, because no construction would occur and there would be no new plant, there would be no impacts to the supply of water or management of wastewater.

Alternatives B and C
Water supply and wastewater impacts were not explicitly addressed in TVA's 1974 FES, except for a commitment to handle on-site sewage properly (Subsection 2.7.1.4). These issues are addressed in the BLN Conversion FEIS (Subsection 4.2.6) and in the CLWR FEIS (Subsection 5.2.3.4). For completion of a single BLN unit, these impacts are expected to be similar to those discussed in the COLA ER, Subsection 4.4.2.3. No concerns were identified with water supplies, as county water systems and wastewater treatment facilities are generally not operating at or near capacity. Local communities are adequately served by the existing water supplies, and there are no plans, or needs, to expand. Therefore, impacts to water supplies and wastewater treatment would be insignificant in the county and in the region under either Alternative B or Alternative C.

Impacts from operation are briefly addressed in the BLN Conversion FEIS (Subsection 4.2.6.2). However, the COLA ER addresses operations impacts to these services in Subsection 5.8.2.3.1. No concerns were identified. As discussed in the COLA ER, existing systems are expected to be adequate to handle the increased need resulting from operation of the plant. Therefore, impacts to water suppliers would be minor in the county and in the region under either Alternative B or Alternative C.

3.13.6. Police, Fire, and Medical Services

3.13.6.1. Affected Environment

Jackson County, as of February 2010, has a total of 102 sworn officers and approximately 500 firefighters (K. Stapleton, Enercon, personal communications, February 2010). Local police and fire protection are currently considered adequate, but future expansion and facility upgrades may be needed to accommodate future population growth.

In addition to the Jackson County Sheriff's Department (38 officers), there are seven local police departments in the county. These seven departments have the following number of law enforcement officers: Hollywood (2), Scottsboro (47), Section (1), Woodville (1), Skyline (1), Stevenson (5), and Bridgeport (7), with jurisdiction within and around their

respective city/town limits. Scottsboro city jurisdiction extends 3 miles beyond the city limits. (K. Stapleton, Enercon, personal communications, February 2010)

There are 25 fire departments in the county and 31 fire stations (includes Scottsboro's three stations). There are 38 paid firefighters and approximately 480 volunteer firefighters (no less than 10 per station). Fire departments receive grant money from the county and forestry commission, so each station must maintain no less than 10 firefighters, but each usually has approximately 13 volunteer firefighters. Some communities may have as many as 30 volunteers. (K. Stapleton, Enercon, personal communications, February 2010)

The Hollywood Fire Department would be the first responder for the BLN site (see COLA ER Subsection 2.5.2.7.2.), and the department is a volunteer fire department with 12 firefighters, one brush truck, three pumper trucks, and two response vehicles (one medical and one with overall supplies). Hollywood has two fire stations. The closest station is located at the municipal building on U.S. Highway 72 west of the intersection of U.S. Highway 72 and County Road 33, approximately 2 miles measured in a straight line from the BLN site. The second fire station is located in downtown Hollywood, east of the intersection of County Road 33 and Rail Road Street, approximately 3 miles measured in a straight line from the BLN site. Three other municipalities in Jackson County provide firefighters: Scottsboro (36 paid firefighters); Bridgeport (19 volunteer firefighters, and a paid fire chief and deputy fire chief); and Stevenson (10 volunteer firefighters) (K. Stapleton, Enercon, personal communications, February 2010). The balance of firefighters are volunteers, as noted above.

The single hospital in Jackson County, Highlands Medical Center, is located in Scottsboro. The center currently has 39 doctors and employs approximately 700 staff, (including nursing home and part-time). Approximately 95 beds are currently occupied, but the center is licensed for 170 beds (K. Stapleton, Enercon, personal communication, February 2010). The center also operates Highlands Health & Rehab, a 50-bed short-term rehabilitation and long-term nursing home facility (Highlands Medical Center 2010). The Jackson County Health Department provides general medical services for approximately 6,100 individuals per year as discussed in the COLA ER Subsection 2.5.2.7.2.

Police, fire, and medical services, including other nursing home facilities, are discussed in greater detail in the COLA ER, Subsection 2.5.2.7.2.

3.13.6.2. Environmental Consequences

Alternative A

Under the No Action Alternative, the in-migration of people associated with construction and plant operation would not occur. Therefore, there would be no additional demand for public services under Alternative A.

Alternatives B and C

Impacts to these services are not analyzed in the earlier studies, except for fire, which was discussed in the Conversion FEIS (TVA 1997), Subsection 4.2.12. The COLA ER, Subsection 4.4.2.3, concludes that construction at BLN would result in a minor, short-term increase in the ratio of population to police officers and to firefighters. Likewise, the COLA ER, Subsection 5.8.2.3.1, concludes that operation of BLN would result in a small increase in the ratio of population to those services. However, these ratios would still be within existing guidelines. Impacts from completion of a single BLN unit should be similar to those

in the COLA ER. Therefore, under either Alternative B or C, the impacts of on-site construction and operation of a nuclear plant on local police and firefighters are expected to be insignificant and offset by increased tax revenue.

Regarding medical services, the shortage of physicians is a statewide problem in Alabama, including Jackson County. Minor injuries to workers would be treated by on-site medical personnel. Other injuries likely would be treated at Highlands Medical Center. Construction of a single BLN unit would have a minor effect on the already-existing physician shortage. Overall, as discussed in the COLA ER, Subsection 4.4.2, the impact of plant construction on medical services likely would be minor under either Alternative B or Alternative C. The COLA ER, Subsection 5.8.2, concludes that operation of BLN would have a small impact on the already-existing physician shortage. Furthermore, employment levels for single unit operation would be less than two-unit operation employment levels described in the COLA ER, which would reduce anticipated impacts on demand for physicians relative to the impact reported in the COLA ER. Increased need for hospital services would impact Highlands Medical Center, which currently has adequate beds and staff. Overall, under either Alternative B or Alternative C, the impact of plant operations on medical services likely would be minor and insignificant.

3.13.7. Schools

3.13.7.1. Affected Environment

Public schools are discussed in TVA's 1974 FES, Section 2.8. Schools are also discussed in the BLN Conversion FEIS, Subsection 3.1.12.3, and in the CLWR FEIS, Subsection 4.2.3.8. There are two school systems within Jackson County—Jackson County Schools and Scottsboro City Schools—both providing K-12 education. Jackson County Schools has 19 schools under its jurisdiction, while Scottsboro City Schools has six schools under its jurisdiction. For the 2007-08 school year, these districts had 5,998 and 2,681 enrolled students, respectively.

There are 50 school districts associated with the counties and cities that are either wholly or partially within the 50-mile radius of the BLN site center point. According to the National Center for Education Statistics, more than 297,091 students were enrolled in these school districts for the 2004-2005 school year. School districts within the 50-mile radius do not, in general, have a maximum capacity. Instead, virtually no student is turned away.

The COLA ER, Subsection 2.5.2.8.2, provides a detailed discussion on K-12 schools in Jackson County, nearby vocational and technical schools, and community colleges and universities within the 50-mile region. Also included in the COLA ER, Subsection 2.5.2.8.2, is a brief discussion on entry-level training in the duties for various positions specific to operations and maintenance of their facilities that is periodically offered by TVA.

3.13.7.2. Environmental Consequences

Alternative A

Under the No Action Alternative, no construction would occur, and the population increase associated with operation of a nuclear plant would not occur. Therefore, there would be no additional demand for public schools.

Alternatives B and C

In TVA's 1974 FES, Section 2.8, it was concluded that the school system could handle the additional students with ease. The BLN Conversion FEIS, Subsection 4.2.12.1, concluded that the system would have adequate space for the projected increase. However, the CLWR FEIS, Subsection 5.2.3.8.1, concluded that while long-term receipts from TVA would offset additional cost, there would be a short-term gap in costs that would need to be filled. A more current analysis in the COLA ER, Subsection 4.4.2.5., concluded that the impact would be potentially significant but temporary, depending on the speed with which current school district expansion plans are implemented. Under either Alternative B or Alternative C, the impact from construction of a single BLN unit is expected to be moderate to significant, as concluded in the COLA ER.

The TVA 1974 FES did not evaluate operations impacts on schools. In the CLWR FEIS, Subsection 5.2.3.8.1, it was concluded that over the long term, increased school receipts from TVA in-lieu-of-tax payments would exceed increased costs. The BLN Conversion FEIS, Subsection 4.2.12.2, noted that operations impacts should present no special problems. Under either Alternative B or Alternative C, the impact from operation of a single BLN unit is expected to be similar to, but less than, the impact discussed in the COLA ER, Subsection 5.8.2.3.3, where it was estimated that operation of BLN 3&4 would result in about 340 additional school-age children. This impact is considered small to moderate.

3.13.8. Land Use

3.13.8.1. Affected Environment

Jackson County, Alabama, in which the plant would be located, has an area of approximately 1,127 square miles.

Scottsboro, the county seat of Jackson County, is the largest city in the county, with an estimated 2008 population of 14,994. As described in Subsection 2.5.2.4 of the COLA ER, the city has a well-developed zoning plan and supporting zoning laws in place for land inside the city limits.

Hollywood, immediately to the west of the site, is the closest town to the site, with an estimated 2008 population of 924. The town of Hollywood, Alabama, has basic zoning laws, which designate agricultural, residential, or business zones within the city limits; however, no detailed zoning information is available. Areas outside of incorporated communities in Jackson County, including the Bellefonte site, do not have zoning laws. In Alabama and specifically Jackson County, because there is little zoning or designated land use outside of the communities, code and regulation enforcement is administered through the appropriate town or city, county, state, or federal governmental agency with the appointed oversight powers.

Land use is discussed in detail in TVA's 1974 FES, Section 1.2 and Appendix A, as well as in the CLWR FEIS, Subsection 4.2.3.1, and the BLN Conversion FEIS, Subsection 3.1.14. These describe the surrounding area as largely forest and agriculture or undeveloped, with development concentrated largely along the Scottsboro-Stevenson-Bridgeport corridor around U.S. Highway 72. Since these studies were completed, there has been a noticeable increase in development, primarily commercial, along U.S. Highway 72 through most of Jackson County. The COLA ER, Section 2.2 and Subsection 2.5.2.4, contain a recent description of land use. Section 3.9 of this FSEIS discusses recreational land use within

the 50-mile region, and Figure 3-14 illustrates the distance from the site to recreational locations within the 6-mile vicinity.

3.13.8.2. Environmental Consequences

Alternative A
Under the No Action Alternative, no construction would occur, and there would be no new plant. Therefore, there would be no impacts to land use.

Alternatives B and C
Impacts of plant construction on land use were discussed in TVA's 1974 FES, Section 2.9. They are also discussed in the CLWR FEIS, Subsection 5.2.3.1, and in the Conversion FEIS, Subsection 4.2.14.1. Under either Alternative B or Alternative C, the proposed construction would require no changes in designated land use, no additional land acquisition, and no road relocations. No new transmission lines or other uses of off-site land related to construction are proposed. According to COLA ER, Figure 2.5-29, the nearest residence is located across Town Creek, 2,309 feet from the north cooling tower location. The demand for housing could convert some land in the area to residential housing or to use for temporary housing units, such as mobile homes or RVs. To a great extent, this conversion likely would be an acceleration of the longer-term trend reflecting growth in the area and likely would not significantly alter the long-term trends in land use. These impacts are expected to be minor and similar to those described in more detail in the COLA ER, Section 4.1.

Impacts of plant operation on land use were discussed in TVA's 1974 FES, Sections 2.9 and 3.0. They are also discussed in the CLWR FEIS, Subsection 5.2.3.1, and in the Conversion FEIS, Subsection 4.2.14.2. Under either Alternative B or Alternative C, adverse impacts to land use from operation of a single BLN unit would be insignificant. A detailed discussion of these impacts is included in the COLA ER, Section 5.1. No additional land is expected to be disturbed after the construction phase.

3.13.9. Local Government Revenues

3.13.9.1. Affected Environment

Local government revenues are not discussed in TVA's 1974 FES. They are discussed in the CLWR FEIS in Subsection 4.2.3.8, but not in the BLN Conversion FEIS. A more recent and extensive discussion is included in the COLA ER, Subsection 2.5.2.3, and the TVA in-lieu-of-tax payments are discussed in detail in that subsection. These payments are made to eight states, including Alabama. The State of Alabama allocates its payments in accordance with state law (Title 40 "Revenue and Taxation"). The state distributes 78 percent of the payments to the 16 TVA-served counties based on the book value of TVA power property and TVA power sales in each of these counties. A portion of the county receipts is then shared with cities, schools, hospitals, etc., within their boundaries. In fiscal year 2007, TVA paid the state $112.1 million, of which $87.4 million was paid to the TVA-served counties, including Jackson County, which received $10.4 million. As discussed in the COLA ER, the book value of the partially completed BLN 1&2 is used in determining the payment to Jackson County. The book value of these units is likely to be entirely or largely depreciated by the time the proposed unit would be operational.

3.13.9.2. Environmental Consequences

Alternative A
Under the No Action Alternative, tax revenues would continue to decrease slowly due to depreciation, because the plant would not be constructed or operated.

Alternatives B and C
Under either Alternative B or C, construction activities and purchases and expenditures by workers and their families would increase revenues on various state and local taxes. These impacts, including TVA in-lieu-of-tax payments, are discussed in the CLWR FEIS, Subsection 5.2.3.8.1, but not in the Bellefonte Conversion FEIS. These impacts would be similar to those described in the COLA ER, Subsection 4.4.2.2.1. They are expected to be moderate to significant and beneficial in Jackson County, but minor and beneficial in the region.

Under either Alternative B or C, revenues from state and local taxes would increase during operations, although to a lesser extent than during construction. TVA in-lieu-of-tax payments to the State of Alabama also would increase. As a result, the amount allocated from these payments to Jackson County would increase. These impacts are discussed in the CLWR FEIS, Subsection 5.2.3.8.1. The amount of the increase has not been estimated; however, it would be a noticeable increase. These impacts would be similar to those described in the COLA ER, Subsection 5.8.2.2.1, considered moderately beneficial in Jackson County. As discussed in the COLA ER, Subsection 5.8.2.2.1, the increase in tax-equivalent payments to Jackson County due to construction of two units has been estimated to be about $3.2 million. The increase from one unit would be expected to be somewhat larger than half of this amount, because the cost of constructing one unit likely would be more than half the cost of two at the same site. However, many other factors would affect the actual payment. Completion of the Watts Bar Nuclear Unit 2 and other construction of TVA facilities outside of Alabama would somewhat decrease the Alabama share of the total TVA payments, thereby decreasing the BLN-related payment. Other future events would also affect this payment, such as fluctuations or growth in revenue from power sales, plant retirements, and future depreciation of assets. In addition to the direct effects of the proposed plant, other state and local tax revenues would see small increases due to increased employment and population in the county. Because of the many variables involved, the final net impact could vary considerably, but the result would be a moderate positive impact to local government revenues.

3.13.10. Transportation

3.13.10.1 Affected Environment

Transportation was discussed in TVA's 1974 FES, Section 1.2. U.S. Highway 72 was identified as the primary highway near (within 2 miles of) the BLN site and was being widened to four lanes with unlimited access. Two access roads to the BLN site were identified: one via existing roads on the south end of the site and a second new permanent access road (Bellefonte Road) from U.S. Highway 72 on the north end of the site. No new roads or general upgrading of existing roads were planned, but repairs were anticipated due to abnormal use (construction traffic). TVA's 1997 Bellefonte Conversion Project FEIS, Subsections 3.1.13.1 and 4.2.1.3, provided a detailed description of the major highways and local roads near the BLN site. In that study, the Alabama Department of Transportation (ALDOT) 1994 Average Annual Daily Traffic (AADT) count indicated a traffic count of 12,910 vehicles on U.S. Highway 72 in the vicinity of the intersection of U.S. Highway 72

and the south access road. A traffic count of 9,670 vehicles was reported on U.S. Highway 72 approximately 1.5 miles northeast of that intersection. The CLWR FEIS (DOE 1999), Subsection 4.2.3.8, identified primary transportation routes and effect on transportation related to the operation of at least one unit at the BLN site for the production of tritium.

Most recently, the COLA ER (TVA 2008a), Subsection 2.5.2.2, described the transportation network of federal and state highways within the BLN region, as well as local roads in Jackson County. Within Jackson County, Alabama, the one federal highway, U.S. Highway 72, runs east across the county into the city of Scottsboro, Alabama, then northeast through the town of Hollywood, Alabama, into the state of Tennessee. U.S. Highway 72, the closest major road to BLN, is a four-lane divided highway that connects the BLN site to Interstate 24 in Marion County, Tennessee, and to Interstate 565 in Madison County, Alabama, as shown in Figure 1-1. Numerous state routes traverse the county, providing rural areas access to the larger populated areas as shown in Figure 3-16. A small vehicular public transportation system exists in Jackson County, which transports residents from rural portions of the county into Scottsboro for shopping.

Vehicle volume on roads, obtained from estimated AADT counts from ALDOT, reflects the urban and rural traffic characteristics of the county. AADT counts in 2008 indicate that approximately 16,600 vehicles travel on U.S. Highway 72 at Mile 145.4 (west of the site). Approximately 4,900 vehicles travel on Alabama State Route 279 at Mile 9.0 (west of the site), which is located before east-bound traffic on Alabama State Route 279 merges with U.S. Highway 72. Approximately 5,600 vehicles travel on Alabama State Route 40 at mile 1.7 (south of the site). On average, 13,700 vehicles travel past Mile 148.2 (north of the site) on U.S. Highway 72. These counts are slightly lower than the 2005 traffic counts reported in the COLA ER.

No road modifications near the BLN site are planned; however, several road construction projects have been planned and/or completed in Jackson County. As noted in the COLA ER, the existing truss bridge over the Tennessee River on Alabama State Route 35 was scheduled for replacement, and the highway was to be widened to four lanes between the Tennessee River and Section, Alabama. There are also plans to build a west bypass around the city of Scottsboro, Alabama (ALDOT 2006). Replacement of the bridge on Alabama State Route 35 over the Tennessee River is estimated to be completed in spring 2010 (ALDOT 2009a). In addition, the bridge on Alabama State Route 35 over Roseberry Creek west of Scottsboro is scheduled for replacement (ALDOT 2009b).

Both construction workers and truck deliveries would access the site via U.S. Highway 72 and County Road 33. Operations workers and security personnel are expected to access the site during construction and operations using U.S. Highway 72 and Bellefonte Road.

3.13.10.2 Environmental Consequences

Alternative A

Under the No Action Alternative, no construction would occur, and no new plant would be operated. Therefore, there would be no impacts on transportation.

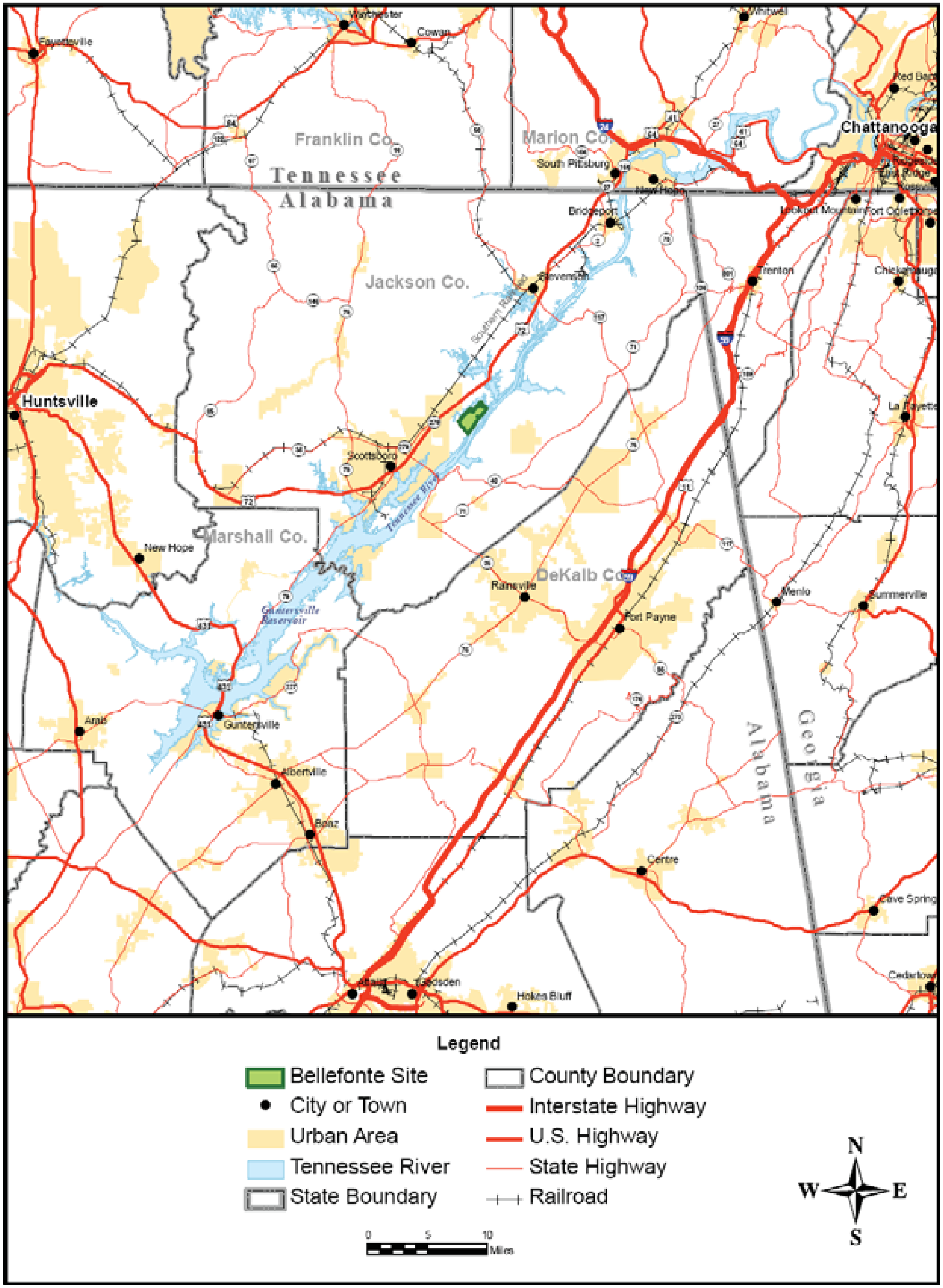


Figure 3-16. Road and Highway System in Jackson County Providing Access to the BLN Site

Alternatives B and C
Plant construction at the BLN site would increase traffic on local roads. TVA's 1974 FES estimated approximately 1,200 worker vehicles (TVA and contractor employees) would travel to and from the BLN site at the peak of construction and reported a 1970 daily traffic count on U.S. Highway 72 past the plant of approximately 3,700. As a result, increased traffic, some congestion, and delays were anticipated. Because most equipment was expected to be shipped by rail or barge, numerous truck shipments of equipment were not expected; however, deliveries of concrete aggregate, cement, etc., were expected to require many shipments by truck. For the Bellefonte Conversion Project (TVA 1997), increased traffic during construction was expected to affect primarily U.S. Highway 72 and the access roads leading off the highway to the plant. It was also noted that effects on the local road network during construction might require mitigation measures to improve future service levels on Bellefonte Road and County Road 33 (e.g., physical improvements to the local road network to increase capacity, employee programs that offer flexible work hours, incentives for ride-sharing, and bus and/or van pool programs. In the CLWR FEIS, DOE concluded that traffic generated by construction activities could strain the local road network and would be temporary, but similar to the effects identified in the Bellefonte Conversion FEIS.

The COLA ER (TVA 2008a) described planned road use for the construction of AP1000 units, which is also applicable to the completion of a B&W unit. All construction workers and plant staff would commute to the site, because there are no provisions for housing at the BLN site. The construction workers and plant staff who live in Jackson County, Alabama, are anticipated to commute from two major areas, western Jackson County (areas west of the Tennessee River) and eastern Jackson County (areas east of the Tennessee River). The roads and highways in Jackson County that provide vehicular access to the BLN site are illustrated in Figure 3-16. For the construction workers and plant staff who would live outside Jackson County, including those who might commute from the suburbs of Chattanooga, Tennessee, and Huntsville, Alabama, an adequate road network is already present to allow these workers to commute to the BLN as discussed above.

County Road 33 is planned to be used as the sole access road for construction workers. During peak construction period, a single "construction" shift of 10 hours during daylight hours would be scheduled. However, to accommodate construction traffic converging on the site during this shift, TVA expects to use staggered shift start times (over a two-hour period). Using staggered shifts also allows for extra road capacity that could prove useful for scheduling flexibility and the occasional delivery during dayshift start times. As construction ramps up, scheduling of a nightshift dedicated to preparation of the site for the next day's construction work is expected. Approximately 70 percent of the construction workers would work the dayshift and approximately 30 percent would work the nightshift. Truck deliveries would occur during daytime hours and in-bound shipments would occur outside of the startup shift hours. These deliveries include shipments of materials, trash removal, etc. In addition to the construction workers, the peak on-site construction workforce would include operations engineering and testing and security workforce that would access the site during the construction period using Bellefonte Road.

For both Alternatives B and C, impacts on transportation corridors from the construction period workforce and deliveries are considered minor for all roads except Jackson County Road 33, where impacts are expected to be temporary, but minor to moderate, during the construction period. Should traffic counts exceed predicted levels, TVA would meet with local officials to determine an appropriate solution. Potential mitigation measures include

establishing a temporary centralized parking area away from the site and shuttling construction workers to the site, mandatory carpooling, installing traffic-control lighting and directional signage, county road modifications, and further staggering of shifts further to avoid traditional traffic congestion time periods.

Plant operation would increase traffic on local roads. The 1974 FES (TVA 1974a), Bellefonte Conversion FEIS (TVA 1997), and CLWR FEIS (DOE 1999) all indicated commuter traffic generated by operation of a plant at the BLN site would increase traffic loads on the local road network and decrease availability capacity of the roads. However, the effects of commuter traffic during operations would be less than during the construction phase, especially peak construction. The Bellefonte Conversion FEIS indicated that any mitigation efforts accomplished for the construction phase were expected only to improve the capacity levels during operation. The CLWR FEIS offered mitigation measures for transportation effects similar to those discussed in the Bellefonte Conversion FEIS.

The COLA ER (TVA 2008a) noted that impacts on transportation and traffic from operating nuclear units at the BLN site would be greatest on the rural roads of Jackson County and during shift changes. Impacts on traffic are determined by (1) number of operations workers and their vehicles on the roads, (2) number of shift changes for the operations workforce, (3) projected population growth rate in the region, and (4) capacity of the roads.

For plant operations, it was assumed that the BLN site would operate in three shifts. The dayshift would comprise 60 percent of the workers, the nightshift would comprise 30 percent of the workers, and the midnight (graveyard) shift would comprise 10 percent of the workers. The largest number of the worker vehicles is expected to be on the roadway at the end of the dayshift and start of the nightshift (shift change). Other impacts may be present during outages and during refueling periods when more workers are present. Additional information on transportation is discussed in the COLA ER, Subsection 2.5.2.

Because approximately half of the B&W operations workers and half of the AP1000 operations workers are expected to be temporally phased in during the construction stage, the initial impact on transportation from worker vehicular traffic at the start of BLN operations would be lessened. Given the volume of traffic on the road network (indicated by AADT counts discussed in Subsection 3.13.10.1), the impact on transportation from the addition of operations worker vehicles on the roadway during shift change between dayshift and nightshift would be minor. Should traffic concerns arise, TVA would meet with local officials to determine an appropriate solution. Potential mitigation measures could include mandatory carpooling, staggering outage shifts opposite traditional high-traffic periods, and busing in employees, if necessary.

3.13.11. Cumulative Socioeconomic Effects

TVA's 1974 FES did not address cumulative effects, other than radiological impact on the Tennessee River (see Appendix J of the FES). They were discussed in the CLWR FEIS, Section 5.3, and in the BLN Conversion FEIS, Subsection 4.4.2. In the COLA ER, Subsection 4.7.3, the only foreseeable project identified as having the potential to contribute to cumulative socioeconomic effects within 50 miles of BLN was the realignment of Redstone Arsenal as part of the *Base Realignment and Closure Act of 2005*. Because Redstone Arsenal is located at the periphery of the 50-mile BLN region and the construction periods of Redstone Arsenal and BLN would not likely coincide, BLN is not likely to result in significant cumulative impacts on socioeconomics. The impacts would be similar to those discussed in more detail in the COLA ER, Section 4.7.

Several other projects are now identified that will be occurring within the 50-mile radius. In Chattanooga, Tennessee, a new Volkswagen manufacturing plant will be completed in early 2011, and Alstom has announced it will build a new facility to manufacture turbines and other major components for U.S. power generation facilities. Construction of the Alstom plant is expected to be complete in late 2010. Another company is said to be planning construction of a facility in Marion County, Tennessee, to begin in the near future. In Madison County, Alabama, the University of Alabama-Huntsville has some large construction projects underway. In DeKalb County, a small metal fabrication facility is under construction that will employ 25 people beginning in March 2010. The county is also recruiting a Canadian automotive supplier that would employee 158 initially and up to 350 in the long term. Additionally, the local highway projects described in Subsection 3.13.10.1 are either underway or could occur within the project time period.

Because all of these efforts are either underway, or will likely be completed before the construction workforce begins to grow at the Bellefonte site, it is unlikely that these facilities and highway projects would impact recruiting for construction for a nuclear reactor at Bellefonte. None of these projects are close enough to Hollywood, Alabama, to contribute co-impact community services or traffic congestion on local roads, including any traffic congestion due to the road projects discussed in Subsection 3.13.10.1, which are located near Scottsboro. If the local highway projects are completed by peak construction for either alternative, the cumulative effects of traffic would be reduced due to these improvements.

No cumulative effects on socioeconomics are expected from construction or completion and operation of a single nuclear unit at the BLN site in combination with the projects described above.

For over a decade, the Federal Highway Administration has discussed the need for a new interstate highway connecting Memphis, Tennessee, to Atlanta, Georgia, via Huntsville, Alabama. This project was tabled before the 2008-2009 recession and is not likely to be funded and under construction until after the construction at the Bellefonte site would be completed.

3.14. Solid and Hazardous Waste

3.14.1. Affected Environment

The earliest BLN NEPA document, TVA's 1974 FES, addressed expected solid waste generation resulting from plant construction, normal plant activities, and transmission line clearing and maintenance practices, and the proposed disposal of those wastes.

Plant construction solid waste, such as metal, lumber scrap, and other salvageable material, was to be collected periodically for sale or removal from the site. Trees having no commercial value and stumps were cut, piled, and burned in accordance with federal, state, and local air quality regulations. Broken concrete, rock, and residue from wood burning were "used in landfill material" on site.

Normal nonradiological solid wastes included sludge from water treatment plant filters and demineralizers, paper, soft drink cans, glass, wood, and to a much lesser extent garbage. Scrap metals (other than cans) were to be salvaged and sold. Scrap lumber was to be salvaged for TVA use, or made available to scavengers, and the remainder disposed of with other solid waste. It was anticipated that this solid waste would be disposed of at either a TVA sanitary landfill operated by TVA personnel in accordance with EPA

regulations, or in a state-approved landfill operated on non-TVA property by a municipality, county, or private contractor. Economics was expected to be a major determinant of the option selected for disposal.

The 1974 FES analysis formed the general basis (template) for the evaluation of the management and disposal of solid waste in the subsequent NEPA documents, addressing the various phases and alternative options for the use of the plant and the site. Thus, while the nominal categories changed over time, the general assemblage of wastes remained largely the same. Furthermore, the manner/location of disposal varied, with off-site disposal retained as the favored option, but with disposal of various wastes on site being maintained as an option. Actual and planned disposal was always in accordance with existing applicable environmental regulations.

TVA 1976 restated the solid waste categories as demolition/construction waste, domestic (municipal type) waste, clearing and demolition/construction waste, and added the category nonradiological hazardous waste or problem waste.

An exhaustive list of typical domestic waste was provided: garbage, paper, plastic, packing materials (metal-retaining bands, excelsior, cardboard), leather, rubber, glass, soft drink and food cans, dead animals and fish, oil and air filters, floor sweepings, ashes, wood, textiles, and scrap metal. Domestic waste, by this definition, was listed as the largest type of nonradiological solid waste. Domestic and demolition/construction wastes were to be disposed of in a local, state-approved sanitary landfill.

Broken concrete and bricks, waste concrete, asphalt, rocks, and dirt, along with the residue from burning clearing wastes, were used as unclassified fill material on site. In addition, there was no planned disposal of domestic solid waste or hazardous wastes in the fill area. All lumber used for forms, scaffolding, etc., was reused as long as practical and then offered to the general public for firewood or other use. Unwanted scrap lumber from the salvaging operation was disposed of in an unclassified fill area. Scrap metals and other recyclable materials were collected, offered for periodic sale, and removed from the site.

Nonradiological hazardous wastes were represented as those that require special handling and/or disposal methods to avoid illness or injury to persons or damage to the environment. Examples of hazardous waste were empty containers from paints, solvents, pesticides, acids, oils, PCBs, chemical grouts, as well as the materials themselves. Problem wastes were those wastes that are difficult to handle by conventional means. Examples of problem wastes were sludges from water and wastewater treatment plants, tires, materials from intake screens, and materials used in the clean up of chemical or oil spills. It should be noted that the RCRA regulations (40 CFR Parts 260-273), the basis for current hazardous waste management, were not yet in force at the time of TVA's 1976 final environmental report.

The TVA white paper (TVA 1993a), was developed to determine if the 1974 FES needed to be supplemented for the proposed change from deferred status, and it added asbestos materials to the list of BLN wastes. For the disposal of certain nonradiological nonhazardous waste, the intent was to be able to dispose of these wastes either off site in state-approved sanitary landfills or in on-site approved landfills, depending on the economics. Any hazardous wastes would be disposed of or treated off site at state-approved treatment/disposal facilities.

The BLN Conversion FEIS (TVA 1997) addressed solid and hazardous wastes generated by five fossil-based alternatives to the exclusion of the nuclear option for the BLN plant. Only relatively small quantities of solid hazardous and nonfossil-based nonhazardous wastes were generated at the BLN site at that time, as the existing plant was in regulatory deferred status. In addition to large-volume solid wastes associated with the fossil-based options, the typical hazardous and nonhazardous waste generation was discussed.

Discussions of the tritium option (TVA 2000), in addition to a relisting of the likely solid wastes, included estimates of the hazardous and nonhazardous waste generated by the completion of Unit 1 and Units 1&2.

In the 2006 final environmental assessment, solid and hazardous waste generation was included in the discussion of impacts associated with the cancellation of construction of the existing facility and withdrawal of the construction permits. This action was taken to pursue other site alternatives. Further details are presented and discussed in the Environmental Consequences section below.

Most recently, the COLA ER provided a description of the estimated solid waste generation associated with the construction and operation of BLN 3&4 (two AP1000 units), including a discussion on the types of solid waste and the quantities. Further details are presented and discussed under Alternative C below.

The changes in solid and hazardous waste generation at BLN from the earlier NEPA review conditions are the result of further reduction of plant activities from those prevailing under the deferred status (TVA 2006) and reflect changes primarily in the quantitative distribution of wastes rather than changes in the types of wastes.

With the plant in deferred status, the solid waste generated is minimal, commensurate with the low level of activity at the plant. Typical sanitary solid waste is routinely put in dumpsters on site and subsequently disposed of off site in an approved sanitary landfill. Within the last three years (2007 to present), nonhazardous waste generated at BLN included four roll-offs (20 cubic yards each) of roofing materials (flashing, felt, etc.), 11 roll-offs (20 cubic yards each) of asbestos waste generated from the repair and upkeep of plant buildings, and one roll-off (20 cubic yards) of oily debris (dirt and gravel). Material contained in the roll-offs was disposed of at the ADEM-approved Sand Valley Landfill in Collinsville, Alabama. This landfill has available capacity for the disposal of solid waste for the next 59 years, at the current disposal rates.

Other nonhazardous solid waste generated at BLN during the same period, included 1,392 kg of used oil (used oil, oily water, used grease, etc.) in large part from the decommissioning of plant operating equipment; 2,489 kg of oily debris (oily rags, pads, and absorbents); and 125 kg of non-PCB ballasts. These drummed nonhazardous materials were shipped to the TVA Hazardous Waste Storage Facility (HWSF) for disposal or recycling, as appropriate. The TVA HWSF provides interim storage of some of TVA's nonhazardous waste prior to disposal.

As with solid waste, the hazardous waste generated is minimal, again commensurate with the reduced level of activity at the plant. The BLN site is a conditionally exempt small quantity generator (CESQG). A CESQG generates hazardous waste at a rate of less than 100 kg (220 pounds [lb)]) in any calendar month and manages the waste in a manner specified by the EPA (40 CFR §261.5). Within the last three years (2007 to present),

761 kg of hazardous waste were shipped to the TVA HWSF for disposal. These hazardous wastes included paints, paint-related materials, solvents, corrosive liquids, aerosol cans, discarded chemicals, and broken fluorescent bulbs. Drummed PCB ballasts (268 kg), which can be described as toxic rather than hazardous in terms of the regulations, were also sent to the TVA HWSF for disposal. Just as for the solid waste, the TVA HWSF manages a number of waste management contracts that provide TVA with a variety of hazardous waste disposal options approved by regulators (Table 3-11).

The TVA HWSF is located in Muscle Shoals, Alabama, and provides interim storage of most of the TVA hazardous wastes and some other wastes, pending shipment to permitted commercial facilities for appropriate disposal.

Table 3-11. Hazardous Waste Storage/Disposal Capacity Available to BLN

Facility	Specialty	Capacity
TVA HWSF	Interim storage prior to shipment for disposal	720 55-gallon (gal) equivalent containers
Veolia Environmental Services RMI, Morrow, Georgia	Fuel blending	87,750 gal/day treatment in containers 110,000 gal/day treatment in tanks 167,500 gal storage in containers 176,598 gal storage in tanks
Veolia Environmental Services TWI, Sauget, Illinois	Incineration	4x63 cubic yards solid bulk[a] 300,000 gallons liquid bulk[a] 11,380 55-gal containers[a]
Chemical Waste Management Emelle, Alabama	Stabilization and landfilling	~ 800,000 tons/year for 10 to 20 years

[a] Maximum to be held on site at any one time.

3.14.2. Environmental Consequences

3.14.3. Alternative A

For this alternative, there would be no construction activity beyond routine maintenance of the physical plant. Any construction/demolition waste would be minimal and would be disposed of in a state-approved landfill. A minor amount of construction-related hazardous waste is anticipated for this alternative beyond paint-related waste, and this would be sent to the TVA HWSF for disposal. There would be limited quantities of solid waste for disposal and, with regard to hazardous waste, the plant would continue to be a CESQG.

Alternative B

The quantities and types of solid waste generated by this option during the construction phase would be determined primarily by the number of buildings demolished and/or renovated to meet the needs of the new generation system and the equipment that must be taken out and replaced. In the CLWR FEIS, DOE estimated that 392 cubic meters of concrete waste and 208 tons of steel waste would be generated for the completion of BLN Unit 1 for the duration of the construction period (DOE 1999). Under Alternative B, no major buildings would be demolished. However, it is expected that scrap metal waste would be generated from the replacement of old equipment and components. Therefore, it is expected that a large number of motors would be discarded, producing steel and copper for recycling. Other sources for scrap metal for recycling include steel from the replacement of the steam generator, copper from the replacement of electrical cables, and sheet metal from the renovation of the Control Room/Building. This material would be

recycled as much as practicable. In addition, as indicated in the COLA ER, the intended use of an existing cooling tower would require some maintenance and refurbishment. This renovation would include removal of asbestos fill material and replacement with a nonhazardous material. This process would generate asbestos waste for disposal. Any construction/demolition wastes generated during the building/renovation process would be managed through the existing TVA waste disposal contracts to access permitted disposal capacity or recycling facilities, as needed.

Likely hazardous wastes generated during the construction phase would include paint wastes, paint thinners, dried paint, and parts cleaning liquids. In the CLWR FEIS, DOE estimated that 6.3 tons of solid hazardous waste and 56.7 tons of liquid hazardous waste would be generated for the completion of BLN Unit 1 for the duration of the construction period (DOE 1999). These hazardous wastes would be sent to the TVA HWSF for disposal.

Although the exact calculations of the quantities of solid and hazardous waste that would be generated during operation are yet to be determined by the DSEP process, indications can be gleaned from the ongoing experience of existing nuclear plants. Solid wastes generated currently by the TVA nuclear plants include oily debris (absorbent, boom, rags from cleanup, oily gravel and dirt), spent resin, desiccant, and alkaline batteries. These wastes are shipped to the TVA HWSF for disposal by contractor in a permitted landfill. Wood waste that cannot be recycled also goes to a permitted landfill. Scrap metal is recycled. Based on waste generated at SQN from 2004 through 2008, the estimated quantity of solid nonhazardous, nonradiological waste generated annually during operation of a single B&W unit would be approximately 500 tons.

Types of hazardous waste generated currently by the TVA nuclear plants include paint, paint thinners, paint solids, discarded laboratory chemicals, spent fixer (X-ray solution), parts washer liquid, hydrazine, rags from hydrazine cleanup, and sulfuric acid and sodium hydroxide waste from demineralizer beds and makeup water treatment, and broken fluorescent bulbs. These operating plants tend to be EPA hazardous waste small quantity generators (SQGs) (i.e., they generate between 100 kg and 1,000 kg of hazardous waste per calendar month). During outages, these plants may temporarily become EPA hazardous waste large quantity generators (greater than 1,000 kg per calendar month) for the period of the outage. The operating TVA nuclear plants providing these generation rates are multiunit plants, thus it is likely that the proposed single unit plant would have a lower generation rate, and it is likely that the single unit plant would be a CESQG during normal operation. Based on waste totals from SQN from 2004 through 2008, operation of a single B&W unit would generate approximately 1,300 lb (approximately 600 kg) of hazardous, nonradiological per year.

Regardless, the hazardous wastes are shipped to the TVA HWSF in Muscle Shoals, Alabama, for interim storage prior to disposal at a permitted facility. The TVA HWSF has contracts for hazardous waste disposal by a number of methods (Table 3-11) with companies with significant disposal capacity.

In summary, under Alternative B, recycling of potential waste materials such as oils, wood/lumber, and scrap metal, reduces the pressure on sanitary and other landfill capacity, ultimately mitigating any potential adverse disposal effects. Furthermore, the likely implementation of a chemical traffic control program at the plant minimizes the discarded chemicals hazardous waste stream, reducing the pressure on hazardous waste disposal

landfill capacity, ultimately mitigating any potential adverse disposal effects. Because all of the solid and hazardous wastes would be disposed of off site, there would be no direct effects. Because the disposal of the solid and hazardous wastes from construction and operation would be in accordance with the applicable regulations and at permitted facilities, and these facilities currently have adequate capacity to serve BLN needs, any adverse effects from the generation, management, and disposal of these wastes are likely to be small. In addition, cumulative effects would be minimized by the use of permitted landfills. These facilities would provide substantive barriers separating the waste from the at-risk groundwater and would be capped as well, minimizing the cumulative effect of placing BLN and non-BLN waste in the same facility.

Alternative C

During the initial phase of construction, solid waste for this alternative would be generated from the demolition of several existing buildings, the construction of the new plant, and the clearing and grubbing of a limited amount of additional acreage. Based on a comparison of the existing structures on the Alternative B and Alternative C site plans (Figures 2-1 and 2-12), several buildings including the existing turbine building and the office and service building would need to be demolished.

Construction/demolition wastes are likely to include scrap metal, masonry, broken concrete, wallboard, lumber, manufactured wood products, cardboard, plastics, broken glass, roofing material, and such. The additional acreage to be disturbed is currently covered in overgrowth and some forestation (TVA 2008a). As a result, site preparation would generate some wood and other vegetative waste from the clearing and grubbing. As stated for Alternative B, the intended use of an existing cooling tower would require some maintenance and refurbishment and would result in similar effects. All solid wastes would be disposed of in state-approved landfills, as needed.

Hazardous waste generated during construction would include paint wastes, paint thinners, dried paint, and parts cleaning liquids. The COLA ER estimated that 5,000 lb (2,230 kg) of hazardous waste per year would be generated during the construction of a two-unit AP1000 plant. This translates into about 2,500 lb (1,115 kg) per year for Alternative C. Assuming a uniform distribution of the hazardous waste generation over the year would make the plant a CESQG. Therefore, based upon the assumption that construction of the AP1000 would last 6.5 years, an estimated 16,250 lb (8.1 tons) of hazardous waste would be generated during construction of the AP1000.

Anticipated nonradioactive waste for the operation of an AP1000 would include typical industrial wastes such as metal, wood, and paper, as well as process wastes such as nonradioactive resins, filters, and sludge (TVA 2008a). That study estimated “the plant [Units 3&4] would generate approximately 800 tons of nonhazardous, nonradiological solid waste (i.e., trash) during each year of plant operation.” Based on this estimate for two AP1000 units, the estimated quantity of nonhazardous, nonradiological solid waste generated annually during operation of a single AP1000 unit would be approximately 400 tons. Based on TVA’s experience, additional smaller amounts of nonhazardous waste, such as oily debris and desiccant, would be expected also.

Hazardous waste generated during normal plant operation would include paint wastes, paint thinners, dried paint, parts cleaning liquids, discarded chemicals, waste acid and waste base. Based on waste totals from SQN from 2004 through 2008, operation of a single AP1000 would generate about 1,300 lb (approximately 600 kg) of hazardous,

nonradiological waste per year. Assigning a uniform distribution of the hazardous waste generation over the year would make the plant a CESQG. Hazardous wastes would be shipped to the TVA HWSF for disposal.

As with Alternative B, the direct and cumulative effects on the environment from disposal of solid and hazardous waste disposal would be small.

3.15. Seismology

3.15.1. Affected Environment

TVA's 1974 FES describes the maximum historical Modified Mercalli Intensity (MMI, a scale of earthquake effects that ranges from Roman numeral I through XII) experienced at BLN from nearby earthquakes. Section 2.5 of the BLN FSAR (TVA 1986) describes the geology and seismicity in the vicinity of BLN and contains a summary of significant regional earthquakes through 1973. The seismic history of the region around BLN from 1974 through January 2005 is contained in Appendix 2AA of the COLA FSAR. Table 3-12 lists the most recent seismic history (February 2005 through December 2008) for earthquakes within 200 miles of BLN having magnitudes of 2.5 or greater based on the earthquake catalog maintained by the Advanced National Seismic System (ANSS) 2010.

Table 3-12. Earthquakes Within 200 Miles of BLN (February 2005-December 2008)[1]

Date	Time (Universal Coordinated Time)	Latitude (Degrees North)	Longitude (Degrees West)	Depth (km)	Magnitude	Magnitude Type
03/18/2005	01:02:16.3	35.723	-84.164	9.1	2.7	Md
03/22/2005	08:11:50.5	31.836	-88.060	5.0	3.3	ML
04/05/2005	20:37:42.6	36.147	-83.693	10.0	2.9	Md
04/14/2005	15:38:15.7	35.468	-84.091	15.5	2.8	Md
06/07/2005	16:33:36.7	33.531	-87.304	5.0	2.8	ML
10/12/2005	06:27:30.1	35.509	-84.544	8.1	3.3	Md
10/25/2005	05:18:10.5	34.429	-85.315	9.1	2.6	Md
10/28/2005	21:05:40.3	33.003	-83.094	14.4	2.7	Md
10/29/2005	23:46:20.7	33.034	-83.156	17.1	2.5	Md
03/11/2006	02:37:20.1	35.192	-87.996	0.0	2.9	Md
03/11/2006	08:08:54.2	32.712	-88.159	30.7	2.6	Md
04/11/2006	03:29:20.8	35.362	-84.480	19.6	3.3	Md
05/10/2006	12:17:29.2	35.533	-84.396	24.7	3.2	Md
05/16/2006	05:23:19.9	32.850	-88.087	20.5	2.5	Md
06/16/2006	00:57:26.8	35.512	-83.203	1.4	3.4	Md
07/11/2006	13:45:40.7	33.606	-87.146	1.0	2.8	ML
08/07/2006	08:44:27.7	34.937	-85.461	14.2	2.9	Md
09/05/2006	04:32:42.6	33.705	-82.992	10.2	2.5	Md
10/02/2006	19:56:19.2	35.468	-84.984	8.7	2.5	Md
12/18/2006	08:34:26.5	35.356	-84.351	17.7	3.3	Md
01/03/2007	23:05:44.7	35.916	-83.955	15.3	2.7	Md
01/30/2007	21:20:29.4	33.664	87.107	1.0	2.6	ML
02/07/2007	00:34:53.6	34.607	-85.308	10.7	2.6	Md
03/23/2007	14:15:33.3	33.652	-87.067	5.0	2.6	ML
05/04/2007	16:16:28.2	33.797	-87.299	5.0	3.0	ML
06/19/2007	18:16:26.8	35.793	-85.362	1.2	3.5	Md

Date	Time (Universal Coordinated Time)	Latitude (Degrees North)	Longitude (Degrees West)	Depth (km)	Magnitude	Magnitude Type
07/27/2007	17:16:39.8	33.834	-87.329	1.0	2.6	ML
10/23/2007	05:16:11.6	35.591	-84.104	21.3	2.8	Md
11/17/2007	19:22:55.7	37.393	-83.087	1.0	2.5	ML
01/01/2008	10:59:53.0	37.039	-88.894	4.0	2.5	Md
01/04/2008	14:55:28.5	33.106	-86.161	5.0	2.5	ML
01/23/2008	22:22:13.8	33.739	-87.180	1.0	2.8	ML
02/23/2008	17:03:18.5	33.864	-87.165	1.0	2.6	ML
04/08/2008	17:43:44.4	33.649	-87.502	1.0	2.6	ML
05/07/2008	16:44:35.1	33.691	-87.211	1.0	2.7	ML
05/10/2008	17:52:49.6	34.350	-88.835	0.0	3.1	Md
05/16/2008	18:39:14.9	31.773	-88.203	5.0	3.1	ML
06/23/2008	23:30:20.0	34.925	-84.841	8.8	3.1	Md
06/28/2008	01:40:36.5	33.276	-87.396	5.0	3.1	ML
08/19/2008	01:47:58.0	34.276	-87.988	0.0	2.6	Md
10/25/2008	23:47:17.3	36.052	-83.604	15.8	2.5	Md
10/31/2008	16:37:34.0	35.768	-84.000	7.6	2.9	Md
11/10/2008	02:29:00.8	35.766	-84.591	25.1	2.5	Md
12/18/2008	00:05:07.1	36.050	-83.592	9.5	3.3	Md

Md = Duration magnitude (USGS 2010)
ML = Local magnitude (USGS 2010)
[1] Source: Advanced National Seismic System Earthquake Catalog (2010)

The most significant earthquake to occur near BLN since 1973 was the Fort Payne earthquake, which occurred on April 29, 2003, in northeastern Alabama, near the Georgia border. This earthquake has a measured Lg wave magnitude (mbLg) of 4.9 and a moment magnitude (M) of 4.6 (USGS 2009). The Fort Payne earthquake caused minor damage, including damage to chimneys, cracked walls and foundations, broken windows, and collapse of a sinkhole 9 meters (29 feet) wide near the epicenter (Geological Survey of Alabama 2009). Based on reconnaissance in the epicentral area, no landslides were reported, and damage to chimneys was observed only for chimneys with masonry in poor/weakened condition. Other masonry, including chimneys in good condition, and several old masonry buildings did not appear to be damaged. The earthquake occurred at a depth of about 8 to 15 km (5.0 to 9.3 miles) (Kim 2009; USGS 2009). Based on the U.S. Geological Survey's Community Internet Intensity Map, the observed MMI at BLN would have been IV to V (USGS 2009). The Fort Payne earthquake's magnitude is still lower than that of the maximum historical earthquake in the southern Appalachians, which was the 1897 Giles County, Virginia, earthquake. The 1897 earthquake had a maximum MMI of VIII and an estimated body wave magnitude of 5.8. Therefore, the 2003 Fort Payne earthquake is well within the known historical maximum magnitude earthquake in the southern Appalachian region and is consistent with the earthquake history of the region described in TVA's 1974 FES, 1986 BLN FSAR, and 2009 BLN FSAR.

As the record of recent earthquakes indicates, small to occasionally moderate earthquakes continue to occur in the southern Appalachians. Data from regional seismic monitoring networks, which have been in operation since the 1980s, indicate that the vast majority of these earthquakes occur within the basement rocks of the southern Appalachians at depths from 5 to 26 km (3.1 to 16.1 miles). Reactivation of zones of existing weaknesses within

the basement rocks are believed to be responsible for present day earthquake activity in the region (Algermissen and Bollinger 1993).

3.15.2. Environmental Consequences

Alternative A
Under the No Action Alternative, because there would be no completion or construction and operation of a new plant, there would be no impacts.

Alternatives B and C
Given the historic record of seismic activity in the BLN region described above, TVA believes the basis for the safe shutdown earthquake described in Section 2.5 of the BLN FSAR (TVA 1986) is still valid. The largest historical earthquake in the Southern Appalachian Tectonic Province remains the 1897 Giles County, Virginia, earthquake.

TVA has performed feasibility studies relative to a comparison of the original seismic design basis spectra (NRC Regulatory Guide 1.60 Rev 1) (NRC 1973) to 10 CFR Part 50, Appendix S (Regulatory Guide 1.208 and Interim Staff Guidance) (NRC 2007a). The present regulatory requirements apply to new generation plant sites; however, TVA felt it prudent to perform analyses to understand how the BLN 1&2 original design and construction compared to the latest requirements. Based on results of these studies, it can be demonstrated that the existing seismic Category I structures compare favorably with the latest requirements (AREVA 2009b). At such time that an agreed regulatory framework is established for the completion of either BLN 1 or 2 under Alternative B, design-basis analyses would be performed to demonstrate compliance with regulatory requirements.

As a standard plant, the seismic adequacy of the AP1000 design proposed under Alternative C is addressed through the NRC's review and approval of the vendor-supplied Design Control Document (DCD).

3.16. Climatology and Meteorology, Air Quality, and Global Climate Change

The COLA ER contains an extensive discussion of the meteorology, air quality, and climatology for the BLN site. The COLA ER used information contained in TVA's 1974 FES, on-site data from 1979 to 1982, more recent climatological records, and on-site data for 2006-2007. This information is supplemented in the following sections by data collected for 15 additional months, into 2008.

3.16.1. Climatology and Meteorology

3.16.1.1. Affected Environment

Regional Climatology
The overall regional climate description in the COLA ER remains accurate, as conditions since the application was submitted are consistent with those reported. The COLA ER acknowledged the 2006-2008 drought; however, it was not possible to make substantive conclusions about the impacts of the drought because it was ongoing. Since the application was submitted, the drought has ended, and conditions have returned to near normal. Although this drought represented extreme conditions for northeast Alabama and adjacent areas, it was not as intense as the other regional droughts discussed in the COLA ER in terms of magnitude and duration.

Local Meteorology
The meteorological data collected from the BLN meteorological facility have been expanded by an additional 15 months beyond the 2006-2007 period used in the COLA ER. The data for the full 2006-2008 period are presented in Appendix I. The different data periods (1979-1982, 2006-2007 COLA, and 2006-2008 full period) are compared in Appendix J. The differences between the three data periods are within the normal year-to-year variation for Bellefonte. The conclusions in the COLA ER are updated as discussed below.

The COLA ER discussed only the winds measured at 10 meters above the ground (10-meter winds) and atmospheric stability represented by temperatures measured between 55 and 10 meters above the ground (55-10 meter atmospheric stability), because only that information was relevant to the AP1000 units. However, because of the potential for elevated releases of radioactive effluent from the B&W reactor (releases into the air that rise above the influence of the plant structures), it is also necessary to examine the winds measured at 55 meters above the ground (55-meter winds).

<u>10-meter winds</u>--For the entire 2006-2008 sampling period of 27 months, the most frequent wind directions at 10 meters are from the north-northeast at 13.15 percent and from the south-southwest at 12.54 percent. This is consistent with the downvalley-upvalley flow pattern in the COLA ER and the earlier 1979-1982 data collected at BLN.

The average wind speed of 4.11 miles per hour (mph) equals the value in the COLA ER but is less than the 4.95 mph for the 1979-1982 data. The frequency of calms (defined as wind speeds less than 0.6 mph decreased from 0.753 percent in 1979-1982 to 0.397 percent in 2006-2008.

<u>55-10 meter atmospheric stability</u>--The 2006-2008 data were measured for a 55-10 meter layer, while the 1979-1982 data were measured for a 60-10 meter layer. This slight difference in layer depth should have minimal impact on stability class.

The differences between the 1979-1982 data, the BLN COLA ER data, and the data for the entire 2006-2008 sampling period of 27 months are summarized in Table 3-13.

Table 3-13. Comparison of Atmospheric Stability Data Collected at BLN (Percent Occurrence)

Stability Classification	1979-1982	2007 COLA ER	2006-2008
Unstable (Classes A, B, and C)	8.93	7.3	7.63
Neutral (Class D)	48.75	44.4	44.11
Stable (Classes E, F, and G)	42.33	48.2	48.27

Notes: 1979-1982 data were measured for a 60-10 meter layer above ground.
2006-2007 and 2006-2008 data were measured for a 55-10 meter layer above ground. The 2006-2007 data were used in the COLA ER. The 2006-2008 includes the COLA ER data plus an additional 15 months of data.

The COLA ER states “stability class frequency distributions show that the BLN site data gathered over both time periods (1979-1982 and 2006-2007) are relatively similar.” Because the data for the entire 2006-2008 period agree closely with the COLA ER, this conclusion still applies.

55-meter winds--The 2006-2008 data were measured at 55 meters above ground, while the 1979-1982 data were measured at 60 meters above ground. This slight difference in elevation should have minimal impact on interpretation of wind data.

For the entire 2006-2008 sampling period of 27 months, the most frequent wind directions at 55 meters are from the northeast at 18.35 percent, from the north-northeast at 15.13 percent, and from the south-southwest at 11.97 percent. This is consistent with the downvalley-upvalley flow pattern in the 1979-1982 data.

The average wind speed of 6.46 mph is less than the 7.13 mph for the 1979-1982 data. The frequency of calms (defined as wind speeds less than 0.6 mph) decreased from 0.085 percent in 1979-1982 to 0.005 percent in 2006-2008.

Severe Weather

During 1980-2008, 17 tornadoes occurred in Jackson County, including two storms with a strength of F4/EF-4. Of these tornadoes, seven (including one EF-4 tornado) had tracks (all or part) within 10 miles of the BLN site. Appendix K lists these tornadoes.

In addition to tornadoes, numerous other significant weather events were identified for Jackson County during 1980-2008 from the National Climatic Data Center (NCDC) Storm Events Web site (NCDC 2010). These include the following events:

- 22 Months of Drought (March 2007-December 2008)
- 17 Flood
- 1 Funnel Cloud
- 73 Hail (0.75-2.75 in)
- 3 Hurricane and Tropical Storm
- 10 Lightning
- 3 Precipitation (Heavy Rain)
- 21 Snow and Ice
- 5 Temperature Extremes (3 cold, 2 hot)
- 144 Thunderstorm and High Wind

These are generally typical numbers of events for the region based on equivalent information from surrounding counties.

Subsection 2.7.1.2 of the COLA ER describes possible impacts of hurricanes, tornadoes, thunderstorms, and hail at BLN. This section remains accurate with the exception of the tornado probability discussion in Subsection 2.7.1.2.2.

The COLA ER estimate is based on 1950-2005 data. Based on data from Jackson County alone, the probability of a tornado striking the site is calculated as 2.84E-4 (or a 0.000284/1 chance of a tornado striking the site within any single year). This converts to a tornado striking the site every 3,516 years (i.e., recurrence interval of 3,516 years). For data based on Jackson County and five surrounding counties, this probability is 6.44E-4 with a recurrence interval of 1,552 years.

When the tornado database extends to 2008, the probability calculation changes to 4.1E-4 with a recurrence interval of 2,460 years (for Jackson County only). For data based on Jackson County and five surrounding counties, this probability is 6.7E-4 with a recurrence interval of 1,482 years.

3.16.1.2. Environmental Consequences

Alternative A
Under the No Action Alternative, because there would be no completion or construction and operation of a new plant, there would be no impacts.

Alternatives B and C
Atmospheric dispersion, or the transport and dilution of radioactive materials in the form of aerosols, vapors, or gasses released into the atmosphere from a nuclear power station are a function of the state of the atmosphere along the plume path, the topography of the region, and the characteristics of the effluents themselves. The downwind concentrations of released materials are estimated by atmospheric dispersion models and analysis. Atmospheric dispersion analysis considers two categories of radiological releases: routine and accident. The atmospheric dispersion (χ/Q) values for the B&W units were estimated for both release types using meteorological data collected at BLN during 2006-2008. The AP1000 atmospheric dispersion (χ/Q) values were estimated using meteorological data collected at BLN during 2006-2007 in order to maintain consistency with the atmospheric dispersion (χ/Q) values reported in the BLN COLA. Low atmospheric dispersion (χ/Q) values are indicative of better transport and dilution of released effluents. In all cases, the atmospheric dispersion characteristics of the BLN site result in off-site doses within the regulatory limits of 10 CFR Part 100 for accident effluent releases and 10 CFR Part 20 for normal effluent releases (see Section 3.17).

Routine Releases
For routine airborne releases, the concentration of the radioactive material in the surrounding region depends on the amount of effluent released, the height of the release, the momentum and buoyancy of the emitted plume, the wind speed, atmospheric stability, airflow patterns of the site, and various effluent removal mechanisms. Geographic features and surface roughness can also influence dispersion and airflow patterns.

NRC Regulatory Guide 1.111, “Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases from Light-Water-Cooled Reactors” (NRC 1977b), identifies types of atmospheric transport and diffusion models, source configuration, removal mechanisms, and input data that are acceptable to the NRC for use in providing assessments of potential annual radiation doses to the public resulting from routine releases of radioactive materials in gaseous effluents. The guidance on acceptable models and necessary input data provided in Regulatory Guide 1.111 are utilized in the calculation of annual average relative concentration (χ/Q) and annual average relative deposition (D/Q) values for gaseous effluent routine releases from BLN.

The XOQDOQ software, “Computer Program for the Meteorological Evaluation of Routine Effluent Releases at Nuclear Power Stations,” which is provided under NUREG/CR-2919 (NRC 1982b) and implements the guidance in Regulatory Guide 1.111, was used to develop these χ/Q and D/Q values. This program is used by the NRC meteorology staff in their independent evaluation of routine or anticipated intermittent releases at nuclear power plants.

Figures 3-17 and 3-18 provide the site layout and distances to the EAB for the B&W and AP1000 reactor units, respectively. Figures 3-19 and 3-20 provide the release vents and building heights for the B&W and AP1000 reactor units, respectively. Figure 3-21 provides the off-site receptor locations.

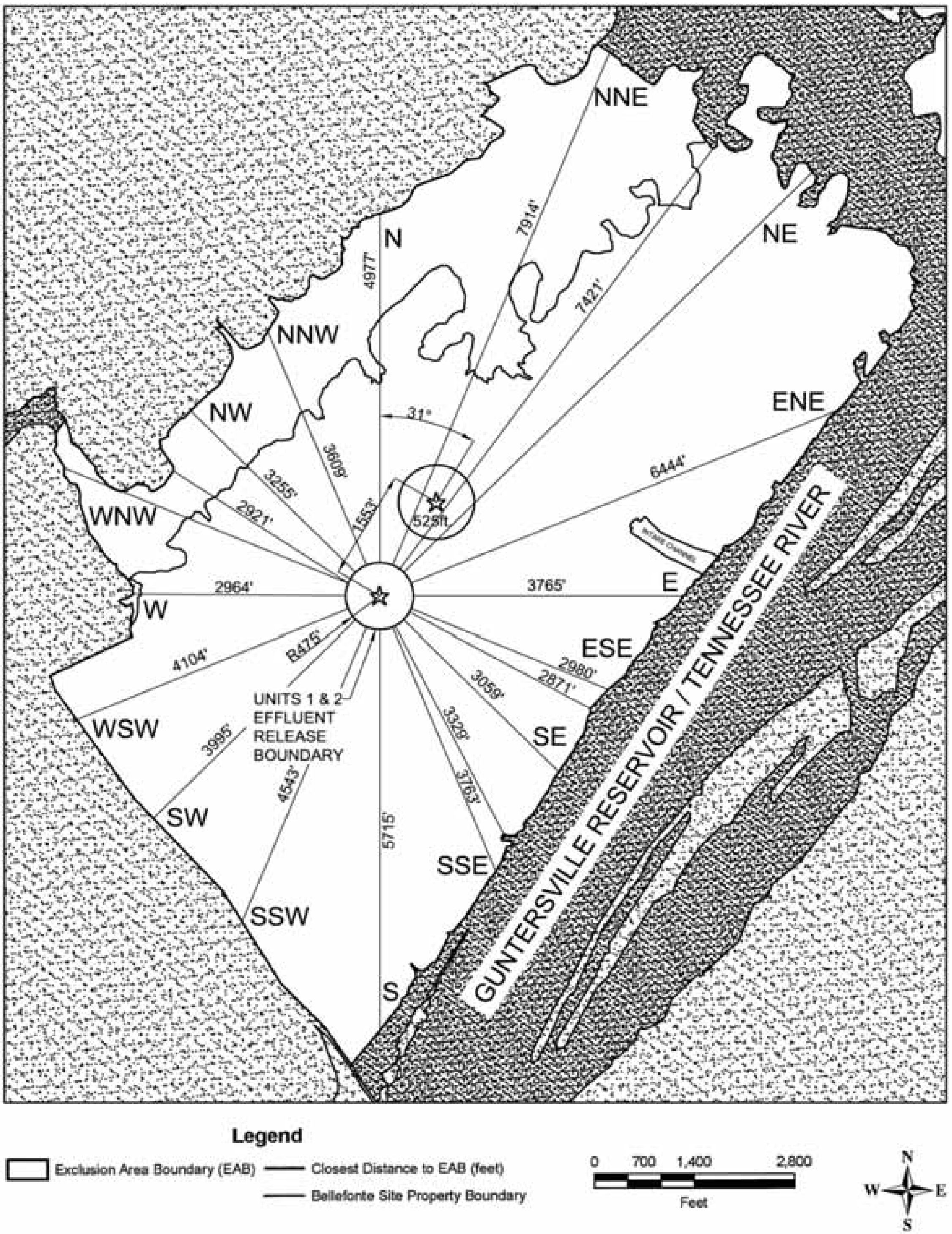


Figure 3-17. EAB Distance for B&W Reactor Unit Layout

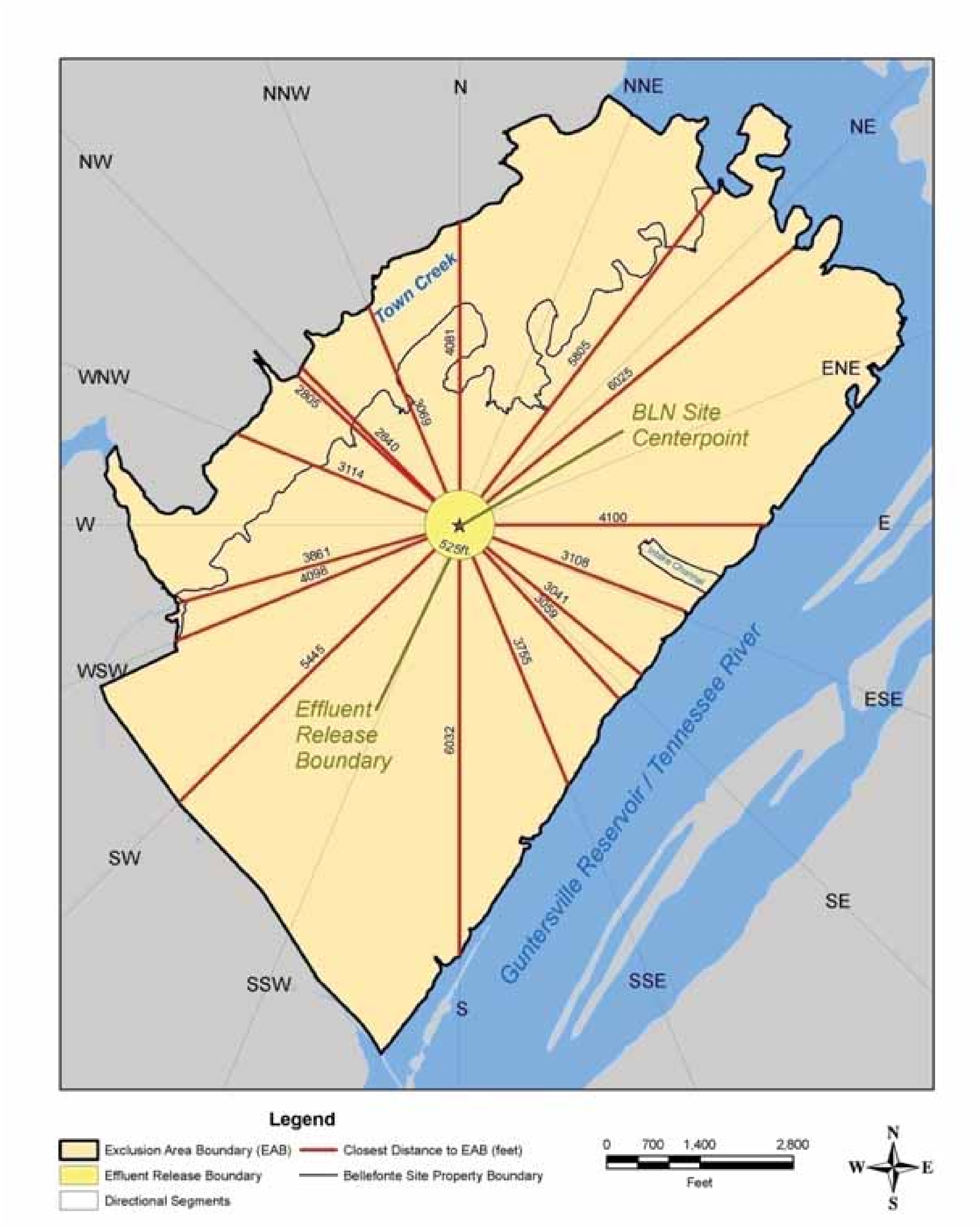


Figure 3-18. EAB Distance for AP1000 Reactor Units

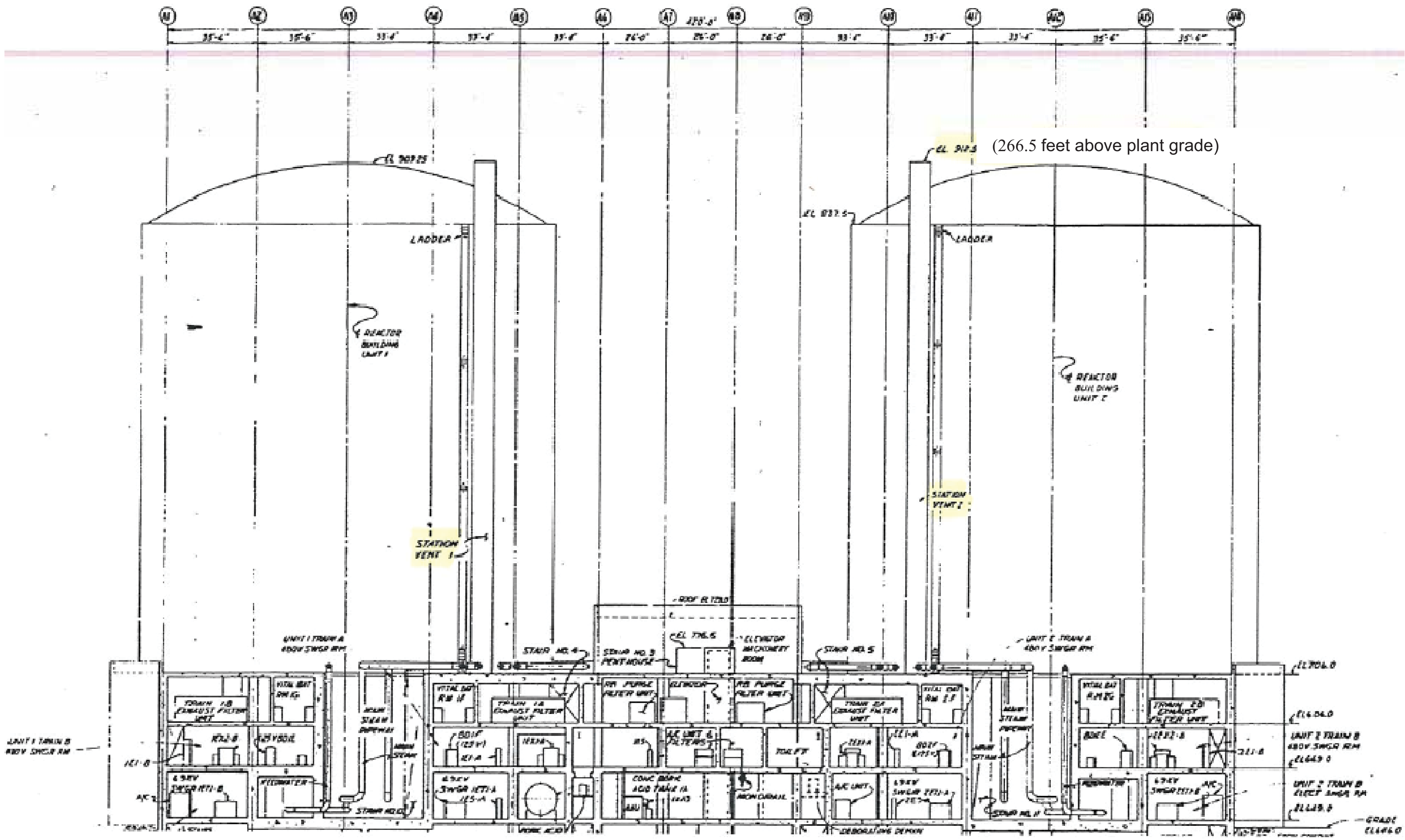
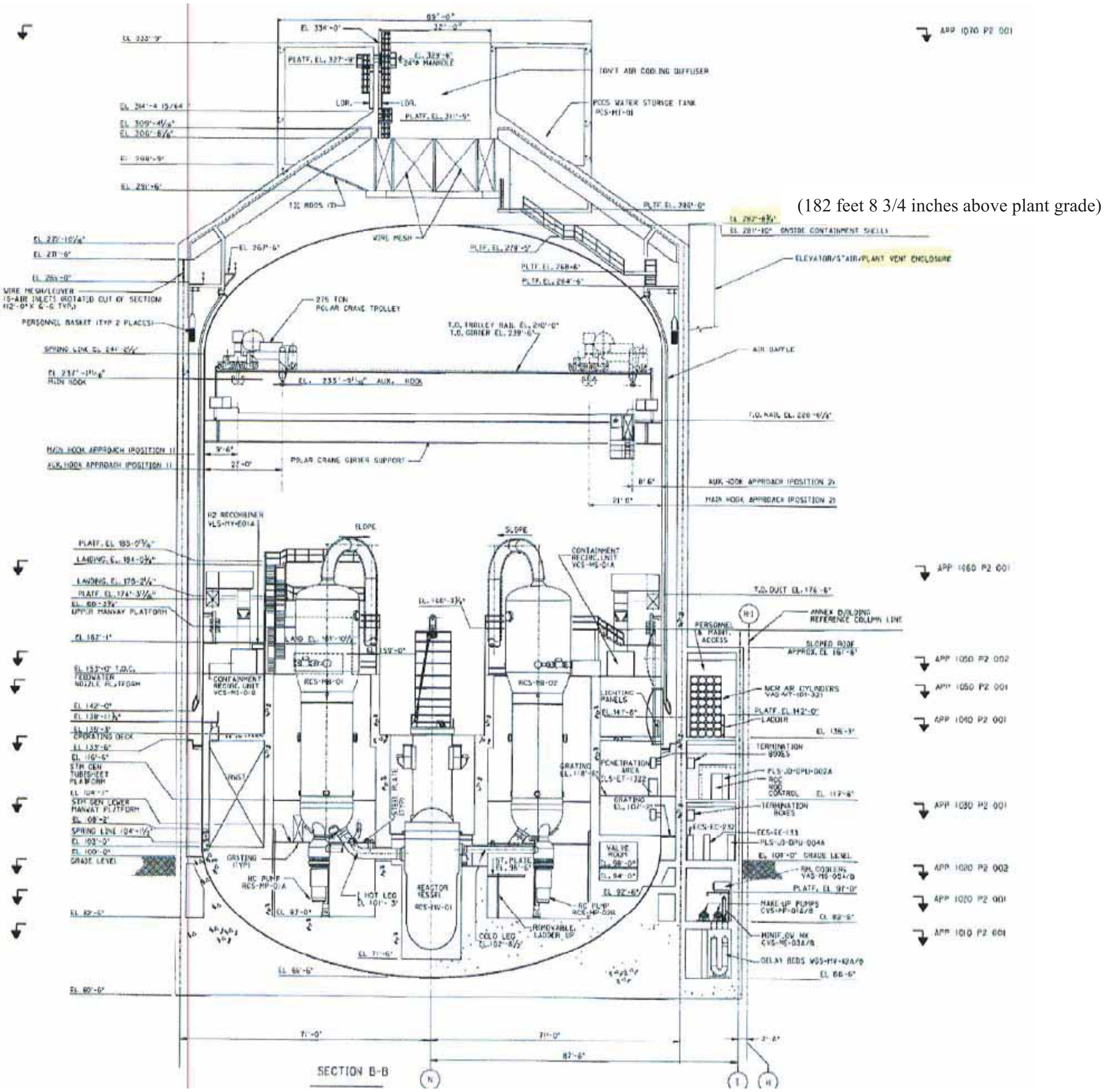
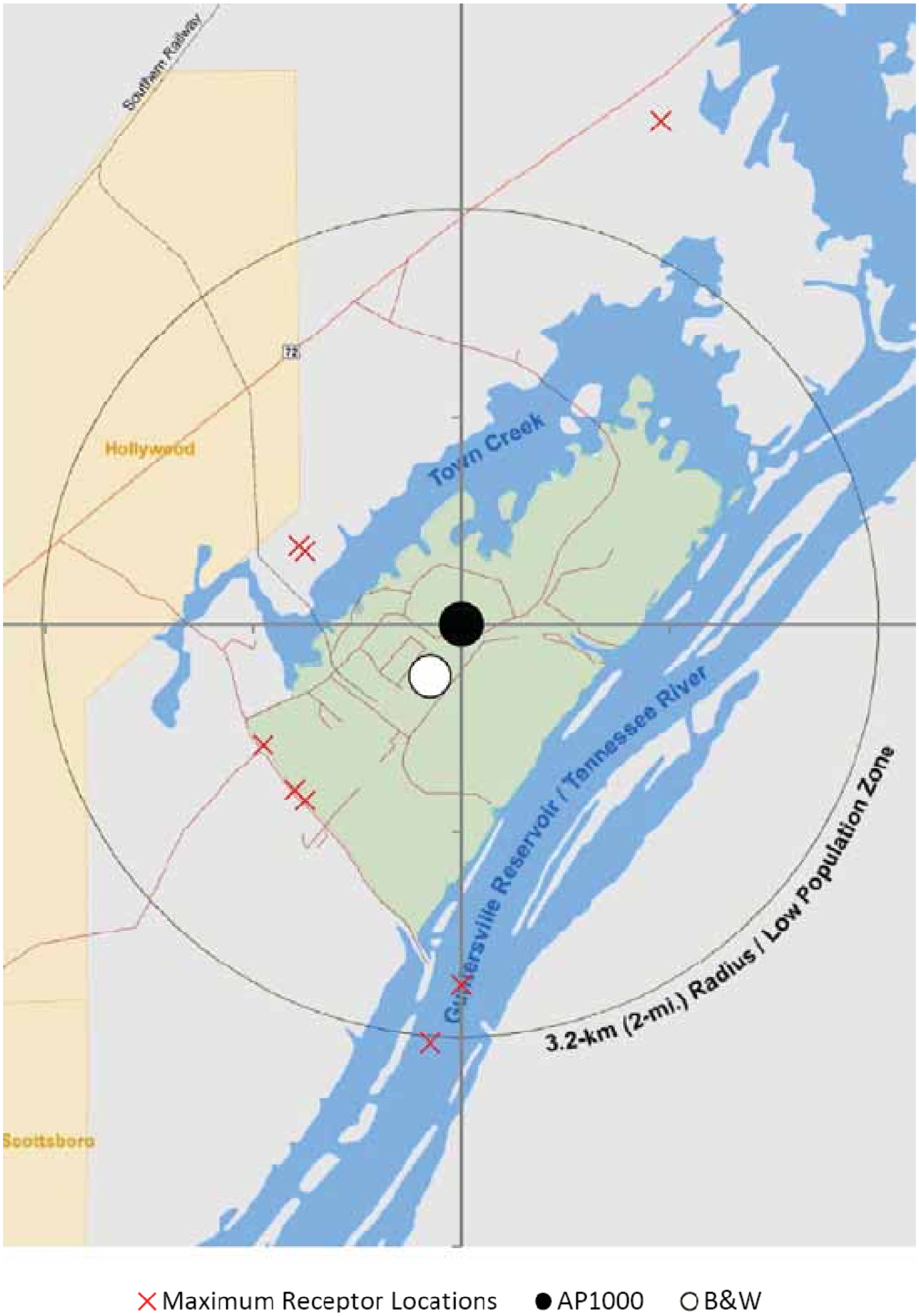


Figure 3-19. B&W Reactor Plant Vents and Building Heights



Source: WEC 2008

Figure 3-20. AP1000 Reactor Plant Vents and Building Heights



Note that the more conservative atmospheric dispersion (χ/Q) value of either a physical receptor location or a peak (χ/Q) value location were used for each pathway and dose analysis. Because peak (χ/Q) value locations do not represent a physical receptor type and are dependent only on meteorological conditions, distance from the release point, and release point conditions, the physical peak (χ/Q) locations may exist over water. These values and locations are used, regardless, for conservatism.

Figure 3-21. Maximum Atmospheric Dispersion (χ/Q) Value Receptor Locations

The atmospheric dispersion factors for normal releases were determined to provide a conservative estimate of the off-site doses due to normal airborne effluent releases. The locations with the highest χ/Q and D/Q values outside the EAB result in the most conservative off-site doses. Normally, the atmospheric dispersion factors decrease linearly with distance from the site such that larger distances produce lower concentrations (i.e., smaller χ/Qs). However, because a mixed-mode release is used for the station vent, there are locations outside of the site boundary where the χ/Q and D/Q values peak due to aerodynamic downwash. Therefore, the atmospheric dispersion (χ/Q) value used for each receptor type is the more conservative of the maximum peak χ/Q value or the χ/Q value for the actual receptor.

The dose pathways are evaluated at the most conservative location outside the EAB where a receptor currently exists. Because a mixed-mode release is also used, there are locations outside of the site boundary where the χ/Q and D/Q values peak. However, a comparison of the locations of the peaks to the locations of the nearest receptors in each sector demonstrates that the peaks occur at distances closer than the nearest receptor identified in the appropriate sectors. Because there are no actual receptors at the peak locations, the receptor location with the maximum χ/Q and D/Q values was used to evaluate all pathways except doses due to immersion in the plume. The highest χ/Q and D/Q values occur at the nearest garden in the southwest sector.The calculated atmospheric dispersion (χ/Q) values are a means of quantifying the relative concentration of released effluents. These values, in conjunction with the isotopic source description of the released effluents, are used to produce doses due to the released effluents. In order to account for radioisotope removal mechanisms accurately, atmospheric dispersion (χ/Q) values are calculated taking into account radioisotope removal via decay in transit corresponding to noble gas radionuclide Xe-133m decay (2.26-day half-life) [see Tables 3-14, 3-15, and 3-16, 2.26-day decay undepleted χ/Q values]. Atmospheric dispersion factors with decay and depletion are used in population dose calculations. For this case, radiological decay in transit is included corresponding to radioiodine I-131 (8-day half-life). Ground deposition factors (D/Qs) are used in population dose calculations. The ground deposition factors do not include radiological decay.

The B&W unit uses two main release locations, the station vent (266 feet above plant grade) and the turbine building vent (152 feet above plant grade). In accordance with the guidance from NRC Regulatory Guide 1.111, the station vent was modeled as a mixed-mode release because the release height is above the height of adjacent buildings. The turbine building vent was modeled as a ground level release because the release height is less than the containment building elevation. The locations with the Maximally Exposed Individual (MEI) doses are presented in Table 3-14 (station vent) and Table 3-15 (turbine building). In Tables 3-14 and Table 3-16, the column titled “Maximum Receptor Type Values” indicates whether the value selected represents an actual receptor location or whether the peak value is conservatively used as a surrogate location. This distinction is not necessary for Table 3-15 because the turbine building releases are ground level releases that do not exhibit off-site peak values. The distances given in Tables 3-14 and 3-15 are relative to the center point between Units 1 and 2. Likewise, the distances given in Table 3-16 are relative to the center point between Units 3 and 4.

The AP1000 unit uses the plant vent release location (182.6 feet above grade), which was modeled as a mixed-mode release as it is near the elevation of the tallest adjacent building. The locations with the MEI doses are presented in Table 3-16. In this table, the cow, goat,

and house receptor locations were assumed to be at the garden location to maximize the resulting doses even though these receptors do not occur at this location.

Table 3-14. B&W Unit Station Vent χ/Q Values Used for Calculating MEI Doses at BLN

Receptor Type Analyzed	Direction	Maximum Receptor Type Values	Distance (miles)	χ/Q (sec/m^3) No Decay Undepleted	χ/Q (sec/m^3) 2.26 Day Decay Undepleted	χ/Q (sec/m^3) 8.00 Day Decay Depleted	D/Q (m^{-2})
EAB	S	PEAK	1.77	2.4E-06	2.3E-06	2.3E-06	4.1E-09
GARDEN	SW	GARDEN	0.85	1.2E-06	1.2E-06	1.1E-06	8.3E-09
COW	S	PEAK	1.77	2.4E-06	2.3E-06	2.3E-06	4.1E-09
GOAT	S	PEAK	1.77	2.4E-06	2.3E-06	2.3E-06	4.1E-09
HOUSE	S	PEAK	1.77	2.4E-06	2.3E-06	2.3E-06	4.1E-09

Note: Receptor locations with maximum D/Q or χ/Q values for each receptor type for the station vent mixed-mode release

Table 3-15. BLN B&W Unit Turbine Building Vent χ/Q Values Used for Calculating MEI Doses

Type of Location	Sector	Distance (miles)	χ/Q (sec/m^3) No Decay Undepleted	χ/Q (sec/m^3) 2.26 Day Decay Undepleted	χ/Q (sec/m^3) 8.00 Day Decay Depleted	Max D/Q (m^{-2})
EAB	W	0.56	2.9E-05	2.9E-05	2.6E-05	2.9E-08
GARDEN	SW	0.85	2.0E-05	2.0E-05	1.7E-05	3.8E-08
COW	NW	0.89	6.1E-06	6.1E-06	5.4E-06	7.9E-09
GOAT	NNE	2.9	1.9E-06	1.8E-06	1.5E-06	1.9E-09
HOUSE	NW	0.81	7.8E-06	7.7E-06	6.9E-06	1.0E-08

Note: Receptor locations with maximum D/Q or χ/Q values for each receptor type for the turbine building ground-level release

Table 3-16. BLN AP1000 Unit χ/Q Values Used for Calculating MEI Doses

Receptor Type Analyzed	Direction	Maximum Receptor Type Values	Distance (miles)	χ/Q (sec/m^3) No Decay Undepleted	χ/Q (sec/m^3) 2.26 Day Decay Undepleted	χ/Q (sec/m^3) 8.00 Day Decay Depleted	D/Q (m^{-2})
EAB	S	PEAK	1.74	2.8E-06	2.7E-06	2.7E-06	4.8E-09
GARDEN	SW	GARDEN	1.13	1.1E-06	1.1E-06	1.0E-06	4.8E-09
COW	SW	GARDEN	1.13	1.1E-06	1.1E-06	1.0E-06	4.8E-09
GOAT	SW	GARDEN	1.13	1.1E-06	1.1E-06	1.0E-06	4.8E-09
HOUSE	SW	GARDEN	1.13	1.1E-06	1.1E-06	1.0E-06	4.8E-09

Reference: BLN AP1000 COL Application, Environmental Report Table 2.7-125

Note: Receptor locations with maximum D/Q or χ/Q values for each receptor type for the station vent mixed-mode release

As shown in Subsection 3.17.3.1, the favorable atmospheric dispersion characteristics presented in the above tables result in annual gaseous-effluent doses within the limits of Appendix I of 10 CFR Part 50 to any individual in unrestricted areas. Because of the favorable atmospheric dispersion at the BLN site, the doses due to routine gaseous effluents, when added to the doses due to liquid effluent releases, meet the requirements of 10 CFR §20.1301 and are not significant. The direct, indirect, and cumulative effects of routine gaseous and liquid effluent releases are expected to be minor.

Accidental Releases

The accident χ/Q values were determined for time periods of two hours, eight hours, 16 hours, four days, and 30 days, in accordance with the guidance of Regulatory Guide 1.145 and Regulatory Guide 1.70. The releases were conservatively modeled as ground-level releases because the highest release location, the plant vent, is less than 2.5 times the height of adjacent buildings.

For accidental releases to the EAB, the χ/Q calculations use a release boundary to determine distances. The release boundaries define the perimeters around all of the release locations for each unit. Therefore, all potential release locations would be contained within this release boundary. Receptor distances are then calculated based on the distance from the closest point on the release boundary perimeter to the EAB. For each of the 16 direction sectors, the distance used in this analysis represents the minimum distance to the EAB within a 45-degree sector centered on the compass direction of interest. This approach conservatively encompasses all release locations and results in higher accident χ/Q values at the EAB. For the B&W unit, a release boundary with a radius of 475 feet centered near the midpoint of the turbine building was used. For the AP1000 Unit, a release boundary with a radius of 525 feet centered on the BLN 3&4 site center was used.

For accidental releases to the Low Population Zone (LPZ), a circle with a 2-mile radius from the BLN site center is used, as shown in Figure 3-21.

In accordance with Regulatory Guide 1.145, the 50 percent probability χ/Q values were determined to provide more realistic doses (Tables 3-17 and 3-18).

Table 3-17. BLN B&W Unit 50 Percent Probability-Level Accident χ/Q Values (sec/m3)

Affected Area	0-2 Hours	0-8 Hours	8-24 Hours	24-96 Hours	96-720 Hours
EAB	1.07E-04				
LPZ		9.39E-06	8.09E-06	5.84E-06	3.66E-06

Table 3-18. BLN AP1000 Unit 50 Percent Probability-Level Accident χ/Q Values (sec/m3)

Affected Area	0-2 Hours	0-8 Hours	8-24 Hours	24-96 Hours	96-720 Hours
EAB	1.04E-04				
LPZ		9.65E-06	8.35E-06	6.09E-06	3.88E-06

The favorable atmospheric dispersion characteristics presented in the above tables result in accident doses at the EAB and LPZ that are well within the limits of 10 CFR Part 100, thereby demonstrating site suitability. The design-basis Loss-of-Coolant Accident (LOCA) dose results presented in Subsection 3.19.1 show that the highest EAB dose is 1.2 rem Total Effective Dose Equivalent (TEDE), compared with the 25 rem TEDE regulatory limit. As another means of comparison, the annual average dose per person from all sources is about 360 mrem (0.36 rem). Therefore, the doses due to accidental releases are not significant.

3.16.2. Air Quality

3.16.2.1. Affected Environment

The 1974 TVA FES identified anticipated gaseous emission rates from auxiliary systems for particulate matter (PM), sulfur dioxides, carbon monoxide, hydrocarbons, and nitrogen oxides. In the intervening years, different air quality standards and criteria have been developed and implemented. According to the 1974 FES, the oil-fired auxiliary steam generators would, at peak load, release sulfur oxides to the atmosphere from a 125-foot stack at a rate of almost 143 lb/hour or 18 grams/second. The maximum SO_2 concentration was calculated to be 0.12 ppm. This peak would occur quite close to the plant stack and decrease quite rapidly with distance. At the time of the 1974 FES, the State of Alabama SO_2 standard was 0.15 ppm for a 24-hour average. The current EPA NAAQS for SO_2 is 0.14 ppm for a 24-hour average. The 1974 FES concluded that the SO_2 releases from the oil-fired auxiliary steam generators were acceptable. The COLA ER Regional Air Quality section updated and discussed recent air quality criteria and attainment status of the area. It references an 8-hour ozone standard of 0.08 ppm, which is the 1997 standard. The newly revised 2008 8-hour ozone standard is 0.075 ppm. The $PM_{2.5}$ 24-hour standard has also been lowered from 65 micrograms per cubic meter (µg/m^3) to 35 µg/m^3, although this standard was not specifically referenced in the COLA ER.

A pertinent “air-shed” for the BLN site cannot be defined as parcels of air move among undefined boundaries, and regional pollutants are capable of long-range transport. However, the COLA ER identifies Jackson County as being located within the Tennessee River Valley (Alabama)-Cumberland Mountains (Tennessee) Interstate Air Quality Control Region. This region includes Colbert, Cullman, DeKalb, Franklin, Jackson, Lauderdale, Lawrence, Limestone, Madison, Marion, Marshall, Morgan, and Winston counties in Alabama and Bledsoe, Coffee, Cumberland, Fentress, Franklin, Grundy, Marion, Morgan, Overton, Pickett, Putnam, Scott, Sequatchie, Warren, White, and Van Buren counties in Tennessee (40 CFR §81.72). Typically, Class 1 areas are only identified within a 100-km radius of the site. The two Class 1 areas nearest to BLN are the Cohutta Wilderness, located in north Georgia, and the Sipsey Wilderness, located in north Alabama. Both are outside the 100-km radius from BLN. This information is shown on Figure 3-22.

The COLA ER identified Jefferson and Shelby counties in Alabama as being designated nonattainment for 8-hour ozone. Since the COLA ER, some of the nonattainment designations have changed for ozone. The original implementation schedule for the new NAAQS required states to send their recommended designations to EPA in March 2009 with EPA finalizing designations in March 2010. However, EPA is now reconsidering the ground-level ozone standards set in 2008. EPA is proposing to strengthen the 8-hour “primary” ozone standard to a level within the range of 0.060-0.070 ppm and to establish a distinct cumulative, seasonal “secondary” standard within the range of 7-15 ppm-hours. EPA will issue final standards by August 31, 2010. If the EPA issues different ozone

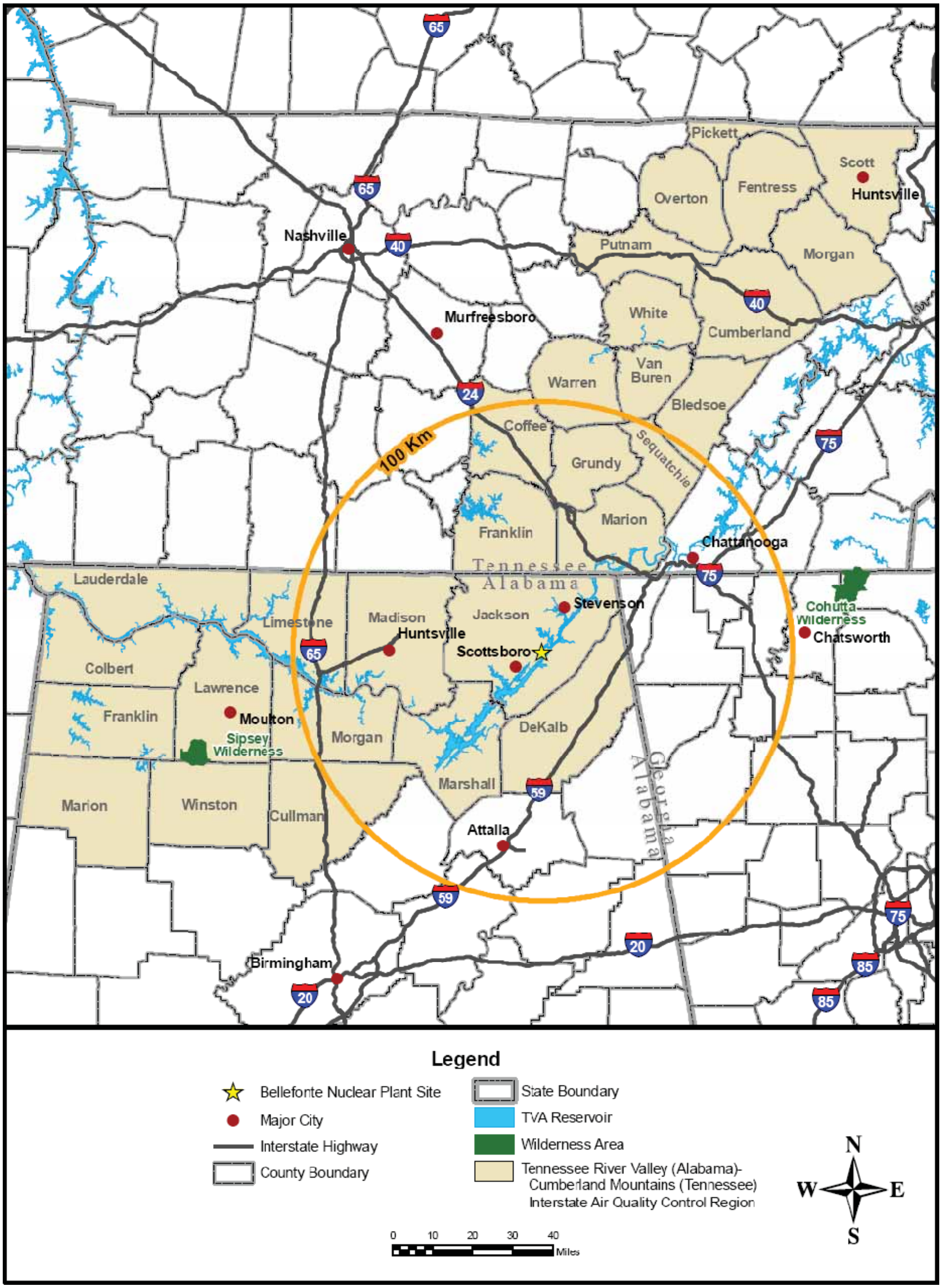


Figure 3-22. BLN 100 Kilometer Wilderness Area

standards at that time, an accelerated schedule for designating areas for the primary standard has been proposed. State recommendations would be due by January 2011, with EPA making final area designations by July 2011. As shown in Table 3-19, areas recommended for nonattainment designation in the vicinity of the Bellefonte site are located in north Alabama, north Georgia, and southeast Tennessee.

Table 3-19. Current Ozone Nonattainment State Recommendations Near BLN

County	State Recommendations	City/State
Jefferson County, Alabama	Ozone - Whole County	Birmingham, Ala.
Shelby County, Alabama	Ozone - Whole County	Birmingham, Ala.
Madison County, Alabama	Ozone - Whole County	Huntsville, Ala.
Murray County, Georgia	Ozone - Partial County	Georgia
Hamilton County, Tennessee	Ozone - Whole County	Chattanooga, Tenn.
Meigs County, Tennessee	Ozone - Whole County	Chattanooga, Tenn.

Source: EPA 2008b

The COLA ER identified the Birmingham area counties of Jefferson, Shelby, and part of Walker as being designated nonattainment for 24-hour $PM_{2.5}$. In addition, part of Jackson County was designated nonattainment due to Chattanooga exceeding the annual $PM_{2.5}$ NAAQS. As discussed previously, the $PM_{2.5}$ 24-hour standard was lowered in 2006 from 65 $\mu g/m^3$ to 35 $\mu g/m^3$, with EPA finalizing designations in December 2008. At this time, EPA retained the 1997 annual fine particle standard of 15 $\mu g/m^3$, with designations effective since 2005. As shown in Table 3-20, the nearest nonattainment areas to the Bellefonte site are located in central Alabama and east Tennessee. It should be noted that the portion of Jackson County that is listed as nonattainment does not encompass the area around the Bellefonte site.

Table 3-20. Current $PM_{2.5}$ Nonattainment Designations Near BLN

County	Designation	City/State
Jefferson County, Ala.[1]	$PM_{2.5}$ - Whole County	Birmingham, Ala.
Shelby County, Ala.[1]	$PM_{2.5}$ - Whole County	Birmingham, Ala.
Walker County, Ala.[1]	$PM_{2.5}$ - Partial County	Birmingham, Ala.
Jackson County, Ala.[2]	$PM_{2.5}$ - Annual Only - Partial County	Chattanooga, Tenn.-Ga.
Catoosa County, Ga.[2]	$PM_{2.5}$ - Annual Only - Whole County	Chattanooga, Tenn.-Ga.
Walker County, Ga.[2]	$PM_{2.5}$ - Annual Only - Whole County	Chattanooga, Tenn.-Ga.
Hamilton County, Tenn.[2]	$PM_{2.5}$ - Annual Only - Whole County	Chattanooga, Tenn.-Ga.

[1] EPA 2006
[2] EPA 1997

3.16.2.2. Environmental Consequences

Alternative A

Under the No Action Alternative, the equipment would not be replaced nor operated, and there would be no increase in vehicular traffic; therefore, these emissions would not occur.

Alternatives B and C

Under Alternative B, construction activities and intermittent operation of emergency diesel generators and potentially the auxiliary boilers would emit small amounts of air pollutants as addressed in the 1974 TVA FES. Adoption of Alternative C would involve more construction activities than Alternative B, while activities related to operations of Alternative C would be roughly equivalent to, or slightly less than, those under Alternative B.

The current EPA NAAQS for SO_2 is 0.14 ppm for a 24-hour average. The 1974 FES concluded that the SO_2 releases from the oil-fired auxiliary steam generators were acceptable. Even with the slightly lower NAAQS, it is still believed that these releases are acceptable. The auxiliary oil-fired boilers associated with the B&W auxiliary steam generators have since been sold and various options for their replacement are being considered, including an electric boiler, which would have no emissions. Because the AP1000 also utilizes an electric boiler, no emissions would occur from the auxiliary boiler with Alternative C. Therefore, operational activities, emissions, and impacts related to Alternative C would be roughly equivalent to, or less than those under Alternative B. The emissions related to either alternative would be controlled to meet applicable regulatory requirements such that resulting impacts are minor.

According to workload projections for Alternative B, an estimated peak of approximately 3,000 personnel would be on site during construction, and approximately 800 personnel would be on site once the plant is operational. Based on these projections and ALDOT statistics for Jackson County, anticipated vehicular traffic would increase as much as 21 percent during peak construction and as much as 6 percent after the plant becomes operational. According to workload projections for Alternative C, an estimated peak of approximately 3,000 personnel would be on site during construction, and approximately 650 personnel would be on site once the plant is operational. Based on these projections and ALDOT statistics for Jackson County, anticipated vehicular traffic would increase as much as 20 percent during peak construction and as much as 5 percent after the plant becomes operational. These percentages are “worst case” meaning they assume that none of the added workforce is local, and therefore not already accounted for in the current traffic statistics, and no carpooling.

The personal vehicle emissions related to either alternative would likely be only for a few hours each day, during shift changes. Gasoline and diesel emissions, in personal vehicles and construction vehicles and equipment, related to either alternative would be controlled to meet current applicable regulatory requirements such as those found in EPA 40 CFR Part 80, which provides regulations concerning fuel and fuel additives. Due to fuel regulations and the intermittent nature of the emissions, the resulting impacts are minor.

Cumulative impacts on local or regional air quality during the course of construction and operation of a single unit at the BLN site would likely be minor and insignificant.

3.16.3. Global Climate Change

3.16.3.1. Affected Environment

Global Climate Change and Relationship to Greenhouse Gases

The topic of greenhouse gases (GHG) and global climate change (GCC) was not discussed in the original 1974 FES for BLN. In common usage, “global warming” often refers to the warming of the earth that can occur as a result of emissions of GHG in the atmosphere. Global warming can occur from a variety of both natural and anthropogenic causes. “Climate change” refers to any substantive change in measures of climate, such as temperature, precipitation, or wind. The two terms are often used interchangeably, but the climate change is broader as it conveys that there are other changes in addition to rising atmospheric temperature.

The following carbon cycle and CO_2 discussion is based primarily on TVA’s supplemental environmental assessment for the Tenaska Site (TVA 2008g). It is believed that certain

substances present in the atmosphere act like the glass in a greenhouse to retain a portion of the heat that is radiated from the surface of the earth. The common term for this phenomenon is the “greenhouse effect,” and it is essential for sustaining life on earth. Water vapor and, to a lesser extent, water droplets in the atmosphere are responsible for 90 to 95 percent of the greenhouse effect. The most abundant long-lived GHG are carbon dioxide (CO_2), methane, and nitrous oxide. Both man-made and natural processes produce GHG. According to some sources, increases in the earth’s average surface temperatures are linked in part to increasing concentrations of GHG, particularly CO_2, in the atmosphere. This has been a cause for concern among scientists and policymakers. On the international level, this phenomenon has been studied since 1992 by the United Nations Framework Convention on Climate Change, Intergovernmental Panel on Climate Change (IPCC).

The global carbon cycle is made up of large carbon sources and sinks. Billions of tons of carbon in the form of CO_2 are absorbed by oceans and living biomass (i.e., sinks) and are emitted to the atmosphere annually through natural and man-made processes (i.e., sources). When in equilibrium, carbon fluxes among these various reservoirs are roughly balanced. According to the IPCC (2007), since the Industrial Revolution (i.e., about 1750), global atmospheric concentrations of CO_2 have risen about 36 percent, principally due to the combustion of fossil fuels.

Greenhouse Gas Emissions

The primary GHG emitted by electric utilities is CO_2 produced by the combustion of coal and other fossil fuels; others include methane and nitrous oxide. Nuclear power plants do not emit large amounts of GHG in the normal course of reactor operations. However, fossil fuels are often used as part of the infrastructure needed to operate a nuclear power facility, primarily for the manufacture of the fuel that is used in the facility. Nuclear energy life-cycle emissions include emissions associated with construction of the plant, mining and processing the fuel, routine operation of the plant, waste disposal, and decommissioning. On a life-cycle-based comparison, nuclear-generated electricity emits about the same amount of GHG per kWh as renewable energy sources and far less than fossil fuel sources. This will be discussed in more detail in a later section.

Worldwide man-made annual CO_2 emissions from utilities are estimated at 29 billion tons, with the United States responsible for 20 percent. U.S. electric utilities, in turn, emit 2.5 billion tons, roughly 39 percent of the U.S. total. Figure 3-23 shows how TVA’s approximately 114 million tons of annual CO_2 emissions from energy production ranked in terms of worldwide, national, and industry emissions in 2004.

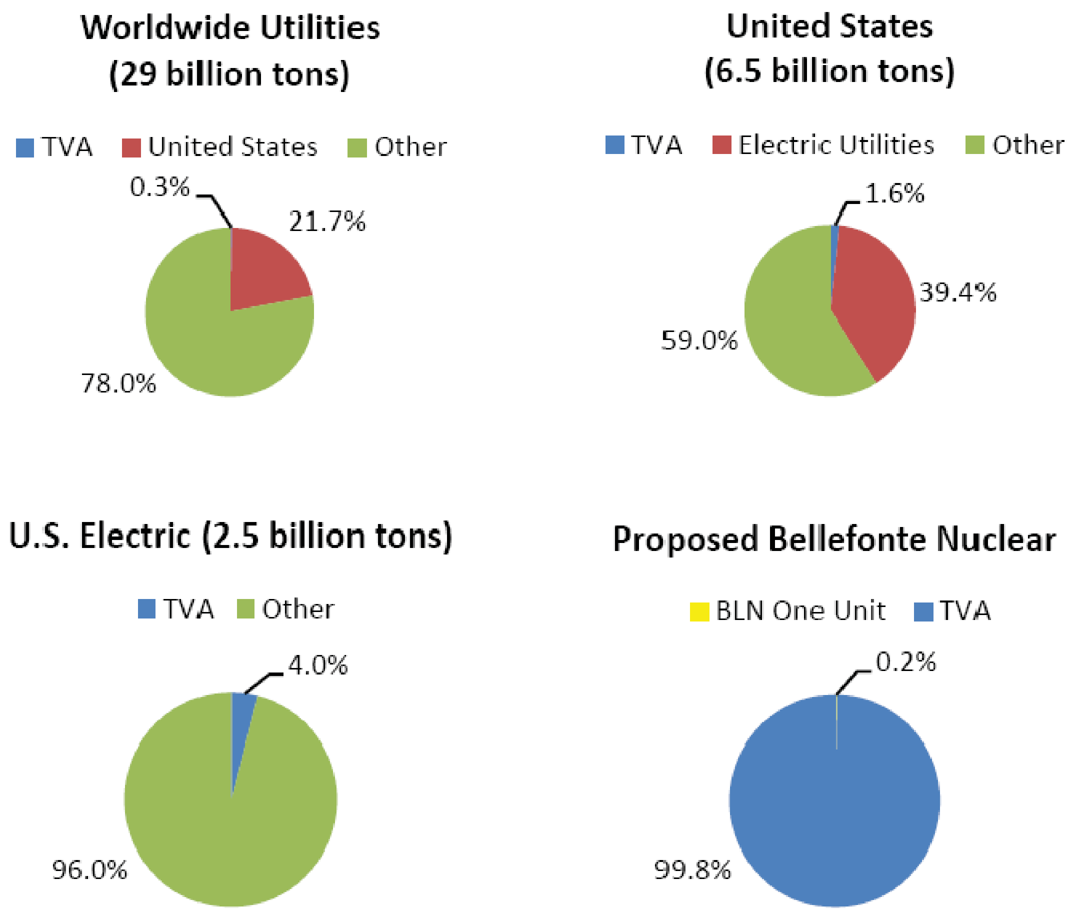


Figure 3-23. Man-Made Carbon Dioxide Emission Percentages in 2004

Regional Climate Change in the Southeast and the Tennessee River Valley
Compared to the rest of the United States, the climate of the Southeast is warm and wet, with high humidity and mild winters. The present-day regional climate specific to the Tennessee Valley and local meteorology are described in Subsection 3.16.1, along with air quality in Subsection 3.16.2. Average annual temperature across the southeastern United States did not change significantly over the last century; however, since 1970, annual average temperature has risen about 2°F. The greatest seasonal increase in temperature has been during the winter months. Since the 1970s, the number of freezing days in the Southeast has declined by four to seven days per year for most of the region. Average autumn precipitation has increased by 30 percent for the region since 1901. There has been an increase in heavy downpours in many parts of the region, while at the same time the percentage of the region experiencing moderate to severe drought increased over the past three decades (Global Climate Change Impacts 2009).

In order to understand future climate scenarios in the TVA region better, TVA contracted with the EPRI to prepare a report on the impacts of global climate change on various resources throughout the Tennessee Valley, including water and air, which could be

reasonably anticipated to occur over the 21st century (EPRI 2009b). Emphasis was placed on the near future (through 2050) as high uncertainty exists for longer-range predictions. The basis for this report is the United Nations IPCC's Fourth Assessment Report, published in 2007, and assumes a medium GHG emissions projection, which does not reflect additional efforts to reduce GHG emissions. In addition to this report, TVA received and reviewed comments (Christy 2009) on the 2009 EPRI report (EPRI 2009b). The 2009 EPRI report forecasts temperatures to increase as much as +0.8°C between 1990 and 2020, and +4°C by the end of the 21st century in the TVA region. Christy (2009) presented two arguments regarding these estimates. First, based on historical climate records, a change of +0.8°C in 30 years is within the natural climate variations of the region. Second, the +4°C estimate is an "up to" result that is the least likely to occur. Furthermore, evidence suggests that climate models are often too sensitive to CO_2 and therefore overestimate temperature rise (Spencer 2008). Precipitation forecasts are more uncertain and vary depending on location in the Valley and time of year. According to the EPRI report, precipitation is forecast to increase in the winter across the Valley as a whole, while in the western portion of the Valley, summers may be drier, and in the eastern portion of the Valley, summers may remain unchanged. Changes in water resource practices may become necessary to adapt to changes in the temporal distribution of precipitation across the region. It is important to emphasize that the current scientific knowledge of climate change is improving but still contains a great amount of uncertainty.

3.16.3.2. Environmental Consequences

Alternative A

In order to meet its obligation to provide safe, reliable power to the region, TVA would need to either purchase the power from other sources, or build elsewhere to create the additional generating capacity identified in the Need for Power discussion. As part of the diverse mix of TVA generation assets, this capacity would be above and beyond that which was obtained from other sources such as energy efficiency efforts or purchase of power from renewable energy sources (see Section 1.4). If purchased, assuming such power would be regionally available when needed, the probable sources of that power would be other base load sources, either fossil-fueled (gas-fired) or nuclear generation from other neighboring utilities. Additionally this No Action Alternative does not meet the portion of TVA's purpose and need of maximizing use of existing TVA assets. If TVA had to construct such nuclear capacity elsewhere, the amounts of GHG created would be greater than those created by the completion of a B&W unit at the BLN site, because it is already partially completed. Furthermore, if a fossil fuel-fired source were constructed to fill this need, as discussed below, the emission of GHG during construction or operation of the facility and from other aspects of the associated fuel cycle would be substantially greater.

Alternatives B and C

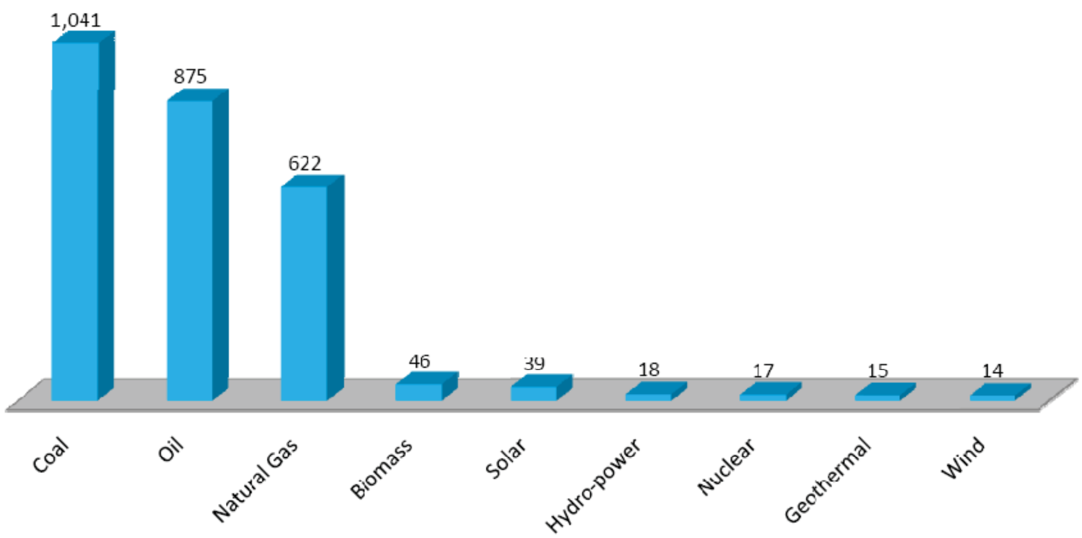
There are primarily two ways in which one BLN unit would potentially interact with GHG and GCC. The first is the emissions of GHG resulting from the construction and operation of one BLN unit operation; as noted above, these emissions would occur through the life cycle of the plant, including the uranium fuel cycle (UFC). The second is the manner in which climate change could affect operations of the BLN facility itself.

Lifecycle Nuclear Greenhouse Gas Production & Mitigation Potential

As discussed previously, nuclear power plants do not emit GHG in large quantities during the normal course of operations. However, fossil fuels are used as part of the infrastructure needed to operate a nuclear power facility, primarily for the manufacture of the fuel that is used in the facility. Nuclear energy life-cycle emissions include emissions associated with construction of the plant, mining and processing the fuel, routine operation of the plant, waste disposal, and decommissioning. Numerous studies demonstrate that over the life cycle of the fuel, electricity generated from nuclear power results in emissions of about the same amount of GHG per kWh as renewable energy sources and far less than fossil fuel sources. One such study is Meier (2002). Using data from that study, Figure 3-24 displays the life-cycle GHG emissions of various energy sources. The GHG emissions are expressed in terms of CO_2 equivalents, in which the emissions of the various GHG are weighted according to their global warming potential relative to the global warming potential of CO_2. The largest variables in life-cycle GHG emissions of a nuclear plant, aside from the operating lifetime, electrical output, and capacity factor, are the type of uranium enrichment process and the source of power for enrichment facilities. Current enrichment facilities use the energy-intensive gaseous diffusion process largely powered by fossil fuels. New enrichment facilities currently under construction will use much less energy-intensive processes resulting in reduced nuclear plant life-cycle GHG emissions. Although the construction-related life-cycle GHG emissions of the Alternative B B&W unit would be slightly less than those of the Alternative C AP1000 unit because the B&W unit would require less construction of new facilities, the difference in overall life-cycle GHG emissions would be negligible.

According to the U.S. Department of Energy (DOE) and NRC estimates, approximately 115,747 tons of carbon would be produced for every 1,000 MW of power produced from a nuclear power plant operating year-round (NRC 2008). Using these estimates, the addition of one unit at the BLN site operating in a projected maximum capacity mode would increase TVA's total CO_2 emissions by approximately 150,000 tons annually. This is less than 0.5 percent of TVA's total output of CO_2.

Even considering life-cycle emissions, the resulting emissions GHG (in CO_2 equivalents) would overall be substantially less than that of a comparable 1,100-1,200 MW coal-fired plant supplying equivalent base load power. As such, nuclear power (i.e., BLN for example), is an effective alternative to help TVA reduce GHG emissions. Given the need for additional capacity (i.e., beyond what can be offset by energy-efficiency efforts), the nuclear option overall leads to substantially lower emissions of GHG than other major sources of new generation in the Tennessee Valley and adjoining service areas in the Southeast and Central United States.



Source: Meier 2002

Figure 3-24. Tons of CO_2 Equivalent Emitted per Gigawatt Hour

Potential for Effects of Climate Change on BLN Operations

Higher air and water temperatures and altered frequency of precipitation resulting from climate change can influence processes for maintaining compliance with environmental and safety standards at nuclear (and fossil) plants, as well as the efficiency of plant operations. Similar to other TVA nuclear plants, BLN would withdraw cooling water from the Tennessee River to operate the plant condenser cooling water system. However, as compared to a once-through, open cooling system, the amount of water needed for the operation of BLN would be reduced considerably by the use of a closed-cycle cooling system. For closed-cycle cooling, water containing waste heat from the condensers is conveyed through cooling towers where the waste heat is rejected to the atmosphere by evaporation. The cooled water, exiting the towers, is then returned and reused in the condensers. This design feature significantly reduces the volume of water needed from the river. Essentially, the water required for secondary plant systems, and that necessary to replenish the loss due to evaporation and cooling tower blowdown, constitute the makeup water. On a daily average basis, the makeup water for a closed-cycle system is typically less than 5 percent of the volume of water that would be required for once-through system. The BLN operation would be less susceptible to climate change influences because it is equipped with a closed-cycle cooling system.

Regulatory requirements for environmental compliance prescribe the maximum temperature of water that could be released from BLN into the Tennessee River. Additional information concerning the BLN requirements for water temperature and the expected impact of the plant releases on the river are discussed in Subsection 3.1.3.

At generating plants with closed-cycle cooling such as BLN, the cooling towers are operated continuously. Increased temperature of the makeup water from the river reduces the efficiency of the power production cycle. In general, hotter, more humid air is less

receptive to evaporation, thereby also reducing the efficiency of cooling tower performance and potentially reducing power output. This is expected to be the case for the hyperbolic, natural draft cooling towers that currently exist at BLN.

When cooling water intake temperatures are high at a closed-cycle plant, derating would be an option available to avoid exceeding the thermal limits of the current NPDES permit, as well as other environmental and safety limits addressed in Subsection 3.1.3. The estimated need for derating of BLN under baseline conditions and current meteorology would occur approximately 0.04 percent of the time under both Alternatives B and C. The construction of additional cooling capacity is a possibility if such derating events become operationally or financially unacceptable.

TVA has previous operational experience in managing the river system during extended, extreme meteorological events. In response to a record drought in the 1980s in the Tennessee River Valley, TVA conducted a multiphase study to assess the impacts of extreme meteorology on the TVA reservoir system and power supply (Miller et al. 1993). The base study examined effects to power operations during representative years in which air temperatures were 3°F cooler and 25 percent wetter (1974), as well as years that were 2°F warmer and 60 percent drier (1986) than normal, in combination with modeled projections. The analysis identified the interrelationship, resiliency, and vulnerabilities of the reservoir and power supply systems to meteorological extremes. Important general trends and critical operating thresholds were also identified. Because the vulnerability of specific plants is a function of plant design, location, and stringency of regulatory constraints, the results of this multiphase study can only provide general indicators of how operations of a closed-cycle plant, such as BLN, located on the midreach of the Tennessee River could be affected.

The Miller study (1993) showed that in the upper Tennessee River drainage, for each 1°F increase in air temperature (April through October), water temperatures increased by 0.25°F to almost 0.5°F, depending upon year and location in the TVA reservoir system. In general, air temperature effects cascaded down the reservoir system. In the Tennessee River system, for both closed- and open-cycle TVA nuclear plants in Tennessee (on or above Chickamauga Reservoir) and in Alabama (on Wheeler Reservoir below both Chickamauga Reservoir and Guntersville Reservoir where BLN is situated), this study found that the incremental impact to operations from increased temperature were greatest during hot-dry years. Operation of nuclear facilities in the TVA power system was resilient to temperature increases during cold-wet and average meteorological years.

Given the general nature of this study (1993) and its uncertainties, some effects on BLN operations may be anticipated assuming an initial 40-year license that runs from approximately the 2018-2020 time frame to about 2058-2060. Thermal, mechanical, and operational limitations; cooling tower performance and use; and environmental and intake safety limits for water temperature would adversely affect the performance of the plant. While plant performance could potentially also be affected by climate change impacts, some of these impacts could be partially ameliorated by the flexibility that the ROS FEIS (TVA 2004) provides TVA in operating the Tennessee River and tributaries as an integrated system.

Based upon (1) the projected air temperature increases discussed in the EPRI report; (2) the relationship of plant performance to intake water temperatures indicated in the 1993 study (Miller et al. 1993); and (3) the existing NPDES permit requirements for BLN, the use of cooling towers in closed-cycle operation in combination with derates would enable BLN

to remain in regulatory and safety compliance during the initial 40-year licensing period. However, during the licensed period of 40 years, an incremental increase should be anticipated in the frequency of derate events to avoid exceeding thermal limits, slightly more for Alternative B than for Alternative C.

3.17. Radiological Effects of Normal Operations

This section discusses the potential radiological dose exposure to the public during normal operation of a BLN B&W unit or an AP1000 unit. The impact of the B&W units was assessed in TVA's 1974 FES and reviewed in the AEC's 1974 FES. In the FES the AEC concluded, "No significant environmental impacts are anticipated from normal operational releases of radioactive materials. The estimated dose to the public within 50 miles from operation of the plant is about 2 man-rems/year, less than the normal fluctuations in the 144,000 man-rems/year background dose this population would receive."

Although the BLN B&W unit FES and AEC's review predated the issuance of Appendix I of 10 CFR Part 50 (NRC 2007b), when compared to the Appendix I guidance, the BLN B&W unit would fully comply. Appendix I provides numerical guides for design objectives and limiting conditions for operation to meet the criterion "as low as reasonably achievable" (ALARA) for radioactive material in light-water cooled nuclear reactor effluents. The new analyses presented in Subsection 3.17.2 regarding the BLN B&W unit are in agreement with the earlier assessments; doses to the public resulting from the discharge of radioactive effluents from a BLN B&W unit would be a small fraction of the NRC guidelines given in 10 CFR Part 50, Appendix I.

The impact of the AP1000 units was assessed in the COLA ER. TVA has determined that the doses to the public resulting from the discharge of radioactive effluents from an AP1000 unit would be a small fraction of the NRC guidelines given in 10 CFR Part 50, Appendix I.

3.17.1. Affected Environment

Exposure Pathways

Evaluation of the potential impacts to the public from normal operational releases is based upon the probable pathways to individuals, populations, and biota near the BLN site. The exposure pathways, described in NRC Regulatory Guides 1.109 and 1.111 (NRC 1977a; 1977b), are illustrated in Figure 3-25. The critical pathways to humans for routine radiation releases from a facility at the BLN site are exposure from radionuclides in the air, inhalation of contaminated air, drinking milk from a cow that feeds on open pasture near the site, eating vegetables from a garden near the site, and eating fish caught in the Tennessee River.

Radiation exposure pathways to biota other than members of the public were assessed to determine if the pathways could result in doses to biota greater than those predicted for humans. This assessment used surrogate species that provide representative information on the various dose pathways potentially affecting broader classes of living organisms. Surrogates are used because important attributes are well defined and are accepted as a method for judging doses to biota. Surrogate biota used includes algae (surrogate for aquatic plants), invertebrates (surrogate for fresh water mollusks and crayfish), fish, muskrat, raccoon, duck, and heron.

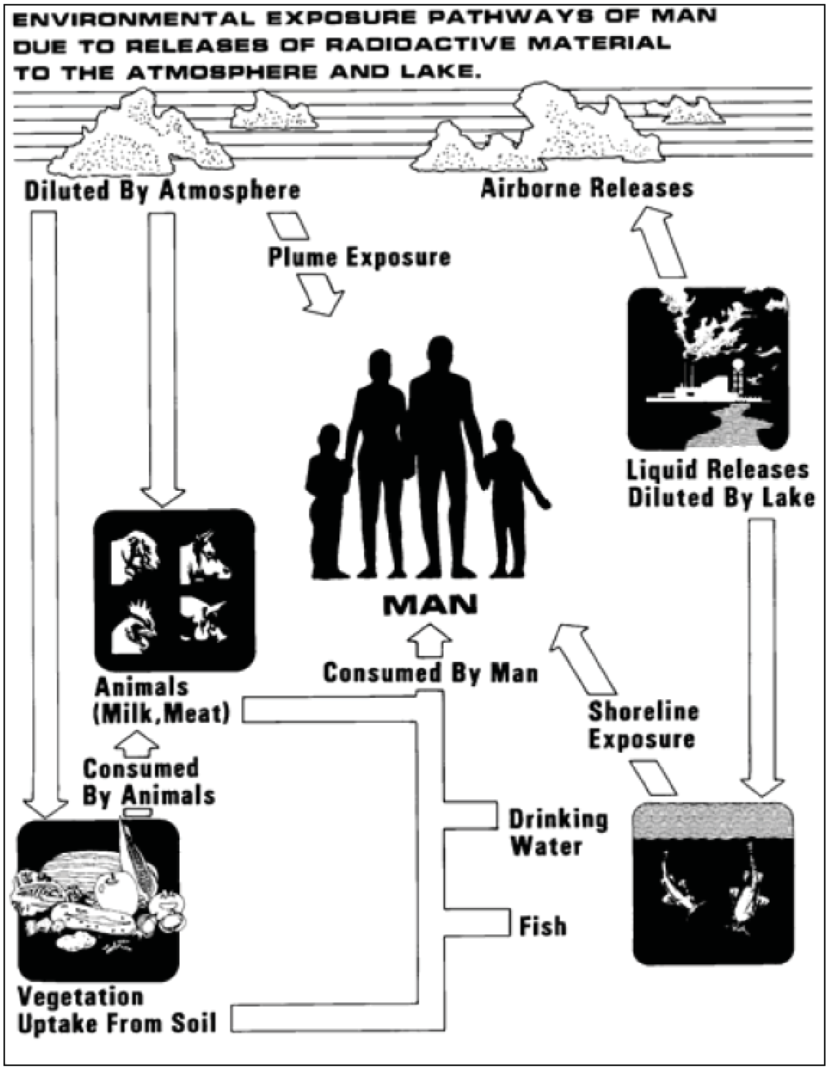


Figure 3-25. Possible Pathways to Man Due to Releases of Radioactive Material

The exposure pathways to humans that were used in the B&W unit 1974 FES and the COLA ER analyses for liquid effluents remain valid and include the following:

- External exposure to contaminated water by way of swimming, boating, or walking on the shoreline.
- Ingestion of contaminated water.
- Ingestion of aquatic animals exposed to contaminated water.

Exposure pathways considered include external doses due to noble gases, internal doses from particulates due to inhalation, and the ingestion of milk, meat, and vegetables (including grains) within a 50-mile radius around the BLN site.

Exclusion Area Boundary
As defined in 10 CFR Part 100, the EAB identifies the area surrounding the reactor, in which TVA has the authority to determine all activities including exclusion or removal of

personnel and property from the area. The boundary on which limits for the release of radioactive effluents are based is the site EAB as shown in Figure 2-3. The EAB follows the site property boundary on the land-bound side and the Tennessee River side. The EAB also extends across the site property boundary to the opposite shore of Town Creek on the northwest side of the property. There are no residents living in this exclusion area. No unrestricted areas within the site boundary area are accessible to members of the public. The Town Creek portion of the EAB is controlled by TVA. Access within the site property boundary is controlled. Areas outside the exclusion area are unrestricted areas in the context of 10 CFR Part 20 and open to the public.

3.17.2. Environmental Consequences

Alternative A
Under the No Action Alternative, completion or construction and operation of a new nuclear plant would not occur; therefore, there would be no radiological impacts.

Alternatives B and C
Estimates of doses to the MEI and the general population during routine operations for Alternatives B and C, and for both the liquid and gaseous effluent pathways, are described in the following paragraphs.

Radiation Doses Due to Liquid Effluents
The release of small amounts of radioactive liquid effluents is permitted for the new facility at the BLN site, as long as releases comply with the requirements specified in 10 CFR Part 20. The liquid effluent exposure pathways given in Subsection 3.17.1 were considered in the evaluation of radiation doses to the public resulting from radioactive liquid effluent releases. Current analyses of potential doses to members of the public due to releases of radioactivity in liquid effluents are calculated using the models presented in NRC Regulatory Guide 1.109 (NRC 1977a). These models are essentially those used in the 1974 FES, and are based on the International Commission on Radiological Protection Publication 2 (ICRP 1959). Changes in the model and inputs since the 1974 FES include the following:

- Doses to additional organs (kidney and lung) have been calculated.
- River water use (ingestion, fishing) and recreational use data have been updated (see Tables 3-21 and 3-22).
- Decay time between the source and consumption is as described in NRC Regulatory Guide 1.109.
- Only those doses within a 50-mile radius of BLN are considered in the population dose.
- The population data are updated and projected through 2057.

The location of public water suppliers and the estimated 2057 populations are given in Table 3-21 and recreational users are given in Table 3-22.

Table 3-21. Public Water Supplies Within a 50-Mile Radius Downstream of BLN

Location	Tennessee River Mile	Estimated 2057 Population
Fort Payne, Alabama	387	29,412
Scottsboro, Alabama	385.8	24,059
Section and Dutton, Alabama	382	12,941
Albertville, Alabama	361	58,823
Guntersville, Alabama	357	7,647
Arab, Alabama	356	25,294

Table 3-22. Recreational Use of Tennessee River Within 50-Mile Radius Downstream of BLN

Pathway	Tennessee River Miles	Estimated 2057 Usage
Sport Fishing (Guntersville Reservoir)	391.5 - 349	73,440 visits/year
Shoreline Use (Guntersville Reservoir)	391.5 - 349	22,814,630 person-hour/year
Swimming (Guntersville Reservoir)	391.5 - 349	22,814,630 person-hour/year
Boating (Guntersville Reservoir)	391.5 - 349	22,814,630 person-hour/year

Other data used in the calculation of doses to the public such as transfer coefficients, consumption rates, and bioaccumulation factors are obtained from Regulatory Guide 1.109 (NRC 1977a).

The BLN 1&2 FSAR (TVA 1991) provided estimated liquid effluent releases based on the guidance given in NUREG-0017 (NRC 1976). The estimated liquid radioactive effluent releases used in the updated analyses are given in Table 3-23 for a B&W unit. As described in Subsection 3.18.1.2, these estimates are expected to envelope the effluent releases from the upgraded liquid radwaste system. The liquid radioactive effluent releases for an AP1000 unit given in Table 3-24 were obtained from Table 11.2-7 of the AP1000 DCD (WEC 2008).

Table 3-23. BLN Annual Discharge for a Single B&W Unit via Liquid Pathway

Nuclide	Total Release (Ci/y)	Nuclide	Total Release (Ci/y)
Br-84	2.295E-11	Sr-90	8.865E-09
I-129	3.744E-11	Sr-91	1.294E-07
I-131	2.737E-03	Sr-92	3.115E-09
I-132	1.376E-05	Y-90	3.766E-09
I-133	1.375E-03	Y-91m	5.075E-08
I-134	5.700E-08	Y-91	4.016E-08
I-135	2.966E-04	Zr-95	1.840E-03
Rb-88	5.715E-11	Nb-95	2.620E-03

Nuclide	Total Release (Ci/y)	Nuclide	Total Release (Ci/y)
Cs-134	1.743E-02	Mo-99	4.136E-05
Cs-136	3.886E-04	Tc-99m	1.806E-05
Cs-137	3.330E-02	Ru-103	1.840E-04
Cs-138	1.159E-08	Ru-106	3.150E-03
Cr-51	5.240E-07	Rh-106	5.590E-09
Mn-54	1.310E-03	Ag-110m	5.750E-04
Mn-56	2.451E-08	Ba-137m	5.925E-04
Fe-59	4.513E-08	Ba-140	2.980E-07
Co-58	5.250E-03	La-140	1.611E-07
Co-60	1.180E-02	Ce-144	6.550E-03
Sr-89	2.552E-07	Pr-144	1.706E-08
H-3	675.5		

Source: BLN 1&2 FSAR, Table 11.2.3-1

Table 3-24. BLN Annual Discharge for a Single AP1000 Unit via Liquid Pathway

Nuclide	Total Releases (Ci/y)	Nuclide	Total Releases (Ci/y)
Na-24	1.630E-03	Rh-106	7.352E-02
Cr-51	1.850E-03	Ag-110m	1.050E-03
Mn-54	1.300E-03	Ag-110	1.400E-04
Fe-55	1.000E-03	Te-129m	1.200E-04
Fe-59	2.000E-04	Te-129	1.500E-04
Co-58	3.360E-03	Te-131m	9.000E-05
Co-60	4.400E-04	Te-131	3.000E-05
Zn-65	4.100E-04	I-131	1.413E-02
W-187	1.300E-04	Te-132	2.400E-04
Np-239	2.400E-04	I-132	1.640E-03
Br-84	2.000E-05	I-133	6.700E-03
Rb-88	2.700E-04	I-134	8.100E-04
Sr-89	1.000E-04	Cs-134	9.930E-03
Sr-90	1.000E-05	I-135	4.970E-03
Sr-91	2.000E-05	Cs-136	6.300E-04
Y-91m	1.000E-05	Cs-137	1.332E-02
Y-93	9.000E-05	Ba-137m	1.245E-02
Zr-95	2.300E-04	Ba-140	5.520E-03
Nb-95	2.100E-04	La-140	7.430E-03
Mo-99	5.700E-04	Ce-141	9.000E-05
Tc-99m	5.500E-04	Ce-143	1.900E-04
Ru-103	4.930E-03	Pr-143	1.300E-04
Rh-103m	1.830E-03	Ce-144	3.160E-03
Ru-106	7.352E-02	Pr-144	3.160E-03
H-3	1010		

Source: AP1000 DCD Table 11.2-7

The LADTAP II computer program, as described in NUREG/CR-4013 (NRC 1986), was used to calculate the liquid pathway doses. The LADTAP II computer program implements the radiological exposure models described in Regulatory Guide 1.109 (NRC 1977a) for radioactivity releases in liquid effluent.

The resulting calculated doses to an individual due to liquid effluents for a BLN B&W unit are given in Table 3-25, and for an AP1000 unit in Table 3-26. The dose guidelines given by the NRC in 10 CFR Part 50, Appendix I, for any individual are 3 millirem (mrem) or less to the total body and 10 mrem or less to any organ, and are designed to assure that doses due to releases of radioactive material from nuclear power reactors to unrestricted areas are kept ALARA during normal conditions. The average annual radiation exposure from natural sources to an individual in the United States is about 300 mrem. Therefore, the Appendix I total body dose limit is about 1/100 of the normal background radiation.

Also shown in Tables 3-25 and 3-26 are the calculated doses to the total population due to liquid effluents for BLN B&W and AP1000 units.

Table 3-25. BLN Doses From Liquid Effluents for B&W Unit per Year

	Annual Dose Total Body	Maximum Organ (Liver) Dose	Maximum Thyroid Dose	TEDE Dose	Dose Limit[a]
Maximum Individual Dose (mrem/year)	0.27[b]	0.37[c]	0.021[d]	0.21	Total Body: 3 Any organ: 10
Population Dose (person-rem)	1.55	1.96	0.85	1.58	Not Applicable

Notes:

a. 10 CFR Part 50, Appendix I
b. An adult was found to receive the maximum individual total body dose.
c. A teenager was found to receive the maximum individual organ dose.
d. A child was found to receive the maximum individual thyroid dose.

Table 3-26. BLN Doses From Liquid Effluents for AP1000 Unit per Year

	Annual Dose Total Body	Maximum Organ (Liver) Dose	Maximum Thyroid Dose	TEDE Dose	Dose Limit[a]
Maximum Individual Dose (mrem/year)	0.21[b]	0.27[c]	0.05[d]	0.21	Total Body: 3 Any organ: 10
Population Dose (person-rem)	1.60	1.90	1.41	1.64	Not Applicable

Notes:
a. 10 CFR Part 50, Appendix I
b. An adult was found to receive the maximum individual total body dose.
c. A teenager was found to receive the maximum individual organ dose.
d. A child was found to receive the maximum individual thyroid dose.

Doses to terrestrial vertebrates (other than man) from the consumption of aquatic plants and doses to aquatic plants, aquatic invertebrates, and fish due to radioactivity in liquid effluents for either a B&W unit or an AP1000 unit would be small because doses to these organisms are less than or equal to the doses to humans. The International Council on Radiation Protection states that "...if man is adequately protected then other living things are also likely to be sufficiently protected" and uses human protection to infer environmental protection from the effects of ionizing radiation.

Four conclusions can be drawn from the results in Tables 3-25 and 3-26:

- Each unit would meet the dose guidelines given in 10 CFR Part 50, Appendix I.
- The dose estimates to the public are a small fraction of the Appendix I guidelines, and the analyses of the radiological impact to humans from liquid releases in the TVA FES and COLA ER continue to be valid.
- The collective population doses are low.
- The impact to members of the public resulting from normal liquid-effluent releases would be minor.

Radiation Doses Due to Gaseous Effluents
Gaseous effluents refer to the release of small quantities of gaseous aerosols and particulates associated with the normal operation of a B&W or an AP1000 unit. Gaseous effluents are normally released through the plant vent or the turbine building vent. The plant vent also provides the release path for containment venting releases, auxiliary building ventilation releases, and gaseous radwaste system discharge. The AP1000 also routes annex building and radwaste building releases through the plant vent. The turbine building vents provide the release path for the condenser air removal system, gland seal condenser exhaust and the turbine building ventilation releases.

The current analysis of potential doses to members of the public due to releases of radioactivity in gaseous effluents was performed using the GASPAR II (NRC 1987) computer program used by NRC staff to perform environmental dose analyses for releases of radioactive effluents from nuclear power plants into the atmosphere.

The GASPAR II model implements the radiological exposure models described in NRC Regulatory Guide 1.109, "Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix I," for radioactive releases in gaseous effluent. The exposure pathway models estimate the radiation dose to selected individuals and population groups. The exposure pathways considered in GASPAR II are external exposure to contaminated ground, external exposure to noble gas radionuclides in the airborne plume, inhalation of air, and ingestion of farm products grown in contaminated soil.

NRC guidance for determining the doses for releases of radioactive effluents from nuclear power plants into the atmosphere is provided in Regulatory Guide 1.109 (NRC 1977a). The gaseous-effluent releases used in the BLN B&W unit analysis are those for the annual average release of airborne radionuclides found in Table 11.3.3-1 of the BLN Units 1&2 FSAR. The gaseous-effluent releases used in the AP1000 unit analysis are those for the annual average release of airborne radionuclides found in Table 11.3-3 of the BLN COLA FSAR.

Radiation doses due to gaseous effluents are calculated using the maximum exposed individual as identified by the atmospheric dispersion (χ/Q) values presented in Subsection 3.16.2.1 for each respective reactor unit. The nearest garden, 1.13 miles southwest of the plant, results in the highest χ/Q values of any receptor and the highest D/Q value of a receptor location consisting of an actual ingestion pathway. Therefore, this location was conservatively evaluated for all exposure pathways except for the doses due to noble gases. This is conservative because it maximizes the doses from all pathways.

The purpose of this SEIS section is to revise the inputs and methodology used in the AEC's 1974 FES to use current values representing recent meteorological, population, and agricultural data. The methodology used in the FES is also revised to be consistent with the current regulatory guidance. Furthermore, this section also provides the gaseous-effluent doses for an AP1000 unit. For this SEIS, identical methodologies, in compliance with NRC Regulatory Guide 1.109, were used for both a B&W unit and an AP1000 unit. The calculated doses provide information for determining compliance with Appendix I of 10 CFR Part 50 (NRC 2007b) and 10 CFR §20.1301 (NRC 2002). When the calculated doses are compared to the 10 CFR Part 50, Appendix I, and 10 CFR §20.1301 allowable dose values, the B&W unit and AP1000 unit demonstrate full compliance.

10 CFR Part 50, Appendix I, defines design objective limits for radioactive material in gaseous effluents for both a B&W unit and an AP1000 unit. Meeting the limits presented in 10 CFR Part 50, Appendix I also meets the ALARA criterion for radioactive material in gaseous effluents. A tabulation of the resulting calculated gaseous doses to individuals for a B&W unit and the dose limits presented in 10 CFR Part 50, Appendix I, is given in Table 3-27. A tabulation of the resulting calculated gaseous doses to individuals for an AP1000 unit and the dose limits presented in 10 CFR Part 50, Appendix I, is given in Table 3-28. For most of the doses, the calculated values are somewhat higher for the Alternative B B&W unit than the Alternative C AP1000 unit. Based on these results, normal operation of a single unit at BLN under both Alternatives B and C would present minimal risk to the health and safety of the public.

Table 3-27. BLN Maximum Individual Doses From Gaseous Effluent for the B&W Unit Compared to the 10 CFR Part 50, Appendix I Limits

Description	Limit	Calculated Values
Noble Gases[1]		
Gamma Dose (millirad [mrad][2])	10	0.88
Beta Dose (mrad)	20	2.40
Total Body Dose (mrem)	5	0.53
Skin Dose (mrem)	15	1.49
Radioiodines and Particulates		
Total Body Dose (mrem)	-	0.57
Max to Any Organ[3] (mrem)	15	4.38

Notes:
1. Doses due to noble gases in the released plume are calculated at the location of maximum dose at or beyond the site boundary (location of highest dispersion and ground deposition values). This location is 1.77 miles south of the plant for the mixed-mode station vent release and 0.56 mile west-southwest of the plant for the ground-level turbine building vent release.
2. An mrad is a unit of adsorbed ionizing radiation dose equal to an adsorbed dose of 0.1 erg/gm.
3. The maximum dose to any organ is the dose to the thyroid of a child. This dose is calculated from the most conservative receptor locations.

Table 3-28. BLN Maximum Individual Doses From Gaseous Effluent for the AP1000 Unit Compared to the 10 CFR Part 50, Appendix I Limits

Description	Limit	Calculated Values
Noble Gases[1]		
Gamma Dose (mrad)	10	0.27
Beta Dose (mrad)	20	1.39
Total Body Dose (mrem)	5	0.16
Skin Dose (mrem)	15	0.96
Radioiodines and Particulates		
Total Body Dose (mrem)	-	0.40
Max to Any Organ[2] (mrem)	15	9.11

Notes:
1. Doses due to noble gases in the released plume are calculated at the location of maximum dose at or beyond the site boundary (location of highest dispersion and ground deposition values). This location is 1.74 miles south of the plant.
2. The maximum dose to any organ is the dose to the thyroid of an infant. This dose is calculated for the most conservative receptor location.

Dose limits for individual members of the public are given in 10 CFR §20.1301, which states that each licensee shall conduct operations so that the TEDE to individual members of the public from the licensed operation does not exceed 100 mrem in a year. The maximum individual dose from a B&W unit due to routine gaseous effluents was calculated to be 1.25 mrem TEDE. The maximum individual dose from an AP1000 unit due to routine gaseous

effluents was calculated to be 0.75 mrem TEDE. These calculated doses are well within the limits provided by 10 CFR §20.1301; therefore, normal operation of a single nuclear unit at BLN would present minimal risk to the health and safety of the public.

Additional dose limits are also provided in 40 CFR Part 190, which specifies environmental radiation protection standards for nuclear power operations. Table 3-29 summarizes the doses to the maximally exposed individual for the total body, thyroid, and bone (the worst-case organ) for a B&W unit along with the 40 CFR Part 190 limits. Table 3-30 summarizes the doses to the MEI for the total body, thyroid, and bone for an AP1000 unit along with the 40 CFR Part 190 limits. Based on comparison to the 40 CFR Part 190 limits, normal operation of either Alternative B or Alternative C would present minimal risk to the health and safety of the public.

Table 3-29. Collective Gaseous Doses for the BLN B&W Unit Compared to 40 CFR Part 190 Limits

Description	Limit	Calculated Values
Total body dose equivalent (mrem)	25	1.1
Thyroid dose (mrem)	75	4.9
Max to any other organ[1] (mrem)	25	2.93

Note:
1. The maximum dose to any organ other than the thyroid is the dose to the bone of a child.

Table 3-30. Collective Gaseous Doses for the AP1000 Unit Compared to 40 CFR Part 190 Limits

Description	Limit	Calculated Values
Total body dose equivalent (mrem)	25	0.56
Thyroid dose (mrem)	75	9.25
Max to any other organ[1] (mrem)	25	2.18

Note:
1. The maximum dose to any organ other than the thyroid is the dose to the bone of a child.

The individual doses due to normal liquid and gaseous-effluent releases under both Alternatives B and C were found to be insignificant and well below the regulatory guidelines in Appendix I of 10 CFR Part 50 and the regulatory standards of 10 CFR Part 20. In addition, the potential doses to the public due to the release of liquid and gaseous effluents meet the requirements of 10 CFR §20.1302 and 10 CFR §50.34a. The impact to the public due to operation of a single nuclear unit at the BLN site is minor.

Population Dose

Population dose calculations determine the cumulative dose to the population within 50 miles of the site for ALARA considerations. The estimated radiological impact from the normal gaseous releases from BLN B&W and AP1000 units using a 50-mile regional population projection for the year 2027 of 1,565,771 is presented in Table 3-31.

Table 3-31. Population Dose Summary for the BLN B&W and AP1000 Units

Organ	B&W Unit Dose (person-rem)	AP1000 Unit Dose (person-rem)
Total Body	5.92	3.00
Gastrointestinal Tract	5.92	3.00
Bone	11.1	8.03
Liver	5.93	3.01
Kidney	5.93	3.00
Thyroid	7.26	6.30
Lung	6.22	3.27
Skin	16.8	14.1
TEDE	6.14	3.19

For perspective, the total body dose from normal background radiation to individuals within the United States ranges from approximately 100 mrem to 300 mrem per year. The annual total body dose due to normal background for a population of 1,565,771 persons expected to live within a 50-mile radius of the BLN site in the year 2027 is calculated to be approximately 156,578 man-rem, assuming 100 mrem/year/individual. By comparison, the same general population would receive a total body dose of less than 7 man-rem from gaseous effluents released from either a B&W or an AP1000 unit.

Based on these results, normal operation of a single nuclear unit at the BLN site would present minimal risk to the health and safety of the public. The annual doses to the public from either Alternative B or Alternative C would be well within all regulatory limits, and there would be no observable health impacts on the public from construction and operation of a nuclear unit at the BLN site. Therefore, the radiation doses and resultant health impacts resulting from operation of the proposed plant at the BLN site are minor.

Radiological Impact on Biota Other Than Man

Radiation exposure pathways to biota other than man (i.e., animals) are examined to determine if the pathways could result in doses to biota greater than those predicted for man. This assessment uses surrogate species that provide representative information on the various dose pathways potentially affecting broader classes of living organisms. Surrogates are used because important attributes are well defined and are accepted as a method for judging doses to biota. Surrogate biota used for gaseous-effluent exposure includes muskrat, raccoon, fish, duck, and heron.

Liquid radioactive effluents from BLN are mixed with cooling tower blowdown and subsequently discharged into the Tennessee River. Other nonradioactive discharges may be combined with the cooling tower blowdown, but they are small in comparison and are ignored as a source of dilution. The LADTAP II (NRC 1986) computer program was used to calculate the liquid pathway doses. Release of radioactive materials in liquid effluents results in minimal radiological exposure to biota. Impacts on aquatic life from radiological releases are minor.

Doses from gaseous effluents contribute to terrestrial total body doses. External doses occur due to immersion in a plume of noble gases and deposition of radionuclides on the

ground. The inhalation of radionuclides followed by the subsequent transfer from the lung to the rest of the body contributes to the internal total body doses.

Immersion and ground deposition doses are largely independent of organism size, and the total body doses calculated for man can be applied. The external ground doses calculated using the GASPAR II computer code are increased to account for the closer proximity to ground of terrestrial biota. The inhalation pathway doses for biota are the internal total body doses calculated by the GASPAR II code for infants because breathing rate and body size are more similar to biota. The total body inhalation dose (rather than organ specific doses) is used because the biota doses are assessed on a total body basis.

The calculation of biota doses due to gaseous-effluent releases are based on the locations of the highest atmospheric dispersion (χ/Q) values at the EAB for both release types. The total body doses to biota for the B&W and AP1000 units' total liquid and gaseous-effluent releases are given in Table 3-32. These doses presented below incorporate biota doses due to routine liquid effluents from a B&W unit and an AP1000 unit, respectively, for comparison with the limits set forth in 40 CFR Part 190 as indicated by NUREG-1555, Subsection 5.4.4 (NRC 1999).

Table 3-32. Total Doses (Liquid and Gaseous) to Biota for Single Nuclear Unit as Compared to the Regulatory Limit

Biota	B&W Unit Total Dose (mrem)	AP1000 Unit Total Dose (mrem)	40 CFR Part 190 Limit (mrem)
Muskrat	5.49	4.10	50
Raccoon	2.76	1.87	50
Fish	2.15	2.15	50
Heron (Little Blue Heron)	25.45	17.70	50
Duck (Mallard)	5.43	3.82	50

Use of exposure guidelines, such as 40 CFR Part 190, which apply to members of the public in unrestricted areas, is considered very conservative when evaluating calculated doses to biota. The calculated biota doses are well below those specified in 40 CFR Part 190 and are well below any dose expected to have any noticeable acute effects. Based on the postulated biota doses presented above, the impact due to operation of a single nuclear unit at the BLN site is considered minor.

3.17.3. Radiological Monitoring

The Radiological Environmental Monitoring Program (REMP) will be conducted to provide the preoperational and operational monitoring of either BLN alternative. Preoperational monitoring will be conducted for at least two years prior to the start of operations. The BLN REMP will be designed to provide the monitoring necessary to document compliance with 10 CFR §20.1302, "Compliance with Dose Limits for the Individual Members of the Public," and to meet the requirements established by NRC Regulatory Guide 4.1, "Radiological Environmental Monitoring for Nuclear Power Plants." The REMP is designed to monitor the pathways between the plant and the general public in the immediate vicinity of the plant. Sampling locations, sample types, collection frequency, and sample analyses are chosen so that the potential for detection of radioactivity in the environment will be maximized. The BLN REMP will be designed based on the guidance provided in NUREG-1301, "Offsite Dose Calculation Manual Guidance: Standard Radiological Effluent Controls for

Pressurized Water Reactors." Quality assurance and quality control procedures and processes will be implemented in accordance with NRC Regulatory Guide 4.15, "Quality Assurance for Radiological Monitoring Programs (Normal Operations) -- Effluent Steams and the Environment."

Radiological Environmental Monitoring Program for Alternative B or C
An operating nuclear plant may release radioactivity into the environment as either gaseous or liquid effluents. Exposure pathways to the public from plant effluents consist of direct radiation, airborne, waterborne, and ingestion. The types of samples collected in BLN REMP are designed to monitor these pathways. The REMP for either Alternative B or C would include the following types of monitoring.

<u>Direct Radiation Monitoring</u>. Monitoring of direct radiation will be performed utilizing a network of environmental dosimeters. Two or more dosimeters will be placed at monitoring locations near the site boundary in each of the 16 meteorological sectors. A second outer ring of dosimeters will be located in each sector at the 4- to 5-mile range from the site. Environmental dosimeter monitoring stations will be placed at a minimum of eight other special interest locations including at least two control stations.

<u>Airborne Pathway Monitoring</u>. Sampling for air particulates and radioiodine will be performed at the following 10 locations: four locations in different sectors near the site boundary, four locations near area population centers, and two control locations greater than 10 miles from the site and in the least prevalent wind direction. The airborne pathway monitoring will be performed with continuous operating air samplers.

<u>Waterborne Pathway Monitoring</u>. Surface water sampling will be performed at a control location upstream of the plant and at one location downstream of the plant discharge beyond, but near the mixing zone. The sampling of surface water will be performed by automatic sequential-type samplers with composite samples analyzed monthly.

Drinking water sampling will be performed at the first potable water supply downstream from the plant using water from the Tennessee River. The sampling method and collection frequency utilized for surface water sampling will also be applied to this first downstream drinking water location. The upstream surface water control location will also serve as the control location for drinking water monitoring. Monthly grab samples will be collected from at least two additional water supply systems downstream of the plant.

Groundwater sampling will be conducted at one location on site downgradient from the plant and at a control location upgradient from the plant. If site groundwater hydrology data indicate that leaks or spills at the site might impact off-site groundwater, sampling of private wells will be added to the REMP.

Samples of shoreline sediment will be collected from the first downstream shoreline recreational use area and from a control location upstream of the plant.

<u>Ingestion Pathway</u>. Monitoring for the ingestion pathway will include milk sampling, sampling of fish from the Tennessee River, and sampling of vegetables from local gardens identified in the land use survey. Samples of milk produced for human consumption will be collected in each of three areas within the 5-mile radius of plant identified by the land use survey to have the highest potential doses and from at least one control location at 10 to 20 miles from the site in the least prevalent wind direction. Sampling of pasture vegetation will be performed at milk-producing locations when milk sampling cannot be performed.

Fish sampling will be performed on the plant discharge reservoir, Guntersville Reservoir, and on Nickajack Reservoir as a control location. Sampling will consist of one sample of commercially important species and one sample of recreationally important species.

Sampling of the principal garden vegetables grown in the area will be performed at private gardens identified by the annual land use survey. Sampling will be performed once during the normal growing season.

Land Use Survey. A land use survey will be conducted annually. The purpose of the survey is to identify changes in land use within a 5-mile radius of the plant that would require modifications to the REMP or the Offsite Dose Calculation Manual. The survey will identify the nearest resident, nearest animal milked for human consumption, and nearest garden of greater than 500 square feet with broadleaf vegetation in each of the 16 meteorological sectors. The results of the annual land use survey will be documented in the Annual Radiological Environmental Operating Report (AREOR).

Interlaboratory Comparison Program. The laboratory performing the analyses of the BLN REMP samples will participate in an Interlaboratory Comparison Program providing radiological environmental crosschecks representative of the types of samples and analyses in BLN REMP. The results of the analysis of the comparison program cross checks will be included in the AREOR.

3.18. Uranium Fuel Use Effects

3.18.1. Radioactive Waste

3.18.1.1. Affected Environment

Radioactive waste (radwaste) sources, treatment systems and potential for effects of operating a B&W plant were described in TVA's 1974 FES and updated in the CLWR FEIS (DOE 1999). Section 2.4 of the FES states that "TVA's policy is to keep the discharge of all wastes from its facilities, including nuclear plants, at the lowest practicable level by using the best and highest degree of waste treatment available under existing technology within reasonable economic limits." While this is still true, current practices for managing radioactive waste have evolved since the B&W units were designed. Subsection 5.2.3.11 of the CLWR FEIS briefly updated TVA's radwaste management practices and potential effects for the BLN B&W unit based on operating experience at SQN and WBN.

The management and effects of radwaste from operation of two B&W units is discussed in Chapter 11 of the BLN 1&2 FSAR. The management and effects of radwaste from operation of two AP1000 units is discussed in Subsections 5.5.2 and 5.7.1 of the BLN COLA ER and in Chapter 11 of the BLN COLA FSAR. Although quantities of radwaste produced by plant operation may differ between the two technologies, and for single unit operation, the method of handling the waste would be consistent with TVA's current practices at its operating plants.

The following information updates and compares the potential for environmental effects from plant operations regarding radwaste for Action Alternatives B and C. Because there has never been an operating nuclear plant on the BLN site, there would be no effect on the environment from radwaste under Alternative A (the No Action Alternative). Additionally, for Alternatives B and C (the Action Alternatives), no radwaste would be generated during construction activities.

3.18.1.2. Environmental Consequences

Alternative A

Under this alternative, no completion or construction and operation of a new nuclear plant would occur; therefore, there would be no impacts.

Alternatives B and C

Liquid Radioactive Waste Treatment Systems

For a B&W unit, the liquid waste disposal system is designed to collect, store, process, and dispose of liquid radwaste in such a manner as to keep the exposure to plant personnel and the releases of radioactive materials to the environment ALARA. The liquid radwaste includes tritiated waste, nontritiated waste, chemical waste, and detergent waste. All of the liquid radwaste would be generated as a result of normal operation and anticipated operational occurrences. Figures 3-26 and 3-27 from the TVA 1974 FES show sketches of the proposed Liquid Waste Disposal System for tritiated and nontritiated liquid, respectively. The disposal systems shown on these figures would likely be replaced by a system similar to upgrades implemented at other TVA nuclear power plants. The following analysis describes the environmental impacts of a future replacement disposal system, which would be designed to comply with all applicable regulations.

The system would be designed and operated to demonstrate continued compliance with requirements to maintain environmental releases of radioactive materials in liquid effluents ALARA in accordance with the requirements of 10 CFR §20.1302, 10 CFR §50.34a, 40 CFR Part 190, and Appendix I to 10 CFR Part 50. This conclusion is consistent with the conclusion of the TVA 1974 FES, which states that “the liquid waste disposal system, as it is now being designed, will reduce liquid emissions to a level which is as low as practicable.”

For an AP1000 unit, the liquid radioactive waste management systems include the systems that may be used to process and dispose of liquids containing radioactive material. The liquid radwaste system would be designed to control, collect, process, handle, store, and dispose of liquid radioactive waste generated as the result of normal operation, including anticipated operational occurrences. The liquid radwaste system would provide holdup tank capacity as well as permanently installed processing capacity of 75 gpm through the ion exchange/filtration train. This would be an adequate capacity to meet the anticipated processing requirements of the plant. The projected flows of various liquid waste streams to the liquid radwaste system under normal conditions are identified in the BLN COLA FSAR, Table 11.2-1. The site-specific impact is further evaluated in the BLN COLA ER 5.4. The liquid radwaste system design accommodates equipment malfunctions without affecting the capability of the system to handle both anticipated liquid waste flows and possible surge load due to excessive leakage. Figure 3-28 shows a drawing of the AP1000 liquid radwaste system.

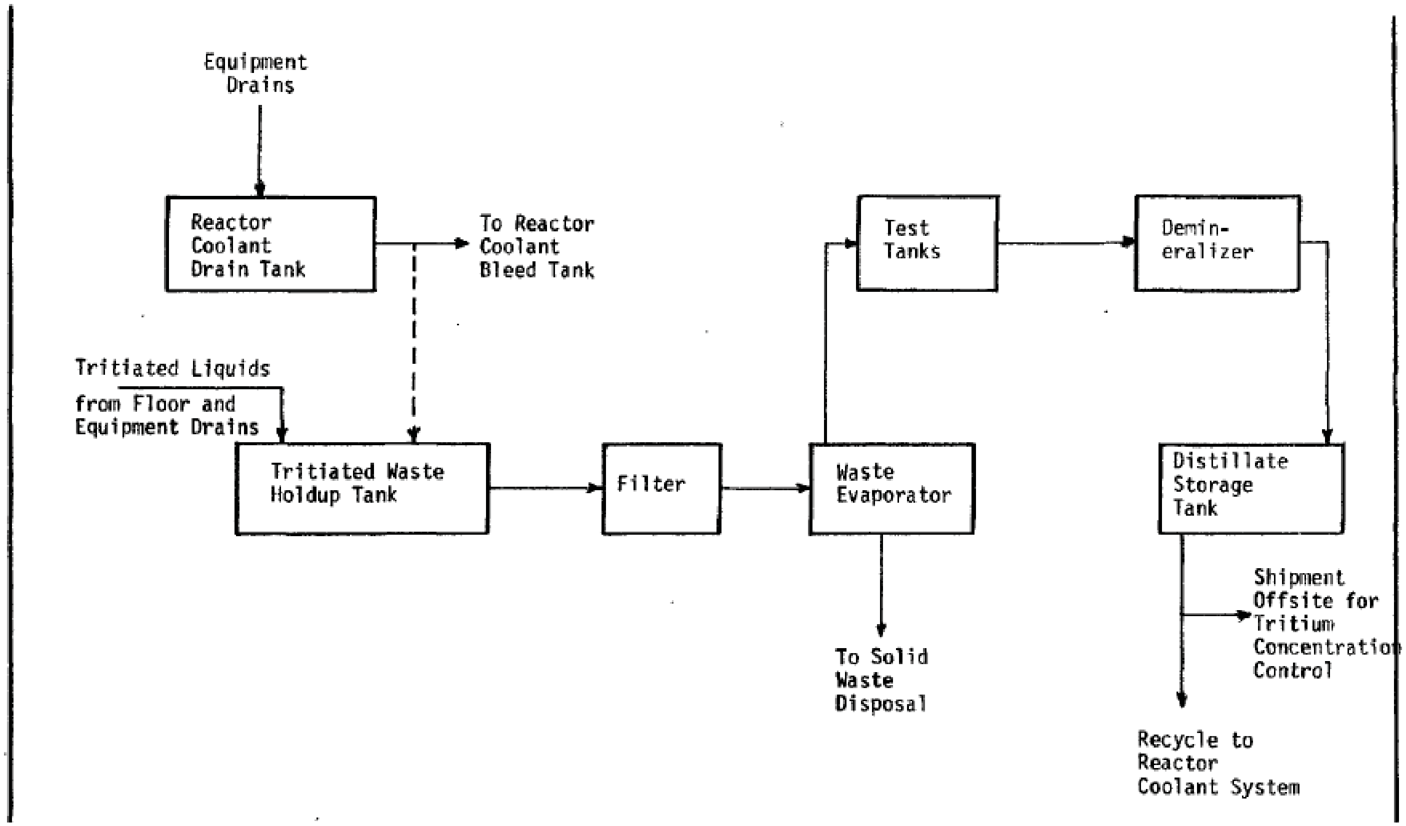


Figure 3-26. B&W Tritiated Liquid Waste Treatment System

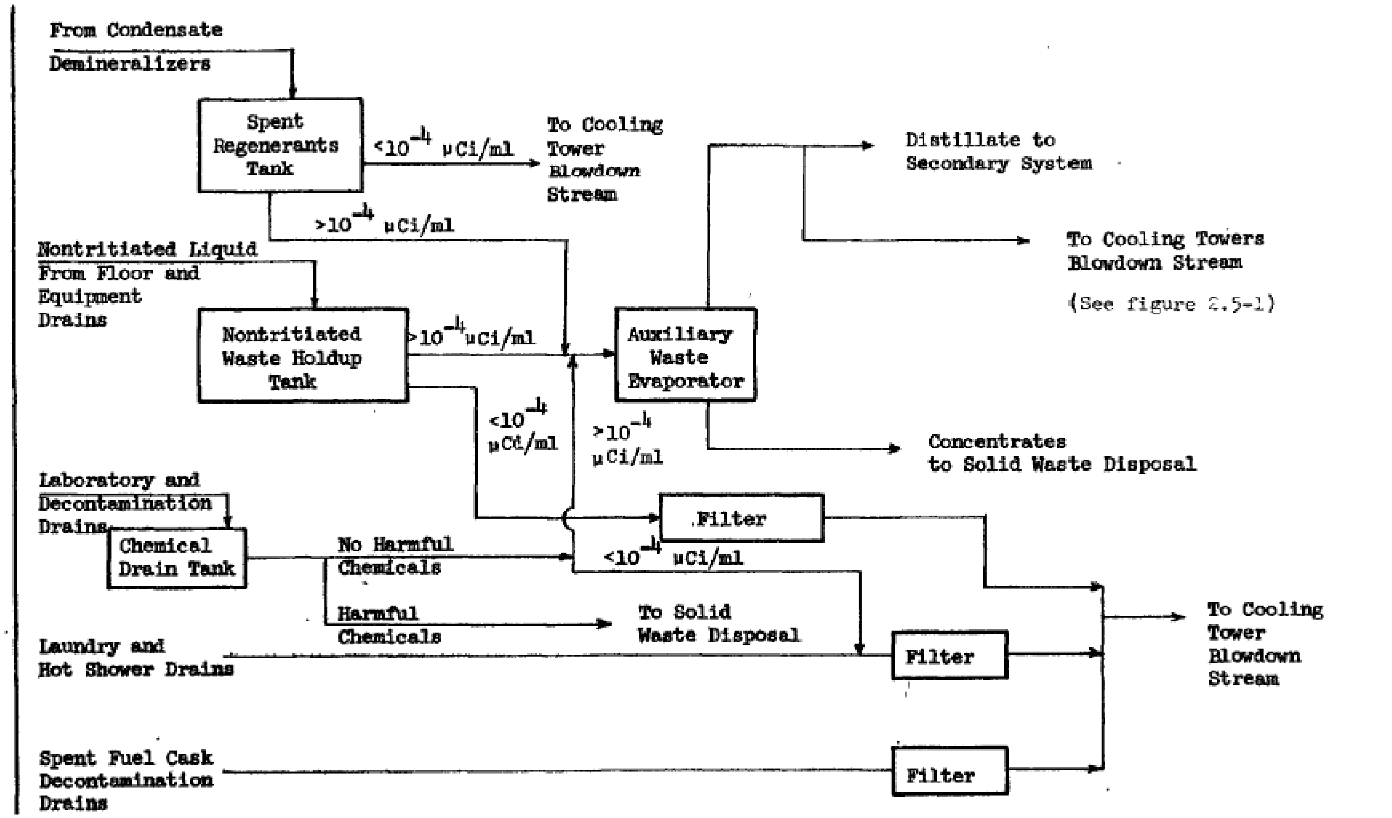


Figure 3-27. B&W Nontritiated Liquid Waste Disposal System

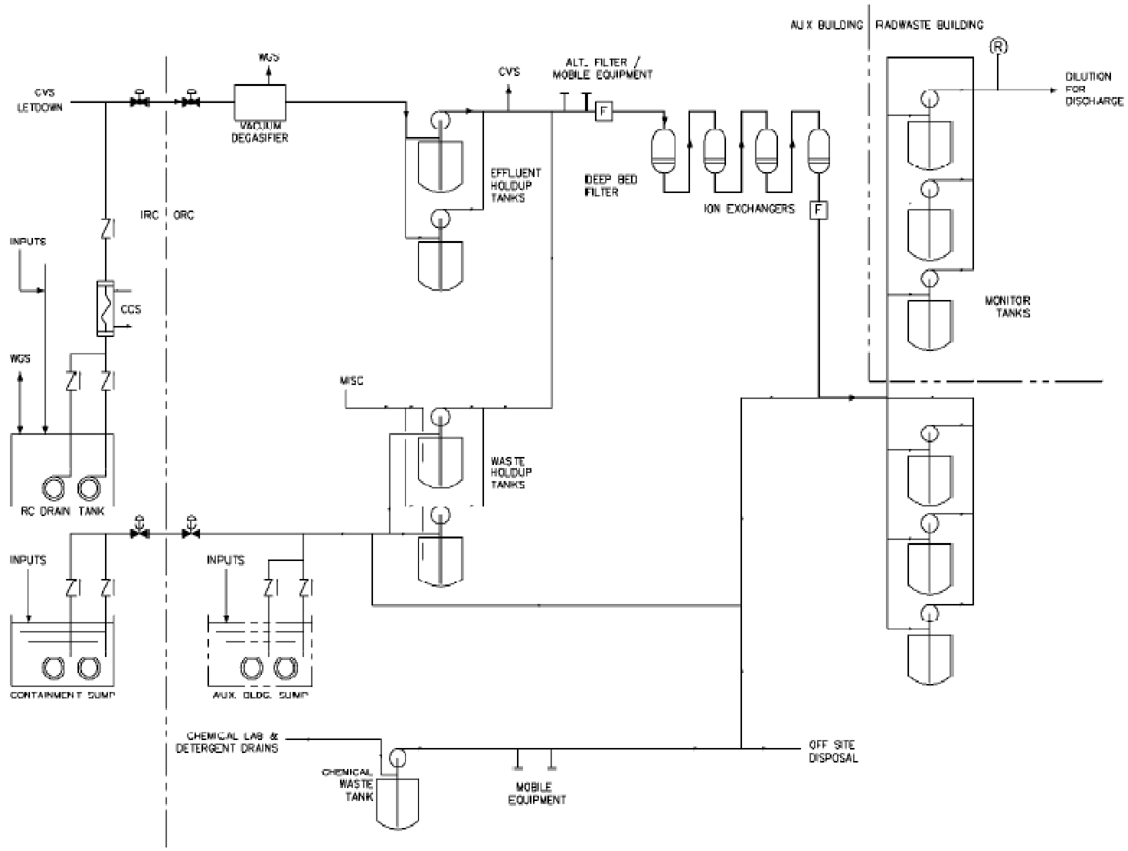


Figure 3-28. AP1000 Liquid Radwaste System

The liquid radioactive waste treatment system for the BLN AP1000 unit would be designed and operated to demonstrate continued compliance with requirements to maintain environmental releases of radioactive materials in liquid effluents ALARA in accordance with requirements of 10 CFR §20.1302, 40 CFR Part 190, 10 CFR §50.34a, and Appendix I to 10 CFR Part 50. As discussed in Section 3.17, the impact to members of the public resulting from normal liquid effluent releases would be minor.

Gaseous Radioactive Waste Treatment Systems

During reactor operation, radioactive isotopes of xenon, krypton, and iodine are created as fission products. A portion of these radionuclides could be released to the reactor coolant due to the potential for a small number of fuel-cladding defects. Potential leakage of reactor coolant could result in a release of the radioactive gases to the containment atmosphere. Airborne releases can be limited both by restricting reactor coolant leakage and by limiting the concentrations of radioactive noble gases and iodine in the reactor coolant system.

For a B&W unit, the gaseous waste disposal system would be designed to collect the radioactive gases, compress the gases into holdup tanks for decay, sample the gases prior to discharge, and monitor the gases during the discharge period. In addition to the gaseous waste disposal system, various gaseous system leaks would be vented to various building ventilation systems. These releases would be processed and released through a monitored location at either the plant vent or the turbine building vent.

The gaseous waste disposal system for a B&W unit would be designed and operated to demonstrate continued compliance with requirements to maintain environmental releases of radioactive materials in gaseous effluents ALARA in accordance with the requirements of 10 CFR §20.1302, 40 CFR Part 190, 10 CFR §50.34a, and Appendix I to 10 CFR Part 50. This conclusion is consistent with the conclusion of the TVA 1974 FES, which states that “the gaseous waste disposal system, as it is now being designed, will reduce gaseous emissions to a level which is as low as practicable.”

For an AP1000 unit, the gaseous radwaste system would be designed to collect gaseous wastes that are radioactive or hydrogen bearing along with processing and discharging the waste gas, keeping off-site releases of radioactivity within acceptable limits.

In addition to the gaseous radwaste system release pathway, release of radioactive material to the environment would occur through the various building ventilation systems. The estimated annual release includes contributions from the major building ventilation pathways. The gaseous radwaste system would be designed to receive hydrogen bearing and radioactive gases generated during normal plant operation. The radioactive gas flowing into the gaseous radwaste system enters as trace contamination in a stream of hydrogen and nitrogen.

The gaseous radwaste system for an AP1000 unit would be designed and operated to demonstrate continued compliance with requirements to maintain environmental releases of radioactive materials in gaseous effluents ALARA in accordance with the requirements of 10 CFR §20.1302, 40 CFR Part 190, 10 CFR §50.34a, and Appendix I to 10 CFR Part 50. As discussed in Section 3.17, the impact to members of the public resulting from normal gaseous-effluent releases would be minor.

Solid Radioactive Wastes
Two additional types of radwaste that could be generated at BLN under both Alternatives B and C are dry active waste (DAW) and Wet Active Waste (WAW). A solid radwaste disposal system would process and package the dry and wet solid radioactive waste produced through power generation for on-site packaging, storage, off-site shipment, and disposal. The solid radioactive handling information presented below is based on TVA operating experience with handling solid radioactive waste.

The DAW consists of compactable and noncompactable material. Compactable material includes paper, rags, plastic, mop heads, discarded clothing, and rubber boots. Noncompactable wastes include tools, pumps, motors, valves, piping, and other large radioactive components. DAW would be collected on site and packaged in appropriate containers to meet processor and/or burial site acceptance criteria. DAW would be placed into a strong, tight container for shipment to an off-site processor, or compacted into 55-gallon drums by a radwaste compactor.

The WAW consists of spent resins and filters. Spent resins would be generated primarily from the makeup and purification, liquid waste processing, and condensate systems. The makeup and purification resins would be sluiced to the spent resin storage tank for radiological decay and then sluiced into high-integrity containers (HICs). Liquid waste processing resins would be sluiced directly from the demineralizer into HICs. Resins would be dewatered prior to shipment for off-site processing or direct disposal.

Tank and sump sludge would be generated during the cleaning of various tanks and sumps located in the auxiliary and reactor buildings. The sludge would be transferred into suitable containers and dewatered. Sludge would be processed into a form suitable for disposal by off-site waste processors utilizing their Process Control Program (PCP) and applicable procedures. The waste processor's procedures and PCP will be approved by BLN prior to the solidification of waste.

Solidification would be performed off site at the waste processor facilities. Spent filters would be removed from service and stored to allow radioactive decay. Filters would be loaded for shipment into appropriate containers (e.g., HICs or 55-gallon drums).

Contaminated oil could be generated during pump oil changes and sump cleaning. This oil would be collected and sent to an off-site processor for disposition.

Throughout the packaging and shipping operations, radiation exposure to personnel would be minimized by the use of various ALARA techniques, as appropriate, including the following:

a. Administrative controls
b. A shielded cask in the truck loading area
c. A shielded drum storage area
d. Use of shielded carts for transporting plant filters

Waste containers would be surveyed for radiological conditions and stored in designated storage areas.

Radwaste is classified as either A, B, or C, with Class A being the least hazardous and Class C being the most hazardous. Class A includes both DAW and WAW. Classes B and

C are normally WAW. For both the B&W and the AP1000 unit, the majority of low-level radioactive waste (LLRW) generated would be Class A waste. Class B and C wastes would constitute a low percent by volume of the total LLRW. The estimated annual volumes of solid radioactive waste generated for the B&W unit and the AP1000 unit are given in Table 3-33 and Table 3-34, respectively.

For the B&W unit, the proposed amount of radwaste generated is taken from Table 11.4.1-1 of the BLN 1&2 FSAR. The amount of radwaste generated for one B&W unit shown below is approximately one-half of that reported in the BLN 1&2 FSAR. However, the sources for these volumes would be replaced by a system similar to upgrades implemented at other TVA nuclear power plants, and the environmental impacts are expected to be similar to those of the AP1000 shown in Table 3-34 below.

For the AP1000, the amount of radwaste generated is as reported for a single unit in the AP1000 DCD (WEC 2008).

Table 3-33. Estimated Volumes of Solid Radwaste for a Single BLN B&W Unit

Source	Volume (before solidification) $feet^3$/year
Spent resin (1.0 $feet^3$ water/$feet^3$ resin)	425
Waste evaporator bottoms	480
Miscellaneous solids - filter cartridges, paper, glassware, rags, equipment (compacted)	175
Spent high-efficiency particulate air (HEPA) and charcoal filters	1,050
Total	2,130
Secondary system - auxiliary evaporator, condensate polishing demineralizer regeneration solution, evaporator bottoms (40% solids)	6,000

Source: Table 11.4.1-1, BLN 1&2 FSAR

Table 3-34. Expected Volumes of Solid Radwaste for a Single AP1000 Unit

Source	Expected Generation ($feet^3$/year)	Expected Shipped Solid ($feet^3$/year)	Maximum Generation ($feet^3$/year)	Maximum Shipped Solid ($feet^3$/year)
Wet wastes				
Primary resins (includes spent resins and wet activated carbon)	400(2)	510	1700(4)	2160
Chemical	350	20	700	40
Mixed liquid	15	17	30	34
Condensate polishing resin(1)	0	0	206(5)	259
Steam generator blowdown(1)(6) Material (Resin and Membrane)	0	0	540(5)	680
Wet waste subtotals	765	547	3176	3173
Dry wastes				
Compactable dry waste	4750	1010	7260	1550
Noncompactable solid waste	234	373	567	910

Source	Expected Generation (feet^3/year)	Expected Shipped Solid (feet^3/year)	Maximum Generation (feet^3/year)	Maximum Shipped Solid (feet^3/year)
Mixed Solid	5	7.5	10	15
Primary Filters (includes high activity and low activity cartridges)	5.2$^{(3)}$	26	9.4$^{(3)}$	69
Dry Waste Subtotals	4994	1417	7846	2544
Total wet and Dry Wastes	5759	1964	11,020	5717

Source: Table 11.4-1 of AP1000 DCD (WEC 2008)

Notes:

1. Radioactive secondary resins and membranes result from primary to secondary systems leakage (e.g., SG tube leak).
2. Estimated activity basis is American National Standards Institute (ANSI) 18.1 source terms in reactor coolant.
3. Estimated activity basis is breakdown and transfer of 10 percent of resin from upstream ion exchangers.
4. Reactor coolant source terms corresponding to 0.25 percent fuel defects.
5. Estimated activity basis from AP1000 DCD Table 11.1-5, 11.1-7, and 11.1-8 and a typical 30-day process run time, once per refueling cycle
6. Estimated volume and activity used for conservatism. Resin and membrane will be removed with the electrodeionization units and not stored as wet waste. See AP1000 DCD Subsection 10.4.8.

Originally, TVA planned to send low-level radwaste to Barnwell, South Carolina, until a new disposal facility at Wake County, North Carolina, opened in mid-1998. The proposed disposal facility in Wake County was never opened, and the LLRW disposal facility in Barnwell, South Carolina, stopped accepting Class B and C radwaste from states outside the Atlanta Compact on September 29, 2009. Because Alabama is not a member of the Atlanta Compact, alternate LLRW disposal plans were necessary. All DAW is currently shipped to a processor in Oak Ridge, Tennessee, for compaction and then by the processor to Clive, Utah, for disposal. Since 2008, TVA has also shipped Class A WAW to the facility at Clive. Class B and C waste from SQN and WBN is currently stored at and shipped to SQN. For either Action Alternative, plans are to resume shipments of DAW and WAW as soon as an acceptable location becomes available.

Should there be no disposal facilities available to accept the Class B and C wastes at the time a nuclear unit begins operation at BLN, TVA has several options available for storage of this LLRW:

- One long-term plan would be to build and license a WAW facility to accept spent resins at the BLN site.
- For either the B&W or the AP1000 unit, TVA could construct or expand a storage facility at BLN or gain access to a storage facility at another licensed nuclear plant (i.e. SQN or BFN). For this option, BLN would have to be licensed by NRC to receive and store low-level radwaste.
- A new Class B and C disposal facility may be licensed that TVA could use as an alternative to on-site storage for the BLN site.

The impact to members of the public resulting from processing, storage, and transport of solid radwaste would be minor.

3.18.2. Spent Fuel Storage

3.18.2.1. Affected Environment

As discussed above, the TVA 1974 FES assumed that spent fuel would be shipped by rail to the reprocessing plant in Barnwell, South Carolina. TVA's 1993 review of the FES noted that reprocessing was no longer likely and that "TVA now expects to store spent fuel on site until the U.S. Department of Energy completes the construction of permanent storage facilities in accordance with the Nuclear Waste Policy Act of 1982." The revised plan was for TVA to provide additional storage capacity on site, if needed, until a licensed DOE facility became available. Subsection 2.1.1 of the 1974 FES stated that TVA would apply for a special nuclear license to receive, possess, and store fuel elements, and TVA received such a license (TVA 1993a). However, that license is no longer in effect.

The need to expand on-site spent fuel storage at TVA nuclear plants was addressed when DOE prepared the CLWR FEIS (DOE 1999). That FEIS analyzed spent fuel storage needs at WBN Unit 1, SQN 1&2, and BLN 1&2, and included a thorough review of the environmental effects of constructing and operating an on-site independent spent fuel storage installation (ISFSI). This FSEIS incorporates by reference the spent fuel storage impact analysis in the CLWR FEIS and updates the analysis to include operation of either one B&W reactor or one AP1000 reactor at the BLN site.

Operation of either a single B&W unit or a single AP1000 unit at the BLN site would result in the generation of spent fuel assemblies beyond the capacity of their respective spent fuel pools. A comparison of spent fuel production for the B&W and AP1000 is provided in Table 3-35. A comparison based on the number of fuel assemblies discharged over the 40-year lifetime can be misleading because of different fuel assembly length (B&W - 12 feet versus AP1000 - 14 feet) and power level (3,600 MW versus 3,400 MW). Fuel is limited in its burnup on a fuel rod to approximately 62,000 MWD/MTU. Allowing for power peaking factors, the average discharge burnup is expected to be 50,000 MWD/MTU for both the AP1000 and the B&W BLN plant designs. Because this fuel characteristic parameter is expected to be the same for both fuel designs, this indicates that the expected amount of fuel to be discharged is proportional to the amount of energy produced.

Table 3-35. Spent Fuel Quantity Determination for BLN Single Unit Operation

Data Parameter	BLN B&W	BLN AP1000	BLN AP1000 Normalized for Power
Core thermal power, MWt	3,600	3,400	3,600
Operating cycle length	18 months	18 months	N/A
Number of assemblies in the core	205[1]	157[2]	N/A
Number of fresh fuel assemblies per refueling cycle	80[3]	64[4]	N/A
Height of active fuel, feet	12	14	14
Number of refueling cycles in 40 years[5]	26	26	N/A
Number of fuel assemblies for 40-year operation[6]	2,285	1,821	N/A
Total Spent Fuel (MTU) for 40-year operation	946	894	946

[1] TVA 1978a
[2] TVA 2008a
[3] T A Keys, TVA, personal communication, September 3, 2009
[4] TVA 2008a
[5] Forty years of operation covers 26 refueling cycles and 27 operating cycles. Spent fuel is discharged a total of 27 times from each unit, which includes the last cycle discharge of the entire core.
[6] Number includes assemblies from 26 refueling cycles, plus assemblies in the core.

For the purpose of this SEIS, it is assumed that all spent nuclear fuel generated by the operation of one BLN unit would be accommodated at the site in a dry cask ISFSI. An ISFSI contains multiple dry casks for storage of spent nuclear fuel. This ISFSI would be designed to store the spent nuclear fuel assemblies (including assemblies in the core) required for 40-year, one-unit operation at the reactor site. To date, no ISFSI has been constructed at the BLN site.

The spent fuel pool capacity for the B&W unit is 1,058 assemblies (TVA 1982c), which accommodates approximately 10 refueling cycles plus the core (i.e., 80 assemblies per cycle x 10 cycles + 205 assemblies in the core). Assuming 18-month refueling cycles, the spent fuel pool for the B&W unit has the capacity for approximately 15 years of storage (i.e., 18 months per cycle x 10 cycles = 180 months/12 months per year = 15 years), plus the core. The AP1000 spent fuel pool capacity is 889 assemblies (TVA 2008a), which accommodates approximately 11 refueling cycles plus the core (i.e., 64 assemblies per cycle x 11 cycles + 157 assemblies in the core). Assuming 18-month refueling cycles, the spent fuel pool for the AP1000 unit has the capacity for approximately 16 years of storage of spent fuel (i.e., 18 months per cycle x 11 cycles = 198 months/12 months per year = 16.5 years), plus the core. Under the current schedule, assuming that one BLN unit would begin operation in 2018, the ISFSI would be needed by 2033 (B&W) or 2034 (AP1000).

The CLWR FEIS assessed the number of dry storage casks needed, per reactor, to accommodate tritium production at the BLN site based on the 24 spent fuel assembly design capacity of four of the ISFSI cask designs in the United States at the time. The estimated number of dry cask storage units that would be needed for 40 years of operation if a B&W unit were completed is 96, and for an AP1000 unit, it would be 76. These numbers are based on 24 fuel assembly cask designs. The SQN uses casks that contain 32 spent fuel assemblies, but this evaluation uses the more conservative 24 fuel assembly cask design capacity. Additional details on dry casks and ISFSI construction are provided in Table 3-36.

A number of ISFSI dry storage designs have been licensed by the NRC and are in operation in the United States, including facilities at TVA's SQN and BFN. Licensed designs include the metal casks and concrete casks. The majority of these operating ISFSIs use concrete casks. Concrete casks consist of either a vertical or a horizontal concrete structure housing a basket and metal cask that confines the spent nuclear fuel. Currently, there are three vendors with concrete pressurized water reactor spent nuclear fuel dry cask designs licensed in the United States: Holtec International, NAC International, and Transnuclear Inc. The Holtec International and NAC International designs are vertical concrete cylinders; whereas, the Transnuclear design is a rectangular concrete block. These designs store varying numbers of spent nuclear fuel assemblies, ranging from 24 to 37. However, because the Holtec design is currently being used at TVA's SQN and is representative of all other designs, the environmental impact of using the Holtec concrete dry storage ISFSI design has been addressed. As stated above, although the multipurpose canister (MPC)-32 is being used at SQN, this update has taken a more conservative approach using the MPC-24, because it would require more casks and correspondingly more concrete and steel. The environmental analysis of spent fuel storage in the CLWR FEIS, which focused on dry storage casks, is still valid. The following sections update information about the equipment vendors and processes that would be used at BLN and provide analysis of the effects of completing one BLN unit (B&W or AP1000) on construction and operation of a spent fuel storage facility.

Table 3-36. ISFSI Construction for a Single BLN Unit

Environmental Parameter	One B&W Unit	One AP1000 Unit
External appearance	96 vertical cylindrical storage modules (casks) placed on a concrete cask foundation pad of an approximate area of 29,760 square feet and 2 feet thick. Each cask would be a nominal 12 feet in diameter.[1]	76 vertical cylindrical storage modules (casks) placed on a concrete cask foundation pad of an approximate area of 23,560 square feet and 2 feet thick. Each cask would be a nominal 12 feet in diameter.[1]
Health and safety (only construction work performed subsequent to the loading of any storage modules with spent fuel may result in worker exposures from direct and skyshine radiation in the vicinity of the loaded horizontal storage modules)	Dose rate: 0.5 mrem per hour [2] Construction hours: 1,500 person-hours per cask/storage module[2] Total dose during construction: 72 person-rem	Dose rate: 0.5 mrem per hour [2] Construction hours: 1,500 person-hours per cask/storage module[2] Total dose during construction: 57 person-rem
Size of disturbed area	ISFSI footprint: 0.70 acre Total disturbed: 1.20 acres	ISFSI footprint: 0.55 acre Total disturbed: 0.94 acre
Materials (approximate)	Concrete: 14,760 tons Steel: 1,680 tons	Concrete: 11,685 tons Steel: 1,330 tons

[1] Numbers based on HI-STORM ISFSI dimensions described in TVA 2007
[2] DOE 1999

3.18.2.2. Environmental Consequences

Alternative A
Under this alternative, no completion or construction and operation of a new nuclear plant would occur; therefore, there would be no impacts.

Alternatives B and C
During their 40-year operating lifetimes, the Alternative B B&W unit would produce 946 MTU of spent fuel in 2,285 fuel assemblies (see Table 2-6). The Alternative C AP1000 unit would produce 894 MTU of spent fuel in 1,821 fuel assemblies. When normalized to account for the difference in power generated by the different design, the lifetime production of spent fuel is comparable. The remainder of this section compares the impacts of the construction and operation of the facilities proposed to store this spent fuel at the BLN site.

Construction of a spent fuel storage facility is addressed in the CLWR FEIS (DOE 1999), which describes a NUHOMS-24P horizontal spent fuel storage module. Currently, HI-STORM vertical storage modules are used at SQN. For the purposes of this analysis, it is assumed that the same type of vertical storage modules would be used at BLN for either Action Alternative. The modules used at SQN consist of cylindrical structures with inner and outer steel shells filled with concrete. The stainless steel MPC that contains the spent fuel assemblies is placed inside the vertical storage module. The MPC is fabricated off site.

Using the SQN ISFSI as a basis for calculating an appropriately sized pad, an area of approximately 29,760 square feet (0.70 acre) would be needed to store the 96 casks required to support operation of a B&W unit at the BLN site for 40 years. Approximately 23,560 square feet (0.55 acre) would be needed to store the 76 casks required to support operation of an AP1000 unit at the BLN site for 40 years. Assuming a proportionate ratio (1.71) of area required for construction disturbance, nuisance fencing, and transport activities (DOE 1999), a projected net disturbed area of approximately 1.20 acres would be required for a B&W unit. A projected net disturbed area of approximately 0.94 acre would be required for an AP1000 unit. The construction and environmental parameters for an ISFSI for one B&W or one AP1000 unit at the BLN site are provided in Table 3-36. The environmental effects of construction and installation of the HI-STORM modules would be similar to that described in the CLWR FEIS for the NUHOMS-24P. There is ample room at the BLN site to locate a spent nuclear fuel storage facility.

Operational impacts for spent fuel storage would be the same for both Action Alternatives. The NUHOMS horizontal storage module dry cask system described in the CLWR FEIS was designed and licensed to remove up to 24 kW of decay heat safely from spent fuel by natural air convection. The Holtec HI-STORM dry cask storage system currently in use at SQN is licensed to remove up to 28 kW of decay heat safely. Conservative calculations have shown that, for 24 kW of decay heat, air entering the cask at a temperature of 70°F would be heated to a temperature of 161°F. For a 28-kW maximum heat load, and assuming similar air mass flow rate through the cooling vents, the resulting temperature would be approximately 176°F. The environmental impact of the discharge of this amount of heat can be compared to the heat (336 kW) emitted to the atmosphere by an automobile with a 150–brake horsepower engine (DOE 1999). The heat released by an average automobile is the equivalent of as few as 12 ISFSI casks at their design maximum heat load of 28 kW. Therefore, the decay heat released to the atmosphere from the spent nuclear fuel ISFSI for a B&W unit is equivalent to the heat released to the atmosphere from approximately eight average-size cars. The decay heat released to the atmosphere from the spent nuclear fuel ISFSI for an AP1000 unit is equivalent to the heat released to the atmosphere from approximately six average-size cars.

SQN has proposed and the NRC is reviewing the use of storage casks with a licensed maximum heat load of up to 40 kW. The use of this higher allowable maximum heat load cask would result in an increase from the values reported in the paragraph above. For example, for a 40-kW maximum heat load and assuming similar air mass, flow rate through the cooling vents results in a projected temperature of approximately 221°F. The heat released by an average automobile is the equivalent of as few as nine ISFSI casks at their proposed higher design maximum heat load of 40 kW. The decay heat released to the atmosphere from the spent nuclear fuel ISFSI for a B&W unit would be equivalent to the heat released to the atmosphere from approximately 11 average-size cars. The decay heat released to the atmosphere from the spent nuclear fuel ISFSI for an AP1000 unit would be equivalent to the heat released to the atmosphere from approximately nine average-size cars. If approved, this type of cask could be used at BLN.

The CLWR FEIS concluded that the heat emitted from the ISFSI would have no effect on the environment or climate because of its small magnitude. The heat emitted by the fully loaded, largest projected ISFSI (ISFSI for one B&W unit), even at the maximum design-licensed decay heat level for each cask of 28 kW, would be approximately 2,700 kW (i.e., 96 casks x 28 kW = 2,688 kW or 2.69 MW), as compared to 2,000 kW for the system analyzed in 1999. This increase of 700 kW of heat added to the atmosphere is not large

enough to change the conclusion that this amount of heat is about 0.1 percent the heat released to the environment from any of the proposed nuclear power plants—on the order of 2,400,000 kW for an operating nuclear reactor. The actual decay heat from spent nuclear fuel in the ISFSI should be lower than 2,700 kW and would decay with time due to the natural decay of fission products in the spent nuclear fuel. As stated in the CLWR FEIS, the incremental loading of the ISFSI over a 40-year period would not generate the full ISFSI heat until 40 years after the initial operation.

The proposed use of casks with higher allowable maximum heat load (40 kW) would result in an increase from the values reported above. For example, for a 40-kW maximum heat load, a total of 3,840 kW (96 casks x 40 kW) would represent about 0.16 percent of the heat released to the environment from the proposed nuclear power plant (2,400,000 kW). Therefore, for the proposed 40-kW cask design, no noticeable effects on the environment or climate are expected.

The environmental impact of ISFSI operation for one unit at the BLN site is shown in Table 3-37. TVA has concluded that due to the small magnitude of the total potential dose, the radiation dose to workers from ISFSI operation would be minor. In general, the operational effects of the HI-STORM modules would be similar to that described in the CLWR FEIS for the NUHOMS-24P, as would be the environmental effects.

Table 3-37. Environmental Impact of ISFSI Operation for a Single BLN Unit

Environmental Parameter	One B&W Unit	One AP1000 Unit
Effects of operation of the heat dissipation system	Equivalent to heat emitted into the atmosphere by approximately 8 average-size cars, or approximately 11 cars if the higher maximum heat load (40-kW) cask at SQN is used.	Equivalent to heat emitted into the atmosphere by approximately 6 average-size cars, or approximately 9 cars if the higher maximum heat load (40-kW) cask at SQN is used.
Facility water use	Transfer cask decontamination water consumption of less than 1,521 cubic feet	Transfer cask decontamination water consumption of less than 1,204 cubic feet
Radiological impact from routine operation	Worker exposure: As the result of daily inspection of casks, during a 40-year life cycle, workers would be exposed to 91.5 person-rem. Public exposure: The regulatory limit for public exposure is 25 mrem per year. Doses to members of the public would be negligible.	Worker exposure: As the result of daily inspection of casks, during a 40-year life cycle, workers would be exposed to 72.5 person-rem. Public exposure: The regulatory limit for public exposure is 25 mrem per year. Doses to members of the public would be negligible.
Radwaste and source terms	Cask loading and decontamination operation generates less than 192 cubic feet of low-level radioactive waste.	Cask loading and decontamination operation generates less than 152 cubic feet of low-level radioactive waste.

Environmental Parameter	One B&W Unit	One AP1000 Unit
Climatological impact	Small (approximately 0.1 percent of the nuclear power plant's heat emission to the atmosphere, or approximately 0.16 percent if 40-kW cask are used)	Small (approximately 0.1 percent of the nuclear power plant's heat emission to the atmosphere, or approximately 0.13 percent if 40-kW cask are used)
Impact of runoff from operation	The storage cask surface is not contaminated. No contaminated runoff is expected.	The storage cask surface is not contaminated. No contaminated runoff is expected.

Postulated Accidents
The CLWR FEIS analyzed the postulated accidents that could occur at an ISFSI and concluded that the potential radiological releases would all be well within regulatory limits. The impact of the calculated doses, which were approximately 50 mrem or less for different scenarios, were compared with the natural radiation dose of about 300 mrem annually received by each person in the United States (DOE 1999). The storage casks proposed for use at BLN for a one-unit operation would be of similar or better design than those analyzed in the mid-1990s, and any accident doses resulting from such a postulated event would be consistent with doses previously determined.

3.18.3. Transportation of Radioactive Materials

3.18.3.1. Affected Environment

Postulated accidents due to transportation of radioactive materials were discussed in Section 2.1, "Transportation or Nuclear Fuel and Radioactive Wastes" in the TVA 1974 FES. Transportation accidents were also addressed in Section 7.2, "Transportation Accidents Involving Radioactive Materials" in AEC's 1974 FES. Normal risks associated with transportation of radioactive materials were discussed in Subsection 5.3.2.4.2, "Transportation of Radioactive Material," of the same AEC FES. Information for Transportation of Radioactive Materials for the AP1000 unit was presented in Sections 3.8 and 7.4 of the COLA ER. This section provides an updated discussion regarding the transportation of radioactive materials associated with a single unit operation.

The NRC evaluated the environmental effects of transportation of fuel and waste for light water reactors in the "Environmental Survey of Transportation of Radioactive Materials to and from Nuclear Plants" in WASH-1238 (AEC 1972) and "Environmental Survey of Transportation of Radioactive Materials to and from Nuclear Power Plants", Supplement 1 of NUREG-75/038 (NRC 1975), and found the impacts to be minor.

The NRC analyses presented in these reports (WASH-1238 and NUREG-75/038) provided the basis for Table S-4 in 10 CFR §51.52 (NRC 2007b), which summarizes the environmental impacts of transportation of fuel and radioactive wastes to and from a reference reactor. The table addresses two categories of environmental considerations: (1) normal conditions of transport and (2) accidents in transport. Subparagraphs 10 CFR §51.52(a)(1) through (5) delineate specific conditions the reactor licensee must meet to use Table S-4 as part of its environmental report. For reactors not meeting all of the conditions in paragraph (a) of 10 CFR §51.52, paragraph (b) of 10 CFR §51.52 requires a further analysis of the transportation effects.

The conditions in paragraph (a) of 10 CFR §51.52 establishing the applicability of Table S-4 relate to reactor core thermal power, fuel form, fuel enrichment, fuel encapsulation, average fuel irradiation, time after discharge of irradiated fuel before shipment, mode of transport for unirradiated fuel, mode of transport for irradiated fuel, radioactive waste form and packaging, and mode of transport for radioactive waste other than irradiated fuel. The following subsection describes the characteristics of a B&W unit and an AP1000 unit relative to the requirements of 10 CFR §51.52, which are necessary to use Table S-4.

Currently, there is not a repository in the United States where commercial spent fuel can be shipped. If at some point in the future a spent fuel repository is available, the risks associated with transport of radioactive materials are already evaluated in the following subsection. Information for the B&W unit's fuel design is taken from the BLN 1&2 FSAR. Information for the AP1000 unit's fuel design is taken from the BLN COLA FSAR.

3.18.3.2. Environmental Consequences

Alternative A
Under this alternative, no completion or construction and operation of a new nuclear plant would occur; therefore, there would be no impacts.

Alternatives B and C

Transportation of Unirradiated Fuel
Subparagraph 10 CFR §51.52(a)(5) requires that unirradiated fuel be shipped to the reactor site by truck. Table S-4 includes a condition that the truck shipments not exceed 73,000 pounds as governed by federal or state gross vehicle weight restrictions. New fuel assemblies would be transported to the BLN site by truck, in accordance with Department of Transportation (DOT) and NRC regulations.

The B&W unit's initial fuel load consists of 205 fuel assemblies. Every 18 months, refueling would require an average of 80 new fuel assemblies for one unit. The fuel assemblies would be fabricated at a fuel fabrication plant and shipped by truck to the BLN site before they are required.

For an AP1000 unit, the initial fuel load consists of 157 fuel assemblies for one unit. Every 18 months, refueling requires an average of 64 new fuel assemblies for one unit.

The details of the new fuel container designs, shipping procedures, and transportation route depends on the requirements of the suppliers providing the fuel fabrication and support services. Truck shipments would not exceed the applicable federal or state gross vehicle weight restrictions.

Transportation of Irradiated Fuel
For a B&W unit, spent fuel assemblies would be removed from the reactor and placed into the spent fuel pool during each refueling outage. The spent fuel storage pool has the capacity to store 1,058 fuel assemblies. Each refueling off load would average 80 fuel assemblies. Therefore, the spent fuel storage pool has the capacity for 10 refueling off loads, which represents approximately 15 years of operation, with a full core reserve. The spent fuel would remain on site for a minimum of five years between removal from the reactor and shipment off site. Packaging of the fuel for off-site shipment would comply with applicable DOT and NRC regulations for transportation of radioactive material. By law,

DOE is responsible for spent fuel transportation from reactor sites to a repository as provided in the *Nuclear Waste Policy Act of 1982,* Section 302, and DOE makes the decision on transport mode.

For an AP1000 unit, spent fuel assemblies would be discharged every refueling outage and placed into the spent fuel pool. The spent fuel storage pool has the capacity to store 889 fuel assemblies. Each refueling off load would discharge 64 fuel assemblies. Therefore, the spent fuel storage pool has the capacity for 11 refueling off loads, which represents approximately 16 years, plus a full core reserve. The spent fuel would remain on site for a minimum of five years between removal from the reactor and shipment off site to allow for adequate cooling. Packaging of the fuel for off-site shipment would comply with applicable DOT and NRC regulations for transportation of radioactive material. DOE would determine the transport mode for the AP1000 unit spent fuel. The following paragraphs compare the BLN site with 10 CFR §51.52(a) requirements.

Reactor Core Thermal Power. Subparagraph 10 CFR §51.52(a)(1) requires that the reactor have a core thermal power level not exceeding 3,800 MW.

A B&W unit has a thermal power rating of 3,600 MWt and would meet this condition. An AP1000 unit has a thermal power rating of 3,400 MWt and also would meet this condition.

Fuel Form. Subparagraph 10 CFR §51.52(a)(2) requires that the reactor fuel be in the form of sintered uranium dioxide (UO_2) pellets. A B&W unit and an AP1000 unit would use a sintered UO_2 pellet fuel form and would meet this requirement.

Fuel Enrichment. Subparagraph 10 CFR §51.52(a)(2) requires that the reactor fuel have a uranium-235 enrichment not exceed 4 percent by weight. A B&W unit's reactor fuel would meet the 4 percent U-235 requirement.

For an AP1000 unit, the enrichment of the initial core varies by region from 2.35 to 4.45 percent, and the average for reloads is 4.51 percent. Therefore, the AP1000 fuel would exceed the 4 percent U-235 requirement. NUREG-1555 states that the NRC has generically considered the environmental impacts of spent nuclear fuel with U-235 enrichment levels up to 5 percent and irradiation levels up to 62,000 MWD/MTU. The generic evaluation of high enrichment and high burnup fuel transport presented in NUREG-1555 determined that the environmental impacts of spent nuclear fuel transport are bounded by the impacts listed in Table S-4, provided that more than five years has elapsed between removal of the fuel from the reactor and any shipment of the fuel off site.

Five years is the minimum decay time expected before shipment of irradiated fuel assemblies from the BLN site. DOE's contract for acceptance of spent fuel, as set forth in 10 CFR Part 961, Appendix E, requires standard spent fuel to undergo a five-year cooling time. In addition, NRC specifies five years as the minimum cooling period when it issues certificates of compliance for casks used for shipment of power reactor fuel as stated in NUREG-1437, Addendum 1. A B&W unit and an AP1000 unit would have sufficient storage capacity to accommodate a five-year cooling of irradiated fuel prior to any transport off site. Therefore, both units would meet the requirements of Subparagraph 10 CFR §51.52(a)(2).

Fuel Encapsulation. Subparagraph 10 CFR §51.52(a)(2) requires that the reactor fuel pellets be encapsulated in Zircaloy rods. A B&W unit's reactor fuel would be encapsulated in Zircaloy fuel rods. Therefore, a B&W unit would meet this requirement.

An AP1000 unit's reactor fuel would be encapsulated in ZIRLO™ cladding. License amendments approving the use of ZIRLO™ rather than Zircaloy have not identified a significant increase in the amounts, or significant change in the types, of any effluents that may be released off site, or a significant increase in individual or cumulative occupational radiation exposure. Therefore, the use of ZIRLO™ cladding for an AP1000 unit would meet this subsequent evaluation requirement.

Average Fuel Irradiation. Subparagraph 10 CFR §51.52(a)(3) requires that the average fuel assembly burnup not exceed 33,000 MWD/MTU. The average fuel assembly burnup for a B&W unit and an AP1000 unit would exceed this requirement. As stated in NUREG-1555, the NRC has generically considered the environmental impacts of irradiation levels up to 62,000 MWD/MTU and found that the environmental impacts of spent nuclear fuel transport are bounded by the impacts listed in Table S-4, provided that more than five years has elapsed between removal of the fuel from the reactor and any shipment of the fuel off site. The B&W unit and the AP1000 unit would be bounded by the 62,000 MWD/MTU average burnup limit considered by the NRC and would therefore meet this requirement.

Transportation. Subparagraph 10 CFR §51.52(a)(5) allows for truck, rail, or barge transport of irradiated fuel. This requirement would be met for the BLN units. DOE is responsible for spent fuel transportation from reactor sites to the repository and makes decisions on transport mode as stated in 10 CFR §961.1. Should an off-site repository be established, the heat load of the spent fuel shipping casks and the doses to the general public would be bounded by the conditions of Table S-4.

Summary
A B&W unit would meet the conditions for average fuel irradiation as described in NUREG-1555 (NRC 1999) and would meet all other criteria outlined in 10 CFR §51.52(a). An AP1000 unit would meet the conditions for maximum fuel enrichment and average fuel irradiation as described in NUREG-1555 and would meet all other criteria outlined in 10 CFR §51.52(a). Therefore, no additional analyses of fuel transportation effects for normal conditions or accidents are required, because the risks of transporting radioactive materials would be bounded by Table S-4 of 10 CFR §51.52. Because a B&W unit or an AP1000 unit would be bounded by Table S-4, the environmental impact of any transportation of irradiated fuel would be minor as defined in 10 CFR §51.52.

3.19. Nuclear Plant Safety and Security

This section assesses the environmental impacts of postulated accidents involving radioactive materials at the BLN site and plant security including intentional destructive acts. It is divided into three subsections that address design-basis accidents, severe accidents, and plant security.

- Design-Basis Accidents (Subsection 3.19.1)
- Severe Accidents (Subsection 3.19.2)
- Plant Security (Subsection 3.19.3)

3.19.1. Design-Basis Accidents

3.19.1.1. Affected Environment

The potential consequences of postulated accidents are evaluated to demonstrate that a new unit could be constructed and operated at the BLN site without undue risk to the health

and safety of the public. These evaluations use a set of design-basis accidents (DBAs) that are representative of the reactor designs being considered for the BLN site. DBAs are those for which the risk is great enough that NRC requires plant design features and procedures to prevent unacceptable accident consequences. The set of DBAs considered covers events ranging from a relatively high probability of occurrence with relatively low consequences to relatively low probability events with high consequences.

A high degree of protection against the occurrence of postulated accidents is provided through quality design, manufacture, and construction, which ensures the high integrity of the reactor system and associated safety systems. Deviations from normal operations are handled by protective systems and design features that place and hold the plant in a safe condition. Notwithstanding this, it is conservative to postulate that serious accidents may occur, even though they are extremely unlikely. Engineered safety features are installed to prevent and mitigate the consequences of postulated events that are judged credible. The probability of occurrence of accidents and the spectrum of their consequences to be considered from an environmental impact standpoint have been analyzed using best estimates of probabilities, realistic fission product releases, and realistic transport assumptions.

The purpose of this SEIS section is to update the accident dose consequences given in the BLN 1&2 FSAR (TVA 1991) using updated atmospheric dispersion values based on current meteorological data and to present corresponding results for the AP1000 unit. This section also presents the calculated dose consequences and methodologies used for both the B&W unit and the AP1000 unit DBAs. The AP1000 unit DBA dose methodologies and results are as reported in the COLA ER.

Selection of Accidents
The site evaluations presented in the BLN 1&2 FSAR (TVA 1991) for the B&W unit and the BLN COLA FSAR for the AP1000 unit use conservative assumptions for the purpose of comparing calculated site-specific doses resulting from a hypothetical release of fission products against the 10 CFR §100.11 (NRC 2002) siting guidelines. Realistic computed doses that would be received by the population from the postulated accidents would be significantly less than those presented in the respective FSARs. The DBAs considered in this section come from Appendix A of NUREG-1555 Environmental Standard Review Plan (ESRP) Section 7.1 (NRC 1999) and apply to both the B&W unit and the AP1000 unit. The DBAs cover a spectrum of events, including those of relatively greater probability of occurrence and those that are less probable but with greater consequences. DBAs are postulated accidents that a nuclear facility must be designed and built to withstand without loss to the systems, structures, and components necessary to ensure public health and safety. The radiological consequences of the accidents listed in Appendix A of ESRP Section 7.1 are assessed to demonstrate that the selected unit can be sited and operated at the BLN site without undue risk to the health and safety of the public.

Evaluation Methodology
Section 7.1 of the BLN FES demonstrates that the calculated DBA doses for the B&W unit are within the limits of the more recently established 10 CFR §100.11. The analysis presented in this SEIS updates applicable inputs used in the previous dose assessments.

Section 7.1 of the BLN COLA ER demonstrates that the postulated DBA doses for the AP1000 are also within the limits of 10 CFR §100.11 using current inputs consistent with those described in this SEIS.

The basic scenario for each accident is that radioactive effluent is released at the accident location inside a building, and this radioactivity is eventually released to the environment. Chapter 15 of the BLN 1&2 FSAR presents conservative radiological consequences for the accidents identified for the B&W unit. Chapter 15 of the BLN COLA FSAR presents the conservative radiological consequences for the AP1000 unit.

Among the conservative assumptions in Chapter 15 of the BLN 1&2 FSAR and the BLN COLA FSAR is the use of time-dependent atmospheric dispersion (χ/Q) values, which are exceeded only 0.5 percent of the time, meaning that conditions would be more favorable for atmospheric dispersion 99.5 percent of the time. In addition to the use of atmospheric dispersion factors corresponding to adverse conditions, the analyses presented in Chapter 15 of the BLN 1&2 FSAR and the BLN COLA FSAR also used conservative assumptions for the radionuclide activity in the core and coolant, the types of radioactive materials released, and the release paths to the environment in order to calculate conservative dose estimates.

These conservative assumptions are maintained for the dose assessments presented in this section, except that realistic atmospheric dispersion factors are used. The doses in this SEIS section are calculated based on the 50th percentile (average) site-specific atmospheric dispersion (χ/Q) values reflecting more realistic meteorological conditions consistent with the guidance provided in the ESRP (NRC 1999). The χ/Q values are calculated using the guidance in NRC Regulatory Guide 1.145 (NRC 1982a) with site-specific meteorological data. The dose from the B&W unit for a given time interval is calculated by multiplying the BLN 1&2 FSAR accident dose by the ratio of the 50 percent probability-level χ/Q value to the BLN 1&2 FSAR χ/Q value. For the BLN AP1000 unit, the accident doses are obtained from the BLN COLA ER, which is based on 50 percent probability-level χ/Q values as required by the ESRP. All other input parameters and assumptions used for the accident analyses remain unchanged from the BLN 1&2 FSAR and BLN COLA FSAR.

Details on the methodologies and assumptions pertaining to each of the accidents, such as activity release pathways and credited mitigation features, are provided in Chapter 15 of the BLN 1&2 FSAR for the B&W unit and in Chapter 15 of the BLN COLA FSAR for the AP1000 unit. The atmospheric dispersion factors (χ/Q values) used to calculate conservative design-basis EAB and LPZ doses for the various postulated accidents for the B&W unit are obtained from Chapter 15 of the BLN 1&2 FSAR. The χ/Q values used to calculate conservative design-basis EAB and LPZ doses for the AP1000 unit are obtained from Chapter 15 of the BLN COLA FSAR. The 50 percent probability-level χ/Q values used to calculate realistic EAB and LPZ doses for the B&W unit are summarized in Table 3-38 and for the AP1000 unit in Table 3-39.

Table 3-38. B&W Unit 50 Percent Probability-Level χ/Q Values (sec/m^3)

Location	0-2 Hours	0-8 Hours	8-24 Hours	24-96 Hours	96-720 Hours
EAB	1.07E-04	–	–	–	–
LPZ	–	9.39E-06	8.09E-06	5.84E-06	3.66E-06

Table 3-39. AP1000 Unit 50 Percent Probability-Level χ/Q Values (sec/m³)

Location	0-2 Hours	0-8 Hours	8-24 Hours	24-96 Hours	96-720 Hours
EAB	1.04E-04	–	–	–	–
LPZ	–	9.65E-06	8.35E-06	6.09E-06	3.88E-06

Differences between the χ/Q values for the B&W unit and the AP1000 unit are the result of differences in distances from the plants to the EAB and LPZ boundaries. The χ/Q values also differ from the values reported in the BLN 1&2 FSAR due to the usage of more current meteorological data.

3.19.1.2. Environmental Consequences

Alternative A
Under this alternative, no completion or construction and operation of a new nuclear plant would occur; therefore, there would be no impacts.

Alternatives B and C
The BLN site-specific radiological consequences of DBAs using the 50 percent probability-level χ/Q values are shown in Table 3-40 for the B&W unit and in Table 3-41 for the AP1000 unit. For each accident, the EAB dose shown is for a two-hour period and the LPZ dose shown is the integrated dose for the duration of the accident as specified in the ESRP. The B&W unit doses are presented as thyroid and whole-body doses as per the original B&W unit licensing basis and the BLN AP1000 unit doses are presented as TEDE.

The results presented in Tables 3-40 and 3-41 provide a realistic estimate of radiological consequences of the postulated accidents for a B&W unit and an AP1000 unit. In all cases, the doses to an assumed individual at the EAB and LPZ are a small fraction of the dose limits specified within 10 CFR §100.11. The results from this realistic analysis show that the environmental risks due to postulated radiological accidents are exceedingly minor. These results confirm the conclusion presented in the 1974 BLN FES.

Table 3-40. Summary of Design-Basis Accident Atmospheric Doses for a B&W Unit

Accident Description	Accident Dose					
	Thyroid (rem)			Whole-Body (rem)		
	EAB	LPZ	Limit[4]	EAB	LPZ	Limit[4]
Steam Line Break	1.14E+01[5]	1.28E-01	300	7.64E-03	7.34E-03	25
Feedwater Piping Break	Note 1	Note 1	300	Note 1	Note 1	25
Reactor Coolant Pump Shaft Seizure (Locked Rotor)	Note 2	Note 2	30	Note 2	Note 2	2.5
Reactor Coolant Pump Shaft Break	Note 3	Note 3	30	Note 3	Note 3	2.5
Failure of Small Lines Carrying Primary Coolant Outside Containment	4.62E-01	4.06E-02	300	4.22E-02	3.71E-03	25

Accident Description	Accident Dose					
	Thyroid (rem)			Whole-Body (rem)		
	EAB	LPZ	Limit[4]	EAB	LPZ	Limit[4]
Steam Generator Tube Failure	1.68E+00	8.26E-02	300	1.95E-02	9.58E-04	25
Loss-of-Coolant Accident	3.09E-01	1.51E-01	300	1.66E-03	2.18E-02	25
Fuel-Handling Accident	5.09E+00	4.46E-01	75	2.18E-01	1.91E-02	6

Notes:

1. The radiological consequences of a Feedwater Piping Break are bounded by a Steam Line Break, as indicated in Subsection 15.2.8.5 of the BLN 1&2 FSAR.
2. The radiological consequences of this accident will not exceed normal operating levels as no fuel barrier failures result from this transient, as indicated in Subsection 15.3.3.5 of the BLN 1&2 FSAR.
3. Radiological consequences of a Reactor Coolant Pump Shaft Break are bounded by Reactor Coolant Pump Shaft Seizure, as indicated in Subsection 15.3.4 of the BLN 1&2 FSAR.
4. Limits from 10 CFR §100.11.
5. 1.14E+01 is the same as $1.14 \times 10^{+01}$, or 11.4.

Table 3-41. Summary of Design-Basis Accident Doses for an AP1000 Unit

Accident Description	Accident Dose (rem TEDE)		
	EAB	LPZ	Limit[3]
Steam System Piping Failure			
Preexisting Iodine Spike	1.00E-01	2.00E-02	25
Accident-Initiated Iodine Spike	1.10E-01	5.00E-02	2.5
Feedwater System Pipe Break	Note 1	Note 1	
Reactor Coolant Pump Shaft Seizure			
No Feedwater	8.00E-02	1.00E-02	2.5
Feedwater Available	6.00E-02	2.00E-02	2.5
Reactor Coolant Pump Shaft Break	Note 2	Note 2	
Spectrum of Rod Cluster Control Assembly Ejection Accidents	3.70E-01	1.10E-01	6.3
Failure of Small Lines Carrying Primary Coolant Outside Containment	2.20E-01	2.00E-02	2.5
Steam Generator Tube Rupture			
Preexisting Iodine Spike	2.30E-01	2.00E-02	25
Accident-Initiated Iodine Spike	1.10E-01	2.00E-02	2.5
Loss-of-Coolant Accident Resulting from a Spectrum of Postulated Piping Breaks Within the Reactor Coolant Pressure Boundary	1.20E+00	0.31E+00	25
Fuel-Handling Accident	5.40E-01	5.00E-02	6.3

Notes:

1. Radiological consequences of a Feedwater System Pipe Break are bounded by Steam System Piping Failure, as indicated in Section 15.2 of the BLN COLA FSAR.
2. Radiological consequences of a Reactor Coolant Pump Shaft Break are bounded by Reactor Coolant Pump Shaft Seizure, as indicated in Subsection 15.3.4.2 of the BLN COLA FSAR.
3. NUREG-1555 specifies a dose limit of 25 rem TEDE for all DBAs. The more restrictive limits shown in the table apply to safety analysis doses, but they are shown here to demonstrate that even these more restrictive limits are met.

3.19.2. Severe Accidents

3.19.2.1. Affected Environment

The term "accident" refers to any unintentional event (i.e., outside the normal or expected plant operation envelope) that results in a release or a potential for a release of radioactive material to the environment. The NRC categorizes accidents as either design basis or severe. DBAs, described in Subsection 3.19.1, are those for which the risk is great enough that NRC requires plant design features and procedures to prevent unacceptable accident consequences. Severe accidents are those that NRC considers too unlikely to warrant normal design controls to prevent or mitigate the consequences. Severe accident analyses consider both the risk of a severe accident and the on-site and off-site consequences.

The risk of a severe accident associated with a B&W PWR is determined by a plant-specific probabilistic safety assessment, which provides a systematic and comprehensive methodology of determining the risks associated with the operation of a plant at the BLN site. Because the BLN 1&2 construction permits were deferred before consideration of severe accidents was required by the NRC, no probabilistic safety assessment model was developed for the specific units at the BLN site. However, such models exist for other B&W PWRs.

For this evaluation, the severe accident frequency analysis is based on the Arkansas Nuclear One (ANO) probabilistic safety assessment (PSA) model (ANO 2000). Use of the ANO probabilistic risk assessment (PRA) as a surrogate for the BLN B&W plant is acceptable because the important safety-related systems, structures, and components at the ANO B&W plant are the same as in the standard B&W design. Consequently the failure modes and frequencies modeled in the ANO PRA are applicable to the BLN B&W plant. The ANO PSA calculates the possible frequencies of four main categories of radioactive release types: early containment failure by leakage (CFEL), early containment failure by rupture (CFER), containment bypass (BP), and late containment failure (CFL). For this analysis, the release plume characteristics in the ANO PSA, such as isotope release fractions, plume size, delay, and duration, had to be proportioned for application to BLN due to the different core thermal power rating for ANO.

Westinghouse has developed a PRA for the AP1000 standard PWR plant design that determines the severe accident frequencies and release characterizations (isotope releases and the plume size and durations) (WEC 2008). The accidents are characterized by six major release types: early containment rupture after core relocation (CFI), early containment rupture before core relocation (CFE), normal leakage from an intact containment (IC), bypass of the containment (BP), containment isolation systems failure (CI), and late containment failure (CFL).

Two severe accident analyses were performed to estimate the human health impacts from potential accidents at BLN. One analysis considering the B&W PWR design, representative of either Units 1 or 2, was prepared to support this SEIS. A separate analysis, prepared in support of the COLA ER, considered the AP1000 design. Only severe reactor accident scenarios leading to core damage and significant off-site releases are presented here. Accident scenarios that do not lead to significant off-site releases are not presented due to significantly reduced risk of adverse public and environmental consequences.

The MELCOR Accident Consequence Code System (MACCS2) computer code (Version 1.13.1) (NRC 1998) was used to perform probabilistic analyses of radiological impacts. The

generic input parameters given with the MACCS2 computer code that were used in NRC's 1990 severe accident analysis (NUREG-1150) formed the basis for the analysis. These generic data values were supplemented with parameters specific to BLN and the surrounding area. Site-specific data included population distribution, economic parameters, and agricultural production. Plant-specific release data included nuclide release, release duration, release energy (thermal content), release frequency, and release category (i.e., early release, late release). These data, in combination with site-specific meteorology, were used to simulate the probability distribution of impact risks (exposure and fatalities) to the surrounding 80-kilometer (within 50 miles) population.

3.19.2.2. Environmental Consequences

Alternative A

Under this alternative, no completion or construction and operation of a new nuclear plant would occur; therefore, there would be no impacts.

Alternatives B and C

The consequences of a beyond-design-basis accident to the maximally exposed off-site individual, an average individual, and the population residing within an 80-kilometer (50-mile) radius of the reactor site are summarized in Tables 3-42 through 3-44. These analyses assumed average or mean meteorological conditions. The analysis also assumed that a site emergency would have been declared early in the accident sequence and that all nonessential site personnel would have evacuated the site in accordance with site emergency procedures before any radiological releases to the environment occurred. In addition, a 95 percent probability was assigned to the assumption that emergency action guidelines would have been implemented to initiate evacuation of the public within 16 kilometers (10 miles) of the plant. This is a reasonably conservative assumption, which implies that 5 percent of the population would not evacuate as directed.

Table 3-42. Severe Accident Analysis Results, Total Risks

Plant Design	Dose-Risk (Person-Rem/yr)	Dollar Risk ($/yr)	Affected Land (hectares per accident)	Early Fatalities (per year)	Latent Fatalities (per year)
B&W PWR	1.06E+00	2.18E+03	6.35E+04	0.00E+00	5.95E-04
AP1000	2.88E-02	7.68E+01	1.40E+05	0.00E+00	1.83E-05

Note: 2.88E-02 is equal to 2.88×10^{-2} or 0.0288

Table 3-43. Severe Accident Individual Annual Risks, B&W Unit

Release Category (frequency per reactor year)	Maximally Exposed Off-Site Individual		Average Individual Member of Population Within 80 Kilometers (50 miles)	
	Dose Risk[1] (rem/year)	Cancer Fatality[2]	Dose Risk[1] (rem/year)	Cancer Fatality[2]
CFER (2.91E-07)	1.73E-04	3.72E-09	1.32E-07	8.72E-11
CFEL (2.54E-07)	8.69E-06	6.96E-09	1.19E-07	6.01E-11
BP (3.59E-07)	3.77E-05	4.70E-09	2.09E-07	1.37E-10
CFL (1.42E-06)	3.99E-05	3.26E-09	3.54E-07	1.72E-10
Cumulative Total Individual Risk		1.86E-08		4.55E-10

Notes:
1. Includes the likelihood of occurrence of each release category
2. Increased likelihood of cancer fatality per year

Table 3-44. Severe Accident Individual Annual Risks, AP1000 Unit

Release Category (frequency per reactor year)	Maximally Exposed Off-Site Individual		Average Individual Member of Population Within 80 Kilometers (50 miles)	
	Dose Risk[1] (rem/year)	Cancer Fatality[2]	Dose Risk[1] (rem/year)	Cancer Fatality[2]
CFI (1.89E-10)	1.70E-07	2.29E-12	1.07E-10	8.56E-14
CFE (7.47E-09)	2.47E-06	3.34E-11	5.34E-09	2.97E-12
IC (2.21E-07)	1.76E-06	3.38E-11	7.54E-10	3.82E-13
BP (1.05E-08)	2.00E-05	2.35E-10	1.69E-08	1.11E-11
CI (1.33E-09)	7.49E-07	1.21E-11	7.66E-10	6.27E-13
CFL (3.45E-13)	2.95E-12	3.08E-16	2.84E-13	3.26E-16
Cumulative Total Individual Risk		3.17E-10		1.52E-11

Notes:
1. Includes the likelihood of occurrence of each release category
2. Increased likelihood of cancer fatality per year

The B&W unit results (Table 3-43) show that the highest risk to the maximally exposed off-site individual is one fatality every 54 million years (or 1.86×10^{-8} per year) while the risk to an average individual member of the public is one fatality every 2 billion years (or 4.55×10^{-10} per year). The AP1000 unit results (Table 3-44) show that the highest risk to the maximally exposed off-site individual is one fatality every 3 billion years (or 3.17×10^{-10} per year) while the risk to an average individual member of the public is one fatality every 66 billion years (or 1.52×10^{-11} per year). The risk associated with the AP1000 unit is lower due to its advanced design. However, for either a B&W or an AP1000 unit, the risk to the general population and individual members of the public is insignificant because of adherence to applicable radiological standards, specific plant design features in conjunction with a waste minimization program, and employee safety training programs and work procedures. Overall, the risk results presented above for both the B&W and the AP1000 unit are minor.

3.19.3. Plant Security

3.19.3.1. Affected Environment

Some nongovernmental entities and members of the public have expressed concern about the risks posed by nuclear generating facilities in light of the threat of terrorism. TVA believes that the possibility of a terrorist attack affecting operation of one or more units at

BLN is very remote and that postulating potential health and environmental impacts from a terrorist attack involves substantial speculation.

TVA has in place detailed, sophisticated security measures to prevent physical intrusion into all its nuclear plant sites, including BLN, by hostile forces seeking to gain access to plant nuclear reactors or other sensitive facilities or materials. TVA security personnel are trained and retrained to react to and repel hostile forces threatening TVA nuclear facilities. TVA's security measures and personnel are inspected and tested by the NRC. It is highly unlikely that a hostile force could successfully overcome these security measures and gain entry into sensitive facilities and even less likely that they could do this quickly enough to prevent operators from putting plant reactors into safe shutdown mode. However, the security threat that is more frequently identified by members of the public or in the media are not hostile forces invading nuclear plant sites but attacks using hijacked jet airliners, the method used on September 11, 2001, against the World Trade Center and the Pentagon. The likelihood of this now occurring is equally remote in light of today's heightened security awareness at airports, but this threat has been carefully studied.

The NEI commissioned EPRI to conduct an impact analysis of a large jet airliner being purposefully crashed into sensitive nuclear facilities or containers including nuclear reactor containment buildings, used fuel storage ponds, used fuel dry storage facilities, and used fuel transportation containers (NEI 2002). Using conservative analyses, EPRI concluded that there would be no release of radionuclides from any of these facilities or containers because they are already designed to withstand potentially destructive events. Nuclear reactor containment buildings, for example, have thick concrete walls with heavy reinforcing steel and are designed to withstand large earthquakes, extreme overpressures, and hurricane-force winds. The EPRI analysis used computer models, in which a Boeing 767-400 was crashed into containment structures that were representative of all U.S. nuclear power containment types. The containment structures suffered some crushing and chipping at the maximum impact point but were not breached.

The EPRI analysis is fully consistent with research conducted by NRC. When NRC recently considered such threats, NRC Commissioner McGaffigan observed:

> *Today the NRC has in place measures to prevent public health and safety impacts of a terrorist attack using aircraft that go beyond any other area of our critical infrastructure. In addition to all the measures the Department of Homeland Security and other agencies have put in place to make such attacks extremely improbable (air marshals, hardened cockpit doors, passenger searches, etc.), NRC has entered into a Memorandum of Understanding with NORAD/NORTHCOM to provide realtime information to potentially impacted sites by any aircraft diversion.*
>
> *As NRC has said repeatedly, our research showed that in most (the vast majority of) cases an aircraft attack would not result in anything more than a very expensive industrial accident in which no radiation release would occur. In those few cases where a radiation release might occur, there would be no challenge to the emergency planning basis currently in effect to deal with all beyond-design-basis events, whether generated by mother nature, or equipment failure, or terrorists* (NRC 2007c).

3.19.3.2. Environmental Consequences

Alternative A
Under this alternative, no completion or construction and operation of a new nuclear plant would occur, therefore, there would be no impacts.

Alternatives B and C
In the very remote likelihood that a terrorist attack did successfully breach the physical and other safeguards at BLN resulting in the release of radionuclides, the consequences of such a release are reasonably captured by the discussion of the impacts of severe accidents discussed above in Subsection 3.19.2.

Notwithstanding the very remote risk of a terrorist attack affecting operations, TVA increased the level of security readiness, improved physical security measures, and increased its security arrangements with local and federal law enforcement agencies at all of its nuclear generating facilities after the events of September 11, 2001. These additional security measures were taken in response to advisories issued by NRC. TVA continues to enhance security at its plants in response to NRC regulations and guidance. The security measures TVA has taken at its sites are complemented by the measures taken throughout the United States to improve security and reduce the risk of successful terrorist attacks. This includes measures designed to respond to and reduce the threats posed by hijacking large jet airliners.

3.20. Decommissioning

3.20.1. Affected Environment

Decommissioning is not addressed in TVA's 1974 FES. However, the AEC 1974 FES includes a brief discussion of both the process and the cost. The CLWR FEIS (DOE 1999, Subsection 5.2.5) includes discussion of decontamination and decommissioning, but does not mention costs. As these documents explain, at the end of the operating life of a nuclear unit, TVA would seek the termination of its operating license from NRC. Termination requires that the unit be decommissioned, a process that ensures the unit is safely removed from service and the site made safe for unrestricted use. A decommissioning plan would be developed for approval by NRC, with appropriate environmental reviews when TVA prepares to decommission the unit in the future.

For the purpose of this environmental review, the decommissioning process and requirements are essentially the same insofar as both alternative units are concerned. The partially completed B&W unit and the advanced design AP1000 unit are PWRs, which are treated similarly when factors such as minimum estimated decommissioning cost and planning are taken into account.

Methods
The three NRC-approved methods of decommissioning nuclear power facilities described in the CLWR FEIS (DOE 1999) are still viable alternatives:

1. **DECON**. The DECON option calls for the prompt removal of radioactive material at the end of the plant life. Under DECON, all fuel assemblies, nuclear source material, radioactive fission and corrosion products, and all other radioactive and contaminated materials above NRC-restricted release levels are removed from the plant. The reactor pressure vessel and internal components would be removed along with removal and

demolition of the remaining systems, structures, and components with contamination control employed as required. This is the most expensive of the three options.

2. **SAFSTOR**. SAFSTOR is a deferred decontamination strategy that takes advantage of the natural dissipation of almost all of the radiation. After all fuel assemblies, nuclear source material, radioactive liquid, and solid wastes are removed from the plant, the remaining physical structure would then be secured and mothballed. Monitoring systems would be used throughout the dormancy period and a full-time security force would be maintained. The facility would be decontaminated to NRC-unrestricted release levels after a period of up to 60 years, and the site would be released for unrestricted use. Although this option makes the site unavailable for alternate uses for an extended period, worker and public doses would be much smaller than under DECON, as would the need for radioactive waste disposal.

3. **ENTOMB.** As the name implies, this method involves encasing all radioactive materials on site rather than removing them. Under ENTOMB, radioactive structures, systems, and components are encased in a structurally long-lived substance, such as concrete. The entombed structure is appropriately maintained and monitored until radioactivity decays to a level that permits termination of the license. This option reduces worker and public doses, but because most power reactors will have radionuclides in concentrations exceeding the limits for unrestricted use even after 100 years, this option may not be feasible under current regulation.

It is expected that by the time the BLN unit is decommissioned, new, improved technologies and efficiencies will have been developed and approved by NRC.

Cost

In AEC's FES the estimated cost of decommissioning was $25 million. NRC currently estimates that decommissioning a PWR would cost a minimum of $404 million per unit in today's dollars. TVA presently maintains a nuclear decommissioning trust to provide money for the ultimate decommissioning of its entire fleet of nuclear power plants. The fund is invested in securities generally designed to achieve a return in line with overall equity market performance. The estimated assets of the decommissioning trust fund as of March 31, 2010, totaled $908 million. This balance is above the present value of the estimated future nuclear decommissioning costs for TVA's operating nuclear units. TVA recently provided the NRC with a plan to ensure decommissioning funding assurance when eventual decommissioning activities take place. The plan describes an external sinking fund approach that provides funding assurance for each nuclear unit at the end of its respective term of licensed operation. A fund balance is projected for each remaining year of unit operation. In accordance with NRC regulations, TVA will annually review the minimum amount to be provided for decommissioning funding assurance and, as necessary, will make contributions to the funds for each unit, or apply another method or combination of methods of funding assurance consistent with NRC regulations and guidance. TVA monitors the assets of its nuclear decommissioning trust versus the present value of its liabilities in order to ensure that, over the long term and before cessation of nuclear plant operations and commencement of decommissioning activities, adequate funds from investments will be available to support decommissioning.

Prior to the time the BLN unit commences operation, TVA would create a separate trust account for the unit within the decommissioning trust fund. It also has the option of

applying another method or combination of methods of funding assurance to cover the costs of future decommissioning.

3.20.2. Environmental Consequences

Alternative A
Under this alternative, no completion or construction and operation of a new nuclear plant would occur; therefore, there would be no impacts.

Alternatives B and C
Environmental issues associated with decommissioning were analyzed in the *Generic Environmental Impact Statement for Licensing of Nuclear Power Plants*, NUREG–1437 (NRC 1996; 1999). The generic environmental impact statement included a determination of whether the analysis of the environmental issue could be applied to all plants and whether additional mitigation measures would be warranted. Issues were sorted into two categories. For those issues meeting Category 1 criteria, no additional plant-specific analysis is required by NRC, 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 require additional plant-specific review. Environmental analysis of the future decommissioning plan for either alternative BLN unit would tier from this or the appropriate NRC document in effect at the time.

TVA has not identified any significant new information during this environmental review that would indicate the potential for decommissioning impacts not previously reviewed. Therefore, TVA does not at this time anticipate any adverse effects from the decommissioning process. As stated earlier, further environmental reviews would be conducted at the time a decommissioning plan for the BLN unit is proposed.

Page intentionally blank

CHAPTER 4

4.0 TRANSMISSION SYSTEM ALTERNATIVES – AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

This chapter includes a description of the affected environment and expected direct, indirect, and cumulative impacts associated with proposed transmission system improvements described in Section 2.6 and shown in Figure 2-15. Transmission infrastructure, including corridors and switchyards, to support operation of a nuclear plant at the BLN site was identified, reviewed, and evaluated in the earlier environmental review documents prepared by TVA and the AEC for the original facility encompassing BLN 1&2. The AEC subsequently approved and issued a construction license for BLN 1&2 and the supporting transmission infrastructure into and at the site (TVA 2008a). The approved transmission system was constructed before the plant entered deferred status.

The 11 transmission lines that would need to be upgraded or reenergized to support operation of a single nuclear unit at the BLN site are listed in Table 2-1. Nine of the lines need to be reconductored or uprated. Sections of two 500-kV lines need to be connected and energized; ROW vegetation management on those deenergized segments will be brought back to current TVA standards. The Widows Creek-Bellefonte and Bellefonte-Scottsboro 161-kV lines would not need to be changed to support operation of a single nuclear unit at the BLN site. Additional description of proposed transmission line upgrades is provided in Section 2.6. As described in Section 2.6, no new transmission lines would be needed under either Action Alternative, and therefore no additional ROW would be required. In addition, the existing 500-kV switchyard would be refurbished.

The methods used to manage the infrastructure and maintain ROW for the lines would be unchanged. Prior to these activities, TVA archaeologists and biologists would conduct an SAR of the transmission line area (including the ROW) to identify any resource issues that may occur along that transmission line. These reviews are conducted on a recurring basis that coincides with the maintenance cycle, to ensure that the most current information is provided to the organizations conducting maintenance on these transmission lines. A summary of the SAR process is provided in Appendix D.

Only minor editorial changes have been made to Chapter 4 in the FSEIS. There were no comments on the DSEIS related to the proposed transmission system upgrades.

4.1. Surface Water

4.1.1. Affected Environment

The project areas of the proposed transmission line improvements drain to the Tennessee River and its tributaries at the following locations: (1) Guntersville and Wheeler reservoirs in Alabama, (2) at Nickajack and Chickamauga reservoirs in southeast Tennessee and northwest Georgia, and (3) upstream and downstream of Normandy Dam on the Duck River in central Tennessee. Table 4-1 identifies the major streams within the project area and their state designated use classification and 303(d) use impairment listing. Streams on a state 303(d) list do not fully support one or more of their designated uses and are included in a state program to eliminate the water quality impairment.

Table 4-1. State Classification and 303(d) Listing of Major Streams Crossed

Line/Stream-Reservoir	State	Classification[1]	303(d) Listed/Reason
Browns Ferry-Trinity 161-kV (ID: 10)			
Tennessee River-Wheeler	Ala.	S, F&W	No
Bakers Creek	Ala.	F&W	No
Browns Ferry-Athens 161-kV (ID: 11)	Ala.		
Tennessee River-Wheeler	Ala.	S, F&W	No
Round Island Creek	Ala.	F&W	No
Swan Creek	Ala.	F&W, A&I	Yes - nutrients
Town Creek	Ala.	F&W	No
Widows Creek-Bellefonte #1 500-kV[2] (ID: 6); Bellefonte-Madison 500-kV[2] (ID: 7)			
Tennessee River-Guntersville	Ala.	PWS, S, F&W	No
Town Creek	Ala.	F&W	No
Mud Creek	Ala.	F&W	No
Crow Creek	Ala.	F&W	No
Big Coon Creek	Ala.	F&W	No
Little Coon Creek	Ala.	F&W	No
Widows Creek	Ala.	S, F&W	No
Widows Creek-Bellefonte #2 500-kV[3] (ID: 8); Bellefonte-East Point 500-kV[3] (ID: 9)	Ala.		
Tennessee River-Guntersville	Ala.	PWS, S, F&W	No
Coon Creek	Ala.	S, F&W	No
Widows Creek-Oglethorpe #2 161-kV[4] (ID: 4)	Ala.		
Tennessee River-Guntersville	Ala.	PWS, S, F&W	No
Widows Creek	Ala.	S, F&W	No
Long Island Creek	Ala.	PWS, S, F&W	No
Widows Creek-Oglethorpe #3 161-kV[4] (ID: 5)	Ala.		
Tennessee River-Guntersville	Ala.	PWS, S, F&W	No
Long Island Creek	Ala.	PWS, S, F&W	No
Guest Creek	Ala.	F&W	No
Tennessee River-Nickajack	Tenn.	DWS, IWS, FAL, REC, LWW, IRR, NAV	Yes – dioxins, PCBs
Cole City Creek	Ga.	Fishing	No
Lookout Creek	Ga.	Fishing	Yes – nonpoint source pollution
Chattanooga Creek	Ga.	Fishing	Yes – nonpoint source pollution
Rock Creek	Ga.	Fishing, Trout Stream	No
Dry Creek	Ga.	Fishing	Yes – nonpoint source pollution
S. Chickamauga Creek	Tenn.	IWS, FAL, REC, LWW, IRR	Yes – *E. coli*, nutrients, other anthropogenic habitat loss

Line/Stream-Reservoir	State	Classification[1]	303(d) Listed/Reason
W. Chickamauga Creek	Ga.	Fishing	Yes – nonpoint source pollution
Widows Creek-Raccoon Mountain #2 161-kV (ID: 3)			
Tennessee River-Guntersville	Ala.	PWS, S, F&W	No
Long Island Creek	Ala.	PWS, S, F&W	No
Guest Creek	Ala.	F&W	No
Tennessee River-Nickajack	Tenn.	DWS, IWS, FAL, REC, LWW, IRR, NAV	Yes – dioxins, PCBs
Cole City Creek	Ga.	Fishing	No
Lookout Creek	Tenn.	IWS, FAL, REC, LWW, IRR	No
Sequoyah-Widows Creek 500-kV (ID: 2)			
Tennessee River-Guntersville	Ala.	PWS, S, F&W	No
Sequatchie River	Tenn.	DWS, IWS, FAL, REC, LWW, IRR	No
Tennessee River-Nickajack	Tenn.	DWS, IWS, FAL, REC, LWW, IRR, NAV	Yes – dioxins, PCBs
Suck Creek	Tenn.	FAL, REC, LWW, IRR	No
South Suck Creek	Tenn.	FAL, REC, LWW, IRR	Yes – loss of biological integrity
North Suck Creek	Tenn.	FAL, REC, LWW, IRR	Yes - pH
N. Chickamauga Creek	Tenn.	FAL, REC, LWW, IRR, TS	Yes – pH, physical substrate habitat problems
Tennessee River-Chickamauga	Tenn.	DWS, IWS, FAL, REC, LWW, IRR, NAV	No
Wartrace-N. Tullahoma Tap 161-kV (ID: 1)			
Tennessee River-Kentucky	Tenn.	DWS, IWS, FAL, REC, LWW, IRR, NAV	No
Duck River-Normandy	Tenn.	DWS, IWS, FAL, REC, LWW, IRR	No
Carroll Creek	Tenn.	FAL, REC, LWW, IRR	No
Duck River- Below Normandy	Tenn.	DWS, FAL, REC, LWW, IRR, TS	Yes – *E. coli*

Line/Stream-Reservoir	State	Classification[1]	303(d) Listed/Reason
Doddy Creek	Tenn.	FAL, REC, LWW, IRR	Yes – habitat loss from erosion, flow alteration
Garrison Fork	Tenn.	DWS, IWS, FAL, REC, LWW, IRR	No
Wartrace Creek	Tenn.	FAL, REC, LWW, IRR	Yes – *E. coli*

[1] Abbreviations for designated use classifications for **Alabama**: PWS—Public Water Supply, S—Swimming and Other Whole Body Water-Contact Sports, F&W—Fish and Wildlife. For **Tennessee**: DWS—Domestic Water Supply, IWS—Industrial Water Supply, FAL—Fish and Aquatic Life, REC—Recreation, LWW—Livestock Watering and Wildlife, IRR—Irrigation, NAV—Navigation, TS—Trout Stream

[2] Portions of the Widows Creek-Bellefonte #1 and Bellefonte-Madison 500-kV lines share a common ROW.

[3] Portions of the Widows Creek-Bellefonte #2 and Bellefonte-East Point 500-kV lines share a common ROW.

[4] The Widows Creek-Oglethorpe #2 and #3 161-kV lines are co-located.

4.1.2. Environmental Consequences

No Action Alternative

Under the No Action Alternative, because much of the subject lines are located on existing ROW, vegetation maintenance would continue to occur periodically, including the use of herbicides, which could possibly have an impact on groundwater resources. During ROW maintenance, the vegetation management guidelines and procedures as described in Appendix L would be followed. With the implementation of BMPs and routine precautionary measures, no additional impacts to surface water would likely occur related to the ongoing maintenance activities under the No Action Alternative.

Action Alternative

Soil disturbances associated with the use of or maintenance of access roads or transmission line upgrading activities could potentially result in adverse water quality impacts. Soil erosion and sedimentation can clog small streams and threaten aquatic life. Continued removal of the tree canopy along stream crossings can increase water temperatures and algal growth, decrease dissolved oxygen levels, and cause adverse impacts to aquatic biota. However, TVA routinely includes precautions in the design of its transmission line projects to minimize these potential impacts (see Appendices L and M [SOPs]). In the unlikely event that any new permanent stream crossings are necessary, these crossings would be designed to avoid impeding runoff patterns and the natural movement of aquatic fauna. Temporary stream crossings and other upgrading and maintenance activities would comply with appropriate state permit requirements and TVA requirements as described in Muncy (1999). Canopies in all streamside management zones (SMZs) would be left undisturbed unless there were no practicable alternative (see Appendix N). Proper implementation of these controls is expected to result in only minor temporary impacts to surface waters. Any cumulative impacts to surface water quality are anticipated to be minor and insignificant.

4.2. Groundwater

4.2.1. Affected Environment

The affected transmission lines for the Action Alternative span several geographical areas. The geology and the groundwater contained within these areas are diverse, and for the purposes of this review, have been broken into geographic sections according to the physiographic province in which the transmission lines occur.

Northeast Alabama, Southeast Tennessee, and Northwest Georgia Sections
The six transmission lines proposed for upgrades in this section are Sequoyah-Widows Creek 500-kV (ID: 2); Widows Creek-Oglethorpe #2 161-kV (ID: 4); Widows Creek-Oglethorpe #3 161-kV (ID: 5); Widows Creek-Bellefonte #1 500-kV (ID: 6); Widows Creek-Bellefonte #2 500-kV (ID: 8); and Widows Creek-Raccoon Mountain #2 161-kV (ID: 3). These transmission lines are located across two physiographic provinces, i.e., the Valley and Ridge, and the Appalachian Plateaus.

The Valley and Ridge aquifer consists of folded and faulted carbonate, sandstone, and shale. Soluble carbonate rocks and some easily eroded shales underlie the valleys in the province, and more erosion-resistant siltstone, sandstone, and cherty dolomite underlie ridges. The arrangement of the northeast-trending valleys and ridges are the result of a combination of folding, thrust faulting, and erosion. Compressive forces from the southeast have caused these rocks to yield, first by folding and subsequently by repeatedly breaking along a series of thrust faults. The result of the faulting is that geologic formations are repeated several times across the region. Carbonate-rock aquifers in the Chickamauga, the Knox, and the Conasauga groups are repeated throughout the Valley and Ridge Physiographic Province (Miller 1990).

Groundwater in the Valley and Ridge aquifers primarily is stored in and moves through fractures, bedding planes, and solution openings in the rocks. These aquifers are typically present in valleys and rarely present on the ridges. Most of the carbonate-rock aquifers are directly connected to sources of recharge, such as rivers or lakes, and solution activity has enlarged the original openings in the carbonate rocks. In the carbonate rocks, the fractures and bedding planes have been enlarged by dissolution of part of the rocks. Slightly acidic water dissolves some of the calcite and dolomite that compose the principal aquifers. Most of this dissolution takes place along fractures and bedding planes where the largest volumes of acidic groundwater flow.

Groundwater movement in the Valley and Ridge Province is localized, restricted by the repeating lithology created by thrust faulting. Older rocks, primarily the Conasauga Group and the Rome Formation, have been displaced upward over the top of younger rocks (the Chickamauga and the Knox groups) along thrust fault planes thus forming a repeating sequence of permeable and less permeable hydrogeologic units. The repeating sequence, coupled with the stream network, divides the area into a series of adjacent, isolated, shallow groundwater flow systems. The water moves from the ridges, where the water levels are high, toward lower water levels adjacent to major streams that flow parallel to the long axes of the valleys. Most of the groundwater is discharged directly to local springs or streams (Miller 1990).

Aquifers of the Appalachian Plateaus Physiographic Province consist of permeable stratigraphic units of Paleozoic sedimentary rocks. Major aquifers in the Appalachian Plateaus Province are in limestone units of Mississippian age covered by sandstone of the Pennsylvanian Pottsville Formation. Flow in the Appalachian Plateaus aquifers is affected

primarily by topography, structure, and the development of solution openings in the rocks. A thick sequence of shale, sandstone, and coal overlies Mississippian limestone. Recharge to the aquifers is by precipitation on the flat, mesa-like plateau tops. Water then percolates downward through the Pennsylvanian sandstone (Pottsville Formation), primarily along steeply inclined joints and fractures. Some water leaks downward across the interbedded shale into the underlying limestone aquifer. Sandstone of the Pottsville Formation varies greatly in its water-producing capabilities. A thick black shale (the Chattanooga Shale) forms a confining unit for the Appalachian Plateaus aquifer (Miller 1990).

Public drinking water is supplied by both groundwater and surface water sources for the counties in which the ROWs are located (EPA 2009). Sequoyah-Widows Creek 500-kV (ID: 2) intersects a State Designated Source Water Protection Area, which is the recharge area for the Hixson, Tennessee, Utility District in Hamilton County; other State Designated Source Water Protection Areas may occur. Private wells occur throughout the area.

<u>Middle Tennessee Section</u>
The ROW of the Wartrace-N. Tullahoma Tap 161-kV (ID: 1) transmission line proposed for upgrading in this section is underlain by aquifers, from the Ordovician and Mississippian Periods, in the Interior Low Plateaus Physiographic Province. These aquifers are separated by a confining unit. These carbonate rocks are the principal aquifers in large areas of central Tennessee and are part of the Central Basin aquifer system. The carbonate rock aquifers consist of almost pure limestone and minor dolostone and are interlayered with confining units of shale and shaly limestone. Limestone is susceptible to erosion, which produces fissures, sinkholes, underground streams, and caverns forming vast karst areas.

The middle Ordovician, Stones River Group contains the most important carbonate-rock aquifers in the project area. The calcareous siltstones of the middle Ordovician Nashville Group yield small volumes of water, but these units are not considered to be principal aquifers. The lower Ordovician Knox Group is a major aquifer where dolostone contains freshwater (Lloyd and Lyke 1995).

Highland Rim aquifer system from the Mississippian Period consists of flat-lying carbonate rocks. The formations that make up the Highland Rim aquifer within this section of the project area are the Monteagle Limestone, the St. Genevieve Limestone, the St. Louis Limestone, the Warsaw Limestone, and the Fort Payne Formation (Lloyd and Lyke 1995). The bedrock formations weather to form a thick chert regolith, which stores and releases groundwater into fractures and solution openings in the bedrock (TDEC 2002).

Precipitation is the primary source of recharge in the Interior Low Plateaus Province. Most of the precipitation becomes overland runoff to streams, but some percolates downward through soil to the underlying bedrock. In the consolidated rocks, however, most of the water moves through and is discharged from secondary openings, such as joints, fractures, bedding planes, and solution openings. As a result, groundwater discharge from springs is common throughout the Interior Low Plateaus Province (Lloyd and Lyke 1995).

The carbonate rocks that form the Highland Rim aquifer are typical of karst systems. The term karst refers to carbonate rocks (limestone and dolostone) in which groundwater flows through solution-enlarged channels and bedding planes within the rock. Karst topography is characterized by sinkholes, springs, disappearing streams, and caves, as well as by rapid, highly directional groundwater flow in discrete channels or conduits. Because of the

connections between surface and underground features, water in karst areas is not distinctly surface water or groundwater.

Karst systems are readily susceptible to contamination, as the waters can travel long distances through conduits with no chance for natural filtering processes of soil or bacterial action to diminish the contamination. Consequently, the groundwater sources in karst aquifers considered most vulnerable to contamination are those that are under the direct influence of surface water.

Public drinking water for Coffee and Bedford counties in Tennessee is supplied by both surface water and groundwater sources (EPA 2009). Privately owned wells supply water to area restaurants, schools, and marinas in the county. Residential wells are likely to occur near the subject ROWs.

North Alabama Section

The Browns Ferry-Trinity 161-kV (ID: 10) and Browns Ferry-Athens Alabama, 161-kV (ID: 11) transmission lines proposed for upgrading are also underlain by the Highland Rim aquifer system, which is part of the Interior Low Plateaus Physiographic Province. However, the aquifer is known locally as the Tuscumbia-Fort Payne aquifer. The formations that make up this aquifer are the Fort Payne Chert, the Tuscumbia Limestone, and the Monteagle Limestone. The Chattanooga Shale is at the base of the Tuscumbia-Fort Payne aquifer and acts as a confining unit. The upper bedrock formations weather to form a thick regolith that covers the surface of the Fort Payne. The regolith may be as thick as 100 feet and is mostly clay, but may contain significant layers of chert rubble.

Like the rest of the Mississippian Highland Rim aquifer, fractures and solution openings have formed a network of interconnected caves, sinkholes, and springs throughout these formations.

The regolith[7] and underlying bedrock are hydrologically connected. Recharge to the aquifer is largely from precipitation infiltrating and moving through the regolith. Focused recharge also occurs from surface drainage into sinkholes or losing stream reaches that intersect the aquifer (Kingsbury 2003). Like the rest of the Highland Rim aquifer system, the aquifer is readily susceptible to contamination and is considered vulnerable to contamination.

Public drinking water for Limestone County, Alabama, is supplied by both surface water and groundwater sources. Public water for Morgan County, Alabama, is supplied by surface water (EPA 2009). Privately owned wells supply water to area restaurants, schools, and marinas in the county. Residential wells likely occur near the subject ROW.

4.2.2. Environmental Consequences

No Action Alternative

Under the No Action Alternative, vegetative maintenance would occur periodically, including the use of herbicides that could possibly have an impact on groundwater resources. During future revegetation and maintenance activities, application of herbicides and fertilizers would be avoided in the areas along the ROWs where sinkholes, caves, and State Designated Source Water Protection Areas occur to prevent groundwater contamination. Any herbicides applied to the ROWs during periodic maintenance would be applied

[7] Regolith refers to the layer of loose rock resting on bedrock, constituting the surface of most land.

according to the manufacturer's label. During ROW maintenance, the vegetation management guidelines and procedures as described in Appendix L would be followed. With the implementation of BMPs (Muncy 1999) and routine precautionary measures, potential impacts to groundwater under the No Action Alternative would be insignificant.

Action Alternative
Under the Action Alternative, anticipated impacts on existing ROWs from maintenance would be similar to those occurring under the No Action Alternative. Potential impacts to groundwater from upgrades of the transmission lines could result if sediments from disturbed soil enter or clog karst features, or from the transport of herbicides and fertilizers or other contaminants into sinkholes and caves. BMPs and routine precautionary measures, as described in the No Action Alternative, would be used during ROW maintenance and transmission line upgrades to control sediment infiltration from storm water runoff and to avoid contamination of groundwater in the project areas. Therefore, potential impacts to groundwater from the Action Alternative would be insignificant.

4.3. Aquatic Ecology

4.3.1. Affected Environment

As described in Section 4.1 (Surface Water) above, the surface water drainage from the proposed transmission line improvements drain to the Tennessee River and its tributaries at the following locations: (1) Guntersville and Wheeler Reservoirs (Jackson, Limestone, and Morgan counties in Alabama); (2) at Nickajack and Chickamauga Reservoirs in southeast Tennessee (Hamilton, Marion, and Sequatchie counties) and northwest Georgia (Catoosa, Dade, and Walker counties); and (3) upstream and downstream of Normandy Dam on the Duck River in central Tennessee (Bedford and Coffee counties).

TVA routinely monitors streams and reservoirs in the Tennessee River drainage as part of its Reservoir VS monitoring program, and various water quality initiatives. While not all streams potentially affected by transmission line activities have been assessed, those that have been assessed contain diverse aquatic communities (i.e., fish and invertebrates) representative of streams and reservoirs in the Cumberland Plateau, Eastern Highland Rim, Outer Nashville Basin, Plateau Escarpment, Sequatchie Valley, Southern Table Plateaus and Southern Limestone/Dolomite Valleys and Low Rolling Hills ecoregions.

4.3.2. Environmental Consequences

No Action Alternative
Routine maintenance (including vegetative maintenance) is ongoing on the ROWs of the transmission lines currently in service. Maintenance of access roads and transmission facilities can potentially expose soil and increase erosion that can lead to adverse impacts to water quality and aquatic biota. Improper use of herbicides to control vegetation could result in runoff to streams and subsequent aquatic impacts. TVA routinely includes precautions in maintenance of its transmission line projects to minimize these potential impacts (Muncy 1999).

ROW maintenance employs manual and low impact methods within SMZs wherever possible, and these practices would continue (see Appendix N). In areas requiring chemical treatment, only EPA-registered herbicides would be used in accordance with label directions designed in part to restrict applications in the vicinity of receiving waters and to prevent unacceptable aquatic impacts. Proper implementation of these controls is

expected to result in only minor direct and indirect impacts to surface waters or aquatic habitats and the aquatic communities they support. No cumulative impacts are expected.

Action Alternative
The currently inactive 500-kV transmission lines would be reenergized as described in Section 2.6, and routine vegetation and access maintenance would be reestablished for their ROWs. The other transmission lines that would be upgraded are already in service. These lines undergo environmental review as part of TVA's vegetation maintenance program. Because these transmission lines are already in service and being maintained, upgrades associated with operation of a single unit at BLN would have no additional effects above those presently seen on these transmission ROWs. Existing data indicate that no important aquatic resources would be affected by reestablishing maintenance activities of the 500-kV lines or upgrading the other transmission lines currently in service. Field reviews will be conducted prior to vegetation clearing or line upgrade activities to confirm these findings. Appropriate SMZs would be established and maintained per TVA guidelines (Muncy 1999) (also see Appendices L, M, and N). Proper implementation of these controls is expected to result in only minor temporary impacts to surface waters. No direct, indirect, or cumulative impacts to aquatic communities or instream habitat are anticipated.

4.4. Vegetation

4.4.1. Affected Environment

The proposed transmission line upgrades would occur across seven Level IV Ecoregions including the Cumberland Plateau, Eastern Highland Rim, Outer Nashville Basin, Plateau Escarpment, Sequatchie Valley, Southern Table Plateaus and Southern Limestone/Dolomite Valleys and Low Rolling Hills (Figure 4-1). The natural vegetation, along with geologic strata and predominant land use, varies considerably across the project area (Griffith et al. 1998; Griffith et al. 2001). Vegetation in the subject transmission line ROWs included in the proposed project is characterized by two main types: herbaceous vegetation and forest.

Herbaceous vegetation occurs on about 95 percent of the subject transmission line ROWs. Herbaceous vegetation is characterized by greater than 75 percent cover of forbs and grasses and less than 25 percent cover of other types of vegetation, and it is typical of existing transmission line ROWs due to the repeated treatment of woody vegetation to maintain reliability of the transmission system. The type of herbaceous vegetation found in transmission line ROWs can vary, ranging from heavily disturbed areas with high cover of nonnative plants to dry sites dominated by native species that resemble prairie remnants. Some sections of transmission line occurring in areas with low relief likely contain wetland vegetation. Although the percent cover of native species varies considerably across the project area, the high level of disturbance typical of ROWs suggests many areas likely contain a large proportion of nonnative, invasive species.

Forest cover, which occupies 5 percent or less of the subject ROWs is likely deciduous in composition. Deciduous forest is characterized by trees with overlapping crowns where deciduous species account for more than 75 percent of the canopy cover. Deciduous forest occurs only in areas of ROW where the transmission line crosses very steep terrain and in areas where vegetation on existing, deenergized lines has not been maintained for some years. In forested areas with steep terrain the conductor is sometimes high enough above canopy trees such that regular removal of woody species is not necessary to maintain reliability

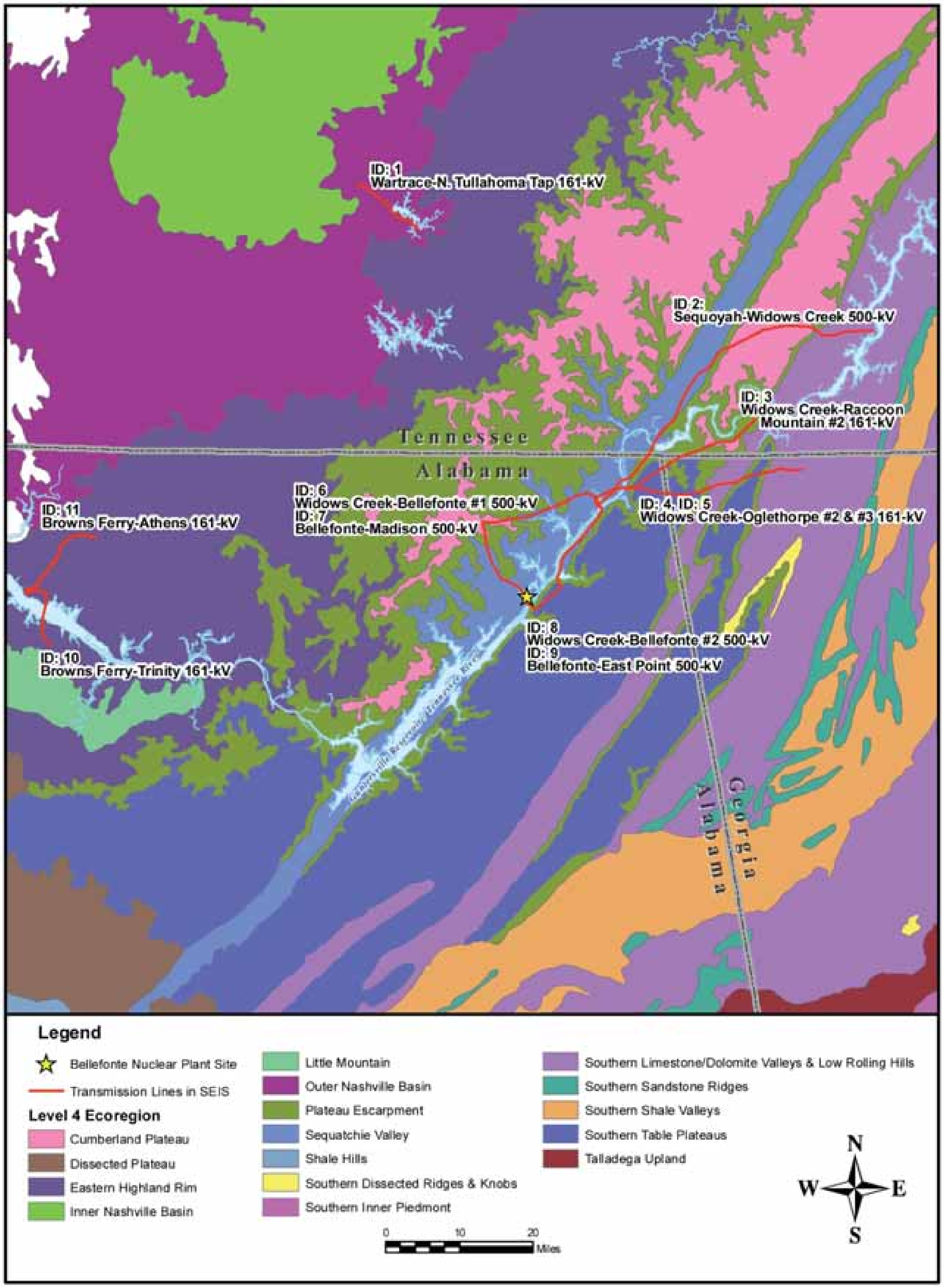


Figure 4-1. Level IV Ecoregions Crossed by Transmission Lines Requiring Upgrades or Actions to Support Operation of a Single Nuclear Unit at the BLN Site

of the transmission system. Because these spanned areas (i.e., those areas of high relief where the transmission is high above the canopy such that ROW clearing is not necessary) often contain relatively undisturbed forest, they are typically dominated by native species indicative of the region. Conversely, those forested areas within unmaintained ROWs along deenergized transmission lines are typically early successional and usually contain a greater proportion of nonnative, invasive species. These areas are typically dominated by saplings and/or small pole-sized trees.

4.4.2. Environmental Consequences

No Action Alternative
Under this alternative, the existing transmission lines would not be upgraded and the area within the ROWs would remain in its current condition. Methods used to manage vegetation along the ROW and maintain transmission infrastructure would be unchanged. Vegetation maintenance of the ROWs would continue, and portions of the ROW could be periodically disturbed by minor activities related to maintaining transmission infrastructure. TVA standard operating procedure of revegetating any disturbed areas with noninvasive species would help prevent introduction and spread of invasive species in the project area (Muncy 1999). Thus, adoption of the No Action Alternative would not affect plant life in the area of the proposed ROWs. The structure and composition of the vegetation would not be appreciably altered, under the No Action Alternative.

Action Alternative
Under this alternative, the existing transmission lines would be upgraded, and the methods used to manage vegetation along the ROWs and to maintain transmission infrastructure would be comparable to what currently occurs. However, botanical surveys of the ROWs that would occur as part of the process (see Subsection 2.6.4) could identify more federally listed or state-listed plants along those ROWs. If rare plants are observed, no aerial application of herbicide would take place along parts of the ROW inhabited by listed species. In areas that currently receive aerial applications of herbicides, local changes to vegetation structure and composition would likely occur if the application was suspended. These changes would have little ecological impact because any shifts in species composition would not change the early successional nature of the plant community.

Adoption of this alternative would not require new clearing of forest, although areas of herbaceous vegetation may need to be cleared to facilitate upgrading activities. Effects to herbaceous vegetation in the existing ROWs would be temporary and would not likely persist for more than approximately one year after activities cease. TVA standard operating procedure of revegetating with noninvasive species would help prevent introduction and spread of invasive species in the project area (Muncy 1999). Adoption of the Action Alternative would not significantly affect the botanical characteristics of the area in which the subject ROWs are located.

4.5. Wildlife

4.5.1. Affected Environment

Two types of terrestrial habitat occur in the transmission line ROWs associated with proposed generation at BLN. These include early-successional, i.e., herbaceous habitat, which occupies about 95 percent of the subject ROWs and forested habitat, which occupies the remaining 5 percent. A more detailed description of vegetation is provided in Subsection 4.4.1.

Early successional habitat occurs along most of the existing transmission line ROWs. Within this habitat type, the ROWs cross agricultural fields (occupying about 40 percent of the coverage), herbaceous or scrub-shrub (about 40 percent of the coverage), and maintained lawns or fields (approximately10 percent of the coverage). Some sections of the subject transmission line ROWs occur in areas with minor topographical relief. Such areas likely contain early successional emergent wetland habitat.

Birds commonly observed in early successional habitat include the Carolina wren, American robin, northern mockingbird, northern cardinal, eastern towhee, eastern bluebird, brown thrasher, field sparrow, eastern meadowlark, and European starling. Red-tailed hawk and American kestrel also forage along ROWs. Mammals frequently observed in this type of habitat include Virginia opossum, eastern cottontail, striped skunk, white-tailed deer, eastern mole, woodchuck, white-footed mouse, and hispid cotton rat. Coyote, bobcat, red fox, and gray fox also use ROWs that cross forest as corridors for travel and foraging. Common reptiles found along ROWs include black racer, black rat snake, milk snake, and garter snake. Wetlands within early successional habitats provide habitat for amphibians such as American toad, green frog, northern cricket frog, upland chorus frog, and red-spotted newt.

Forested habitat present within the existing ROWs is likely upland deciduous forest. Deciduous forest occurs only in areas where the transmission line crosses very steep terrain. In these spanned areas, the conductor is high enough above canopy trees that regular removal of woody species is not necessary to maintain reliability of the transmission system.

Deciduous forests provide habitat for wild turkey, downy woodpecker, pileated woodpecker, white-breasted nuthatch, and American crow, as well as neotropical songbirds such as wood thrush, blue-gray gnatcatcher, red-eyed vireo, and ovenbird. White-tailed deer and gray squirrel are frequently found in deciduous forests, and scattered rock outcrops within these forests provide habitat for a variety of small mammals. Northern zigzag salamander and slimy salamander also inhabit the forest floor of deciduous forests. Common reptiles include eastern box turtle, northern ringneck snake, black rat snake, and northern copperhead.

Unique and important terrestrial habitats, such as caves, occur near the corridors. The TVA Natural Heritage database contains records of 215 caves within 3 miles of the existing transmission line ROWs. The closest cave records are approximately 0.25 mile from the Widows Creek-Raccoon Mountain #2 161-kV (ID: 3) transmission line in Marion County, Tennessee. All other known cave locations are greater than 0.5 mile from the ROWs.

Twelve heron colonies are reported within 3 miles of, but greater than 0.25 mile from, the subject ROWs. Except for seasonal aggregations of waterfowl along the Tennessee River, no other aggregations of migratory birds occur in the project area.

4.5.2. Environmental Consequences

No Action Alternative

Under the No Action Alternative, early-successional and forested habitat within the ROWs would be maintained at current proportions and thus would not result in changes to wildlife habitat. Methods used to manage vegetation along the ROW and maintain transmission infrastructure would be unchanged. Clearing of the ROWs for vegetation maintenance would continue to occur, and portions of the ROWs would be periodically disturbed by minor activities related to maintaining transmission infrastructure. Selection of the No Action Alternative would not result in adverse direct, indirect, or cumulative impacts to terrestrial animals.

Action Alternative
Adoption of the Action Alternative would not require new clearing of forest, although areas of vegetation within some ROWs may need to be recleared to facilitate maintenance activities. Some ROWs likely have undergone secondary succession, resulting in establishment of young trees. The removal of the taller vegetation within these areas may temporarily displace larger animals. Some smaller animals occupying the areas, such as mice, shrews, frogs, and salamanders, also may move into adjacent areas during upgrading and maintenance activities. Following the upgrading and reestablishing maintenance activities of any sites, wildlife favoring edge and early successional habitats would reoccupy these areas.

There are records of 215 caves and 12 heron colonies within 3 miles of the ROWs. However, because caves and heronries are greater than 0.25 mile from the ROWs, adoption of the Action Alternative would not result in adverse impacts to these resources. TVA biologists would perform field surveys to confirm these findings prior to reclearing the ROWs for the 500-kV lines and upgrading the transmission lines currently in service. If previously undocumented resources are identified within these ROWs during the surveys, appropriate protective buffers would be placed around those resources. Most work would be restricted to areas immediately surrounding existing ROWs. Because known terrestrial animal resources within the ROWs are regionally abundant and protective measures would be taken to protect newly discovered sensitive resources, selection of the Action Alternative would not result in adverse direct, indirect, or cumulative impacts to terrestrial animals.

4.6. Endangered and Threatened Species

In accordance with Section 7 of the ESA, TVA has prepared a BA of potential effects to federally listed animals and plants from proposed completion/construction and operation of a nuclear plant at the BLN site, including the proposed transmission system improvements (TVA 2009d). Fifty-two plants and animals federally listed as endangered, threatened, candidate for listing, or protected under the Bald and Golden Eagle Protection Act potentially occur in potentially affected areas. Results of the analysis prepared for the BA indicate proposed actions along transmission lines are not likely to adversely affect any federally listed species or adversely modify critical habitat. TVA received concurrence with these determinations from the USFWS in a letter dated December 7, 2009 (See Appendix H).

4.6.1. Aquatic Animals

4.6.1.1. Affected Environment

As described in Section 4.1 of this document, the project areas of the proposed transmission line improvements drain to the Tennessee River and its tributaries at the following locations: (1) Guntersville and Wheeler Reservoirs (Jackson, Limestone, and Morgan counties in Alabama); (2) at Nickajack and Chickamauga Reservoirs in southeast Tennessee (Hamilton, Marion, and Sequatchie counties) and northwest Georgia (Catoosa, Dade, and Walker counties); and (3) upstream and downstream of Normandy Dam on the Duck River in central Tennessee (Bedford and Coffee counties).

Federally listed aquatic species known to be present in streams in counties in the areas crossed by one or more of these transmission lines are listed in Table 4-2. State-listed animal species are provided in Appendix O, Table O-1.

Table 4-2. Federally Listed Aquatic Animal Species Present in Counties Affected by Proposed Transmission Line Upgrades

Common Name	Scientific Name	Federal Status
Snails		
Anthony's river snail*#	*Athearnia anthonyi*	LE
Armored snail	*Pyrgulopsis pachyta*	LE
Owen spring limnephilid caddisfly	*Glyphopsyche sequatchie*	C
Royal marstonia	*Pyrgulopsis ogmorhaphe*	LE
Slabside pearlymussel	*Lexingtonia dolabelloides*	C
Slender campeloma*	*Campeloma decampi*	LE
Mussels		
Alabama lampmussel#	*Lampsilis virescens*	LE
Alabama moccasinshell	*Medionidus acutissimus*	LT
Birdwing pearlymussel	*Lemiox rimosus*	LE
Cracking pearlymussel	*Hemistena lata*	LE
Cumberland bean	*Villosa trabalis*	LE
Cumberland combshell	*Epioblasma brevidens*	LE
Cumberland monkeyface	*Quadrula intermedia*	LE
Cumberland pigtoe	*Pleurobema gibberum*	LE
Dromedary pearlymussel	*Dromus dromas*	LE
Fine-lined Pocketbook	*Lampsilis altilis*	LT
Fine-rayed Pigtoe#	*Fusconaia cuneolus*	LE
Fluted kidneyshell	*Ptychobranchus subtentum*	C
Orange-foot Pimpleback	*Plethobasus cooperianus*	LE
Pale lilliput#	*Toxolasma cylindrellus*	LE
Pink mucket*#	*Lampsilis abrupta*	LE
Ring pink	*Obovaria retusa*	LE
Rough pigtoe*	*Pleurobema plenum*	LE
Sheepnose	*Plethobasus cyphyus*	C
Shiny pigtoe pearlymussel#	*Fusconaia cor*	LE
Slabside pearlymussel*	*Lexingtonia dolabelloides*	C
Southern pigtoe	*Pleurobema georgianum*	LE
Spectaclecase	*Cumberlandia monodonta*	C
Tan riffleshell	*Epioblasma florentina walkeri*	LE
Tuberculed blossom pearlymussel	*Epioblasma torulosa torulosa*	LE
Turgid blossom pearlymussel	*Epioblasma turgidula*	LE
Fish		
Boulder darter	*Etheostoma wapiti*	LE
Palezone shiner#	*Notropis albizonatus*	LE
Slackwater darter	*Etheostoma boschungi*	LT

Common Name	Scientific Name	Federal Status
Snail darter	*Percina tanasi*	LT
Spotfin chub	*Cyprinella monacha*	LT
Yellowfin madtom	*Noturus flavipinnis*	LT

Species that are known to occur in watersheds directly affected by construction activities are indicated by (*).

Species reported from Jackson County, Alabama are indicated by (#)

Status Codes: LE = Listed endangered; LT = Listed threatened; C = Candidate for Federal Listing

4.6.1.2. Environmental Consequences

No Action Alternative
Under the No Action Alternative, because the proposed project is on existing ROW, no impacts to federally listed or state-listed aquatic organisms would result from transmission infrastructure upgrades or ongoing routine maintenance that would continue.

Action Alternative
The currently inactive 500-kV transmission lines would be reenergized as described in Section 2.6, and routine vegetation and access maintenance would be reestablished for their ROWs. The other transmission lines that would be upgraded are already in service. These lines undergo environmental review as part of TVA's vegetation maintenance program. Because these transmission lines are already in service and being maintained, upgrades associated with operation of a single unit at BLN would have no additional effects above those presently seen on these transmission ROWs.

Routine maintenance of access roads and transmission facilities can potentially expose soil and increase erosion that could lead to adverse impacts to water quality, thereby affecting aquatic biota. Improper use of herbicides to control vegetation could result in runoff to streams and subsequent aquatic impacts. TVA routinely includes precautions in maintenance of its transmission line projects to minimize these potential impacts (Muncy 1999).

ROW maintenance would employ manual and low-impact methods within SMZs wherever possible (see Appendix N). In areas requiring chemical treatment, only EPA-registered herbicides would be used in accordance with label directions designed in part to restrict applications in the vicinity of receiving waters and to prevent unacceptable impacts to aquatic life impacts. Broadcast aerial application of herbicides adjacent to streams containing federally listed species would be prohibited.

Existing data indicate that no important aquatic species would be affected by reestablishing maintenance of the 500-kV lines or upgrading the other transmission lines currently in service. Field reviews will be conducted prior to vegetation clearing or line upgrade activities to confirm these findings. If habitats for any federally or state-listed animal species occur, measures to avoid and/or minimize impacts would be taken such that no significant impacts to sensitive aquatic species or their habitats occur. With the proper implementation of these controls no direct, indirect, or cumulative impacts on federally or state-listed aquatic species or their habitats are anticipated.

4.6.2. Plants

4.6.2.1. Affected Environment

Review of the TVA Natural Heritage database (queried September 2009) indicates that 12 occurrences of nine state-listed species and one occurrence of one federally listed species have been documented within the transmission ROWs subject to proposed upgrades (see Table 4.3 and Appendix O, Table O-2). Additionally, five federally listed, one candidate for federal listing, and 108 state-listed plant species occur within 5 miles of the proposed transmission line upgrades. Five other federally listed and one other candidate for federal listing are known from counties where the transmission line upgrades would occur, but are greater than 5 miles away from the ROWs. No designated Critical Habitat for plant species occurs in the project area.

Table 4-3. Federally Listed Terrestrial Plant Species Known Within and Near (Within 5 Miles) the ROWs Subject to Upgrades/Actions and From the Counties Where Work Would Occur

Common Name	Scientific Name	Federal Status
Price's potato-bean	*Apios priceana*	THR
American Hart's-tongue fern[2]	*Asplenium scolopendrium* var. *americanum*	THR
Morefield's leather-flower[2]	*Clematis morefieldii*	END
Leafy prairie-clover[2]	*Dalea foliosa*	END
Small whorled pogonia	*Isotria medeoloides*	THR
Fleshy-fruit gladecress[2]	*Leavenworthia crassa*	C
Mohr's Barbara's Buttons	*Marshallia mohrii*	THR
Monkey-face orchid	*Platanthera integrilabia*	C
Green pitcher plant[2]	*Sarracenia oreophila*	END
Large-flowered skullcap[1]	*Scutellaria montana*	THR
Chaffseed[2]	*Schwalbea americana*	END
Virginia spiraea	*Spiraea virginiana*	THR

Status codes: C = Candidate; END = Endangered; THR = Threatened.

[1]Federally listed plant species documented from the ROWs where work would occur.

[2]Federally listed species occurring within the county where work would occur, but not within 5 miles of the project area.

The federally listed large-flowered skullcap has been documented from the ROW of the Sequoyah-Widows Creek 500-kV (ID: 2) transmission line and the surrounding forests. According to the TVA Natural Heritage database, the most recent survey of the site was a 2002 visit when one individual plant was observed in the transmission line ROW. The large-flowered skullcap plant documented from the ROW is likely an aberrant and ephemeral individual; it is widely accepted that the preferred habitat for the species is forest (NatureServe 2009; USFWS 2002; Bridges1984). The state-listed rose-gentian and fame-flower have also been observed along the Sequoyah-Widows Creek 500-kV ROW. Two separate occurrences of rose-gentian have been documented along the transmission line. The species preference for open areas suggests that more occurrences of the species likely occur along the ROW, which provides one of the largest sources of consistently open habitat in that section of the Cumberland Plateau. Rose-gentian is endemic to the Cumberland Plateau and adjacent foothills of the Ridge and Valley physiographic province and is considered rare and imperiled across its range (NatureServe 2009).

During a 2008 botanical survey of the Widows Creek-Oglethorpe #2 and #3 161-kV (ID: 4 and ID: 5) transmission line ROWs, TVA botanists observed multiple, previously unreported occurrences of state-listed species. Yellow giant-hyssop (two occurrences), dwarf larkspur, Dutchman's breeches, American columbo, Barrens St. Johnswort, and Eggleston's violet were all observed in portions of the ROW underlain by limestone-derived soils. With exception of Dutchman's breeches, which was found in a spanned section of ROW with a forest overstory, all species occurred in open parts of the ROW dominated by herbaceous species. Between 500 and 1000 Small's stonecrop were estimated to occur in an area of exposed sandstone along the ROW. All occurrences of state-listed species observed along the Widows Creek-Oglethorpe #2 and #3 161-kV transmission lines appeared healthy and viable, and all have been exposed to periodic vegetation clearing associated with ROW maintenance.

One population of fame-flower was also observed along the Widows Creek-Raccoon Mountain #2 161-kV (ID: 3) transmission line ROW. This occurrence contained about 100 plants and was last observed in 2004.

Habitat for the majority of the species listed in Table 4-3 and Appendix O (Table O-2) potentially occurs in the subject transmission line ROWs. Rare plant species that inhabit forested areas may occur in the spanned sections of ROW where woody vegetation has not been removed and species capable of occupying open areas with higher light conditions could inhabit multiple locations along the ROW. TVA botanists would perform appropriately timed field surveys for federally and state-listed plant species along the affected ROWs before any upgrading or maintenance activities begin.

4.6.2.2. Environmental Consequences

No Action Alternative

Under the No Action Alternative, the existing transmission lines would not be reenergized or upgraded, and methods used to manage vegetation along the ROWs and maintain transmission infrastructure would be unchanged. Aerial application of herbicide would continue to be prohibited in areas where federally listed and state-listed species occur or potentially occur in existing ROWs. Known locations of rare plants would also continue to be avoided during routine maintenance of transmission infrastructure. Therefore, adoption of the No Action Alternative would have no significant impacts on endangered, threatened, and rare plant species.

Action Alternative

Under the Action Alternative, the proposed upgrades to the transmission lines would require some level of vegetation disturbance on existing ROWs. Federally listed and state-listed species have been previously documented along small portions of these ROWs. It is reasonably likely that additional listed species would be identified in the project area during the appropriately timed botanical surveys that would be conducted prior to any ground-disturbing work. During these surveys, all sites where species have been previously reported would be resurveyed to determine if the rare species are still present and the full extent of the plants in the ROW. If, after botanical surveys, rare plants are identified in the project area, the following mitigation measures would be used to reduce or eliminate impacts to the species:

- Areas with federally listed plant species would be included in the transmission line and access road engineering design specification drawings used during the planning and implementation of the upgrades. TVA botanists would help fence these areas to ensure construction crews would avoid the sites. Depending on the species present,

construction may be timed so work takes place during the dormant season when plants are less likely to be harmed by construction. Any new structures would be placed to avoid impacting these areas. Additionally, access roads and the associated vehicle traffic would be excluded from these areas.

- Areas where state-listed species occur in the project area would be avoided unless there is no practical alternative. Avoidance measures would be comparable to those used for federally listed plants.

Any federally listed or state-listed plant species observed during field surveys most likely occupy either relatively undisturbed, spanned portions of ROW where woody vegetation has not been cleared, or areas where vegetation is maintained regularly to ensure that woody species do not interfere with the transmission lines. The proposed actions would not require clearing in areas that are currently spanned. Thus, with the implementation of the above mitigation measures, the habitat where listed species occur would not be appreciably different under the Action Alternative. Therefore, the proposed actions under the Action Alternative are not likely to adversely affect federally listed species and would not significantly impact state-listed species.

4.6.3. Wildlife

4.6.3.1. Affected Environment

The TVA Natural Heritage database indicated that three federally listed terrestrial animal species (gray bat, Indiana bat, red-cockaded woodpecker), one federally protected bird (bald eagle), and 14 state-listed terrestrial animal species have been reported within 3 miles of the subject ROWs (Table 4-4 and Appendix O, Table O-3). Populations of six uncommon species tracked by the Alabama or Tennessee Natural Heritage Programs were also reported (Table 4-5). No designated Critical Habitat for terrestrial animals occurs within the ROWs of the subject transmission lines.

Table 4-4. Federally Listed Terrestrial Animals Reported From Jackson, Limestone, and Morgan Counties, Alabama; Dade, Catoosa, and Walker Counties, Georgia; and Bedford, Coffee, Hamilton, Marion, and Sequatchie Counties, Tennessee

Common Name	Scientific Name	Federal Status
Birds		
Bald eagle	*Haliaeetus leucocephalus*	-[1]
Red-cockaded woodpecker	*Picoides borealis*	LE
Mammals		
Gray bat	*Myotis grisescens*	LE
Indiana bat	*Myotis sodalis*	LE

Status abbreviation: LE = Listed Endangered

[1]Federally protected by the *Bald and Golden Eagle Protection Act*

Table 4-5. Number of Federally Listed or State-Listed Species of Terrestrial Animals, Caves, and Migratory Bird Aggregations Within 3 Miles of Each Transmission Line Associated With the Action Alternative

Transmission Line Identification Number	Number of Federal Species[1]	Number of State Species (Tracked Species[2])	Number of Caves Within 3 Miles	Number of Migratory Bird Aggregations Within 3 Miles
1	2	3 (1)	10	0
10	0	1 (1)	6	0
11	0	0 (0)	0	0
4, 5	2	4 (2)	39	2
3	3	7 (3)	27	3
7	2	0 (1)	115	2
2	3	8 (3)	16	10
9	1	3 (0)	11	3
6, 8	1	0 (2)	69	1

[1]Includes federally protected species (i.e., bald eagle)

[2]Species tracked by Alabama, Georgia, or Tennessee State Natural Heritage Programs

Gray bats roost in caves year-round and typically forage over streams, rivers, and reservoirs. Foraging habitat exists along the Tennessee River and associated riparian corridors throughout the project area. Numerous populations of gray bats exist throughout the region. The closest known occurrence of gray bats is approximately 0.25 mile from the Widows Creek-Raccoon Mountain #2 161-kv (ID: 3) transmission line. A second population is reported 0.5 mile from the Wartrace-N. Tullahoma Tap 161-kV (ID: 1) transmission line. Numerous caves occur in the vicinity of the existing transmission line corridors and offer potential gray bat roosting habitat (Table 4-5). However, gray bats have not been reported from these caves.

Indiana bats roost in caves during the winter and typically roost under the bark of dead or dying trees during the summer (Menzel et al. 2001). Optimal summer roosts occur in forests with an open understory and available roost trees, usually near water (Romme et al. 1995). Indiana bats forage primarily in forested habitats. The closest record of Indiana bats occurs in a cave approximately 1.1 mile from Sequoyah-Widows Creek 500-kV (ID: 2) transmission line. Although no other records of Indiana bats occur in the project area, other caves may provide suitable hibernacula[8], and mature forested habitat in the area provides suitable summer habitat for this species.

Habitat for red-cockaded woodpecker consists of open, mature pine woodlands, and rarely deciduous or mixed pine-hardwoods located near pine woodlands. Optimal habitat is characterized as a broad savanna with a scattered canopy of large pines and a dense groundcover containing a diversity of grass, forb, and shrub species, historically maintained by fire. Nesting and roosting occur in tree cavities (USFWS 1980). Historical records for red-cockaded woodpecker exist in Walker County, Georgia, approximately 1.8 miles from the Widows Creek-Oglethorpe #3 161-kV (ID: 5) transmission line. Suitable habitat does not exist within the transmission line ROWs. The species is thought to be extirpated from Walker County, and does not exist in the ROWs.

Bald eagles were removed from the endangered species list in June 2007, but are still protected by *Migratory Bird Treaty Act* and the *Bald and Golden Eagle Protection Act*. This species

[8] Hibernacula are places, e.g., caves or other protected areas, where bats hibernate during the winter.

typically nests near large bodies of waters including lakes, rivers, and riparian wetlands. Bald eagles are fairly common within the region, especially near the Tennessee River. Bald eagles are vulnerable to disturbance during courtship, nest building, egg laying, incubation, and brooding. The closest active bald eagle nest is located at Raccoon Mountain Pumped Storage Facility, less than 0.12 mile from a transmission line ROW. Nesting and foraging habitat exists near (less than 0.5 mile) portions of the existing ROWs.

Barking tree frogs occur in wetlands, and a population is known from New Hope, Tennessee. This record is approximately 2 miles northwest of the closest associated transmission line ROW for Sequoyah-Widows Creek 500-kV (ID: 2) transmission line. Emergent wetlands within the ROW may offer moderately suitable habitat for this species.

Green salamanders primarily inhabit shaded rock outcrops in moist forests between 500 and 1,300 meters in elevation. Breeding females require cool, clean, and moist horizontal crevices or narrow chambers in which to suspend their eggs from an overhead substrate (NatureServe 2009). This habitat is abundant along the numerous stretches of escarpment along the Cumberland Plateau and Sand and Lookout mountains in the area. Records for green salamander exist within 3 miles of five different transmission lines: Widows Creek-Raccoon Mountain #2 161-kV (ID: 3); Widows Creek-Oglethorpe #2 161-kV (ID: 4); Widows Creek-Oglethorpe #3 161-kV (ID: 5); Widows Creek-Bellefonte #2 500-kV (ID: 8); and Bellefonte-East Point 500-kV (ID: 9).

Hellbenders inhabit medium-sized to large free-flowing streams in the Tennessee and Cumberland River drainages. Inhabited streams possess large rocks or logs that provide shelter and breeding sites. Records for hellbender are located in Morgan County, Alabama, and Bedford and Marion counties, Tennessee. Limited suitable habitat exists within the project area.

Tennessee cave salamanders occur in caves with streams free of sedimentation (Cooper 1968). One known locality exists approximately 0.5 mile away from the closest transmission line, the Wartrace-N. Tullahoma Tap 161-kV (ID: 1). There also are historical records of this salamander from Nickajack Cave before it was flooded by Nickajack Reservoir. Suitable habitat still exists in portions of Nickajack Cave beyond the influence of the reservoir. Suitable habitat for this species does not exist within the power line corridors.

Bachman’s sparrows inhabit early successional, old field habitat that contains a high density of grasses and forbs, scattered trees and shrubs with an open understory (Dunning and Watts 1990). Although this species uses the beginning stages of early successional habitat, this habitat only remains suitable for a short time. The species may temporarily use early successional habitats along the existing transmission line ROWs within the project area as they are periodically cleared.

Cerulean warblers have been reported from Marion County, Tennessee, within 3 miles of the Widows Creek-Raccoon Mountain #2 161-kV (ID: 3) transmission line. The species occurs largely in contiguous, mature deciduous forests, particularly along floodplains or along moist ridge tops. Mature forest adjacent to existing ROWs within the project area may provide habitat for this species. With the possible exception of the forested portions of ROWs on steep hillsides, suitable habitat for this species does not exist within project ROWs.

Ospreys typically nest along rivers, lakes, and reservoirs. The species nests in trees or on man-made structures (i.e., transmission towers, channel markers, bridges, mooring cells) within or

over water (NatureServe 2009). Ospreys nest throughout the study area, primarily along the Tennessee River.

Peregrine falcons have been reported from the ROWs of the subject transmission lines area. The species typically nests on exposed cliffs in undisturbed areas, near water, and close to plentiful prey (Burleigh 1958). Suitable habitat for peregrine falcons exists along exposed escarpment on Sand, Lookout, and Cumberland mountains.

The subject ROWs are located within the northern edge of the breeding range of Swainson's warbler, a neotropical songbird. Breeding habitat for this species ranges from deciduous floodplain and swamp forests to moist lower slopes of mountain ravines at elevations to 900 meters. Swainson's warblers typically require areas with deep shade from both canopy and understory cover (NatureServe 2009). The species has been reported along Lookout Creek, near Chattanooga, Tennessee. Suitable habitat for this species within the existing ROWs is unlikely.

Allegheny woodrats occur in rocky bluffs, caves, and other rocky habitats (Whitaker and Hamilton 1998). Numerous caves and small rock outcrops within the project area provide suitable habitat for this species.

Common shrews occupy most terrestrial habitats excluding areas with very little or no vegetation. Thick leaf litter in damp forests may represent favored habitat, although this species appears adaptable to major successional disturbances. Suitable habitat is abundant both within the project area and throughout the region.

Eastern big-eared bats roost in caves, abandoned buildings, or in hollow trees. The species has been reported from a cave in Marion County, Tennessee, that is greater than 1 mile from a ROW. Other caves in the project area offer suitable habitat for big-eared bats.

Eastern small-footed bats roost in rock crevices, caves, bridges, and other rocky habitats. The species has been reported from Nickajack Cave in Marion, Tennessee. Although no other records of eastern small-footed bats occur in the project area, caves in the project area provide suitable habitat for the species.

4.6.3.2. Environmental Consequences

No Action Alternative
Under the No Action Alternative, no impacts to federally listed or state-listed terrestrial animal species would occur as a result of the proposed transmission infrastructure upgrades. Under this alternative, the existing transmission lines would not be upgraded, and the methods used to manage vegetation along the ROW and maintain transmission infrastructure would be unchanged. Routine maintenance would continue.

Action Alternative
Under the Action Alternative, the proposed upgrades to the transmission lines would require some level of disturbance on existing ROWs. Federally listed and state-listed species and their habitat have been previously documented near some ROWs. Listed terrestrial animal species could be identified in the project area during field surveys associated with future maintenance and upgrading activities. If listed terrestrial animals or their associated habitat are observed in the existing ROWs, the following mitigation measures would be used to reduce or eliminate impacts to listed species:

- Depending on the species present, timing restrictions on construction may be implemented. For example, work may be timed to take place outside of the breeding season (such as for nesting bald eagles or ospreys) when species are less likely disturbed by the activity.

- Buffers may be placed around suitable habitat restricting clearing activities within a protective radius (e.g., a 200-foot radius around cave openings, hand clearing only).

The proposed project would not require clearing in areas that are currently spanned. Any listed terrestrial animal species identified within these forested ROWs would not be impacted. With implementation of the above mitigation measures, the habitat where listed species occur would not be appreciably different after upgrading takes place. Therefore, the proposed actions under the Action Alternative are not likely to adversely affect federally or state-listed species.

Prior to energizing the transmission lines associated with BLN, TVA will investigate presence of osprey nests on substation and transmission line structures in the BLN project area. Should nests exist, they would be removed to insure that ospreys are not harmed when the transmission lines are energized. Removal of these nests would be coordinated with the USFWS and/or the U.S. Department of Agriculture, Animal and Plant Health Information Service (APHIS). Removal would be conducted outside the breeding/nesting periods (March – July). Impacts to ospreys are considered insignificant given the abundance of nesting habitat around the BLN site.

4.7. Wetlands

4.7.1. Affected Environment

Wetland areas are likely located within the length of the transmission line corridors proposed to transmit power from the BLN site (Figure 2-15). These corridors cross a landscape dominated by agricultural fields and scattered residential, commercial, and industrial properties between prominent ridge lines, river valleys, associated tributaries, and wetland floodplain complexes. These corridors cross five large-scale watersheds (Guntersville Reservoir, Chickamauga Reservoir, Duck River, Sequatchie River, and Wheeler Reservoir) and 37 local watersheds, all within the Tennessee River Basin. The wetland areas located within these watersheds provide necessary wetland functions for flood abatement, sediment retention, pollutant absorption, and wildlife habitat. The transmission lines proposed for upgrade cross the following significant wetland floodplain complexes: Round Island Creek and associated tributaries, Poe Branch, Chickamauga Creek, Raccoon Creek, Glover Creek, Mud Creek, and Robinson Creek. Based on NWI Data, Soil Survey Geographic Data (USDA-NRCS 2009), USGS topographic maps, and aerial photography, a conservative estimate of 150 acres of potential wetland area occurs on the ROWs proposed for upgrade activities. Because of previous and ongoing ROW maintenance, the majority of wetland habitat within the transmission line corridor, previously mapped or unmapped, would be comprised of emergent or scrub-shrub habitat. Forested wetlands potentially occur along the edges of the ROWs.

Actual wetland acreage within the ROWs will be confirmed and delineated by field surveys prior to upgrades that have the potential to impact wetlands within the ROWs. Wetland delineations would be performed according to USACE standards (Environmental Laboratory 1987), which require documentation of hydrophytic (i.e., wet site) vegetation (USFWS 1996), hydric soil, and wetland hydrology (Environmental Laboratory 1987; Reed 1997; U.S. Department of Defense and EPA 2003). Broader definitions of wetlands, such as provided in EO 11990 (Protection of Wetlands), Alabama state regulations, the USFWS (Cowardin et al. 1979), and the TVA

Environmental Review Procedures (TVA 1983b) would also be considered in making the delineations.

4.7.2. Environmental Consequences

Activities in wetlands are regulated under Sections 401 and 404 of the CWA and are addressed by EO 11990. In order to conduct specific activities in jurisdictional wetlands, authorization would be obtained under a Section 404 Permit from the USACE and under Section 401 from the respective state regulatory agency. In addition, proposed activities would comply with EO 11990, which requires all federal agencies to minimize the destruction, loss, or degradation of wetlands and to preserve and enhance the natural and beneficial values of wetlands in carrying out their responsibilities.

No Action Alternative
Under the No Action alternative, current ROW maintenance and operations of the subject transmission lines would continue. However, no alterations or improvements would be made to the existing transmission lines for the purpose of transmitting power generated from BLN. Therefore, no additional direct, indirect, or cumulative effects to wetlands would occur under this alternative.

Action Alternative
Under the Action Alternative, initial improvements to upgrade approximately 222 miles of existing transmission lines would take place. This would include some reestablishment of ROW vegetation management, filling associated with structure replacement, and vehicular access along the ROWs. Any improvement activities conducted within a wetland would be performed under specific wetland BMPs (TVA 1992) to minimize wetland impacts. This includes conducting work in dry conditions, use of low ground pressure equipment or ground mats, broadcast spray of herbicides approved for aquatic environments, installation of silt fence as needed, and reseeding disturbed areas with native wetland species. Ongoing maintenance would be conducted using similar BMPs and measures to protect wetlands and conserve wetland functions.

Prior to all proposed upgrade activities, TVA would conduct a ground survey to determine the exact extent of any wetland areas located within the corridors proposed for upgrade. Based on this review, specific measures may be implemented to ensure no significant impacts or loss of wetland function occurs as a result of the transmission line upgrade activities. These commitments would result in avoidance strategies, minimization measures, or mitigation should wetland functions be compromised. Mitigation would be provided if substantial quality and quantity of forested wetland would be cleared to accommodate a wider ROW, if fill is proposed for switching-station construction, or for any other activity that reduces the functional capacity of a specific wetland. BMPs would be in place for upgrade activities, and ground surveys would take place to identify wetland areas where avoidance, minimization, or mitigation measures would be required. Therefore, no significant impacts to potentially affected wetland areas within the ROWs are anticipated from the transmission line upgrades.

4.8. Floodplains

4.8.1. Affected Environment

The transmission line routes cross numerous 100-year floodplain areas in several counties in Alabama, Tennessee, and Georgia. The 161-kV and 500-kV switchyards existing on the BLN site are located on the Town Creek embayment side. With respect to Town Creek, the 100-year floodplain is the area lying below elevation 601.4 feet msl. The Flood Risk Profile (FRP)

elevation is 603.1 feet msl. The FRP is used to control flood damageable development for TVA projects, and residential and commercial development on TVA lands. At this location, the FRP elevation is equal to the 500-year flood elevation. The existing switchyards are located outside of the 100-year floodplain and above the FRP elevation.

4.8.2. Environmental Consequences

No Action Alternative
Under the No Action Alternative, the proposed switchyards and transmission lines would not be reenergized or upgraded. Methods used to manage vegetation along the ROWs and maintain transmission infrastructure would be unchanged, and routine maintenance would continue. Therefore, no additional effects to floodplains are likely.

Action Alternative
Consistent with EO 11988, an overhead transmission line and related support structures are considered to be a repetitive action in the 100-year floodplain. Activities conducted within existing switchyards would occur outside the 100-year floodplain. If any new substations, switchyards, or other support facilities need to be constructed to support these transmission lines they would be evaluated prior to construction to ensure compliance with EO 11988. Therefore, any activities occurring in the substations would be consistent with EO 11988 and floodplains would not be affected.

4.9. Natural Areas

4.9.1. Affected Environment

A review of the TVA Natural Heritage database indicated that the transmission lines proposed for reenergizing or upgrading would cover 11 counties in three states, and the lines are within 3 miles of, or cross, 68 natural areas and three Nationwide Rivers Inventory (NRI) streams.

This section addresses natural areas that are crossed by, immediately adjacent to, or within 3 miles of BLN associated transmission line upgrades. Natural areas include managed areas, ecologically significant sites, and streams listed on the NRI.

- Managed areas include lands held in public ownership that are managed by an entity (e.g., TVA, U.S. Department of Agriculture Forest Service (USFS), State of Tennessee, Jackson County) to protect and maintain certain ecological and/or recreational features.
- Ecologically significant sites are either tracts of privately owned land that are recognized by resource biologists as having significant environmental resources or identified tracts on TVA lands that are ecologically significant but not specifically managed by TVA's Natural Areas Program.
- Streams listed on the NRI are free-flowing segments of rivers recognized by the National Park Service (NPS) as possessing remarkable natural or cultural values.

Nine managed areas and ecologically significant sites and two NRI-listed streams are crossed by the existing transmission lines proposed for upgrades associated with operation of a single nuclear unit at the BLN site and are described below. Two NRI-listed streams are within 3 miles of the proposed transmission line upgrades and are described below. The remaining 58 natural areas located within 3 miles of the proposed transmission line upgrades/actions are listed in Table 4-6 by transmission line ID number or grouping of transmission line ID numbers within nearest proximity.

Table 4-6. Natural Areas Within 3.0 Miles of the Transmission Lines Proposed for Reenergizing or Upgrade

Line ID Number	Natural Area	Steward	Distance from Line (miles)
10, 11	Mallard Fox Creek State Wildlife Management Area (WMA)	ADCNR	0.7 west
	Swan Creek State WMA	ADCNR	1.7 east
4, 5, 9	Bellefonte Island TVA Small Wild Area (SWA)	TVA	1.2 west
	Mud Creek State WMA	ADCNR	1.6 west
	Crow Creek Refuge State WMA	ADCNR	0.4 west
	Chickamauga and Chattanooga National Military Park	NPS	0.6 southeast and northeast
	Glades and Barrens of Chickamauga Battlefield	NPS	2.1 southeast
	Lulu Falls/Eagle Cliff Potential National Natural Landmark (PNNL)	NPS	0.57 south
6, 8	Neversink Pit PNNL	NPS	0.5 east
	Robinson Spring PNNL	NPS	1.1 west
	Section Bluff TVA SWA	TVA	2.6 south
	Tumbling Rock Cave PNNL	NPS	2.4 west
3	Bill McNabb Gulf	Ecologically significant site on Tennessee River Gorge Lands*	2.5 northwest
	Blowing Springs Branch. Chesnutt Bridge Protection Planning Site (PPS)	Ecologically significant site on Tennessee River Gorge Lands*	2.2 northwest
	Bluff Point /Hicks Mountain	Ecologically significant site on Tennessee River Gorge Lands*	0.62 north
	Cummings Lake	Ecologically significant site on Tennessee River Gorge Lands*	1.05 north
	Ellis Spring	Ecologically significant site on Tennessee River Gorge Lands*	2.1 north
	Hicks Gap Designated State Natural Area (SNA)	TDEC	1.1 west
	Huff Branch TVA Habitat Protection Area (HPA)	TVA	0.74 north
	Kelly's Ferry Slopes	Tennessee River Gorge Trust	1.06 west
	Lassiter Property	Tennessee River Gorge Trust	1.5 north
	Nickajack River State Mussel Sanctuary	TWRA	1.9 northwest
	Parker Gap Cove	Ecologically significant site on Tennessee River Gorge Lands*	2.6 north
	Piney Branch Bottomland	Ecologically significant site on Tennessee River Gorge Lands*	1.4 northwest
	Pot Point	Tennessee River Gorge Trust	1.1 north
	Renfro Property	Tennessee River Gorge Trust	0.4 north
	Shortleaf Pine Flat PPS	Ecologically significant site on USFS lands*	1.55 northwest

Line ID Number	Natural Area	Steward	Distance from Line (miles)
2	Chickamauga State WMA	TWRA	2.1 north
	Chigger Point TVA HPA	TVA	1.18 east
	Cumberland Trail State Park	Tennessee State Parks	3.0 east, 0.1 north
	Dry Creek Ravine	Ecologically significant site on Tennessee River Gorge Lands*	2.6 east
	Hamilton County Park	Hamilton County	2.3 south
	Harrison Bay State Recreation Park	TDEC	1.44 south
	Little Cedar Mountain TVA SWA/HPA	TVA	1.14 east
	Marion Bridge TVA HPA	TVA	1.9 west
	Marion County Park	Marion County	1.4 southeast
	Mile 434 Oaks	Ecologically significant site on Tennessee River Gorge Lands*	2.7 east
	Montlake/Walden Ridge PNNL	NPS	0.2 northeast
	Nickajack Cave TVA HPA	TVA	0.1 east
	Nickajack Cave State Wildlife Observation Area (WOA)	TVA/TWRA	0.1 east
	Nickajack Oak Wetland and TVA HPA	TVA	0.1 west
	North Chickamauga Creek Pocket Wilderness	Bowaters Paper Company Southern	0.2 north
	Prentice Cooper State Forest	USFS	0.8 east
	Pryor Property	Tennessee River Gorge Trust	1.2 east
	Sequatchie Cave Designated SNA	TDEC	2.5 west
	Shellmound Road Bluff TVA HPA	TVA	1.7 south
	Smith Property	Tennessee River Gorge Trust	0.6 east
	Soddy Creek and TVA HPA	TVA	1.8 north
	Tennessee River Blueway	TVA	0.3 east
	Ware Branch Bend TVA HPA	TVA	2.4 north
	University of Tennessee Friendship Forest	University of Tennessee Forestry Experiment Station	1.4 east
1	Normandy State WMA	TWRA	0.4 northeast
	Bedford State Fishing Lake	TWRA	1.4 northeast
	Rutledge Falls	Tennessee River Gorge Trust	2.4 east
	Short Springs Designated SNA	TDEC	0.5 south
	Short Springs TVA SWA	TVA	0.65 southeast
	Yell Cave	Ecologically significant site on private land*	0.36 northeast

*ESS sites occur on the lands identified but are not managed by these entities.

Guntersville Reservoir State Mussel Sanctuary is crossed by a segment of the Sequoyah-Widows Creek 500-kV (ID: 2) transmission line at the section of the reservoir located in Marion County, Tennessee. The mussel sanctuary extends from the section of the Tennessee River from Nickajack Dam (TRM 424.7) downstream to the Tennessee-Alabama state line (TRM 416.5) and is designated as a sanctuary in which the taking of aquatic mollusks by any means,

and/or the destruction of their habitat is prohibited at all times. This mussel sanctuary is managed by the Tennessee Wildlife Resources Agency (TWRA) Region III office.

Coon Gulf TVA Small Wild Area (SWA) is located in Jackson County, Alabama, approximately 1.0 mile northeast of BLN property boundary and is crossed by a segment of the Bellefonte-East Point 500-kV (ID: 9) transmission line. Coon Gulf SWA comprises approximately 2,366 acres managed by TVA and features a forested cove on Guntersville Reservoir. Coon Gulf provides habitat for federally listed and state-listed endangered species.

Raccoon Creek State Wildlife Management Area (WMA) is located in Jackson County, Alabama, approximately 3.0 miles northeast of BLN property boundary and is crossed by a segment of the Bellefonte-East Point 500-kV (ID: 9) transmission line. Raccoon Creek WMA comprises approximately 7,080 acres managed by ADCNR Division of Wildlife and Freshwater Fisheries for waterfowl and small game hunting.

Crow Creek State WMA is located in Jackson County, Alabama, approximately 1.8 miles north of Cedar Grove and is crossed by a segment of the Widows Creek-Bellefonte #1 500-kV (ID: 6) transmission line. Crow Creek WMA comprises 2,161 acres managed by ADCNR Division of Wildlife and Freshwater Fisheries for waterfowl and small game hunting.

Raccoon Mountain Pumped Storage State Wildlife Observation Area (WOA) is located in Marion County, Tennessee, approximately 3.0 miles west of Chattanooga and is crossed by a segment of the Widows Creek-Raccoon Mountain #2 161-kV (ID: 3) transmission line. Raccoon Mountain WOA comprises approximately 860 acres managed by TVA in cooperation with TWRA. This large pumped-storage lake on top of Raccoon Mountain is surrounded by mature forests and open areas and provides habitat for many bird species, including wintering bald eagles, hawks, falcons, common loons, and vultures.

Tennessee River Gorge is located in Marion and Hamilton counties, Tennessee, approximately 5.0 miles west of Chattanooga. The southern edge of the Tennessee River Gorge boundary is crossed by a segment of the Widows Creek-Raccoon Mountain #2 161-kV (ID: 3) transmission line. The protected area of the Tennessee River Gorge comprises 16,777 acres of the total 27,000-acre gorge. This gorge is the fourth largest canyon in the eastern United States. This ecologically significant site is managed by The Tennessee River Gorge Trust and has an unusually concentrated diversity of land forms and provides habitat for several varieties of plants, ferns, trees, grasses, and flowers, as well as a rich wildlife population. There are federally listed plant and animal species located throughout the gorge.

Grant Property is located in Marion County, Tennessee, approximately 5.0 miles southwest of Chattanooga within the boundary of the Tennessee River Gorge. The southern edge of the Grant Property is crossed by a segment of the Widows Creek-Raccoon Mountain #2 (ID: 3) transmission line. This area is owned in fee by the Tennessee River Gorge Trust in cooperation with the University of Tennessee-Chattanooga for research purposes. The Grant Property comprises approximately 888 acres and contains wooded slopes, mixed mesophytic forest and cove hardwood forest, with land forms characterized by karst topography exhibiting numerous sinkholes and caves. There are federally listed plant and animal species located on the property.

North Chickamauga Creek Gorge and Designated State Natural Area is located in Hamilton County, Tennessee, approximately 7.0 miles west of SQN and is crossed by the Sequoyah-Widows Creek 500-kV (ID: 2) transmission line. The North Chickamauga Creek Gorge consists

of approximately 39,000 acres, and the Designated State Natural Area comprises approximately 3,700 acres of the total acreage. This area is managed by the Tennessee Department of Environment and Conservation (TDEC) in cooperation with the North Chickamauga Creek Conservancy, and includes a rugged steep gorge cut by Chickamauga Creek into a sandstone plateau. River-side shoals and stream bars provide habitat for several listed plants.

Duck River State Mussel Sanctuary is located in Bedford and Coffee counties, Tennessee, and is crossed by the Wartrace-N. Tullahoma tap (ID: 1) at the section of Normandy Reservoir Reservation. The mussel sanctuary, managed by TWRA, extends from Kettle Mills Dam (Duck River Mile 105.6) upstream to the headwaters of the Duck River, including the section impounded by Normandy Dam

The Sequatchie River, an NRI-listed stream, is located in Marion and Sequatchie counties, Tennessee. The Sequatchie River Mile (SRM) 0, its confluence with Tennessee River, to SRM 109 in its headwaters approximately 10 miles south of Homestead is the segment listed on the NRI. This segment is crossed at six locations by the Sequoyah-Widows Creek 500-kV (ID: 2) transmission line proposed for upgrades associated with BLN site operations. The NPS recognizes this 109-mile segment for its scenic, recreational, geologic, fish, and wildlife values, and it is noted as a clean, pastoral float stream that flows through a narrow scenic valley. The first crossing point of the river north of the BLN site is located approximately 0.4 miles north of the town of Ebenezer and west of State Route 27. The second stream crossing occurs 2.07 miles east of Nickletown and west of State Route 27. The third stream crossing occurs at 1.8 miles northeast of Nickletown and west of State Route 27. The fourth, fifth, and sixth stream crossings occur north of the town of Oak Grove at 0.4 mile, 0.8 mile, and 1.6 miles, respectively.

The segment of the North Chickamauga River located in Hamilton and Sequatchie counties, Tennessee, from SRM 13 (its confluence with Falling Water Creek southeast of Falling Water) to SRM 31 (the headwaters north of Lone Oak) is listed on the NRI. This river is crossed at two locations by the existing Sequoyah-Widows Creek 500-kV (ID: 2) transmission line proposed for upgrades associated with BLN site operations. The NPS recognizes this 18-mile segment for its scenic, recreational, geologic, fish, wildlife, historical, and cultural values, and it is noted as a spring-fed, crystal clear mountain stream featuring a variety of flora and an abundance of wildlife. The first crossing point of the river north of the BLN site is located approximately 3.7 miles north of the town of Fairmont on the Sequatchie and Hamilton county line. The second stream crossing occurs approximately 0.5 mile northeast of the town of Mile Straight at Dayton Pike Road.

Little Sequatchie River, located in Marion County, Tennessee, is designated as an NRI-listed stream from river mile 0, at the confluence with the Sequatchie River, to river mile 25 near the headwaters west of Palmer. This stream is located approximately 1.2 miles west of the Sequoyah-Widows Creek 500-kV (ID: 2) transmission line proposed for upgrades associated with BLN site operations. The NPS recognizes this 25-mile segment for its scenic, recreational, fish, and wildlife values, and it is noted as a scenic stream that supports game fishery.

4.9.2. Environmental Consequences

No Action Alternative

Under the No Action Alternative, no alterations or improvements would be made to existing facilities for the purpose of nuclear power generation including associated upgrades of transmission lines. Methods used to manage vegetation along the ROWs and maintain

transmission infrastructure would be unchanged, and routine maintenance would continue. Therefore, there would be no additional effects to natural areas under this alternative.

Action Alternative
Nine natural areas and two NRI streams crossed by the transmission lines would be directly affected by disturbance of vegetation within the area and at stream crossings from heavy equipment associated with the upgrades. Activities necessary to upgrade transmission lines are short term and occur on existing ROW with no new clearing beyond the ROW. BMPs and other routine measures would be implemented to mitigate impacts. Managers of the natural areas crossed by the transmission lines would be notified prior to beginning proposed work. Because the proposed work is confined to existing ROW and because appropriate BMPs would be implemented, direct impacts to natural areas crossed by the transmission lines would be minor. The other natural areas listed in Table 4-6 would not be directly or indirectly affected. Impacts associated with implementation of this alternative would not result in cumulative adverse impacts to natural areas.

4.10. Recreation

4.10.1. Affected Environment

Some low-density dispersed recreation activity such as hunting or wildlife observation may currently take place within these existing transmission line corridors. Two developed recreation areas occur adjacent to the transmission line corridors. A segment of the Sequoyah-Widows Creek 500-kV (ID: 2) transmission line crosses Nickajack Dam Reservation and passes within a few hundred feet of a boat ramp and fishing berm on the right bank and a fishing pier on the left bank below the dam. The Wartrace-N. Tullahoma 161-kV (ID: 1) transmission line crosses Normandy Dam Reservation and passes within 200 feet of Duck River access facilities maintained by TVA as part of the reservation.

4.10.2. Environmental Consequences

No Action Alternative
Methods used to manage vegetation along the ROWs and maintain transmission infrastructure would be unchanged, and routine maintenance would continue. Routine maintenance of these transmission lines and ROWs would have minor impacts on any informal recreation use or developed recreation within the area, and no mitigation would be required.

Action Alternative
Minor impacts on informal and developed recreation could occur during routine maintenance of lines and ROWs, as described in the No Action Alternative. Actions related to upgrading these transmission lines and ROWs could have a minor affect on any informal recreation use that currently occurs. Because these lines already exist and do not directly cross over developed recreation facilities on Nickajack and Normandy Reservations, any impacts on developed recreation facilities should be minor. Further, any impacts on dispersed recreation should be negligible and no mitigation required.

4.11. Land Use

4.11.1. Affected Environment

The transmission lines that would be upgraded cross land with a wide variety of land uses: agriculture, residential, commercial, and forest.

4.11.2. Environmental Consequences

No Action Alternative
Methods used to manage vegetation along the ROWs and maintain transmission infrastructure would be unchanged, and routine maintenance would continue. However, no additional changes in land use would occur under the No Action Alternative.

Action Alternative
Some temporary disruption of some land uses particularly agriculture could occur during upgrade activities. TVA would appropriately compensate land owners for any damage including damage to growing crops. Under this alternative, upgrades to transmission lines in the existing ROWs would not change any existing land use.

4.12. Visual Resources

4.12.1. Affected Environment

The physical, biological, and man-made features seen in the landscape provide any selected geographic area with particular visual qualities and aesthetic character. The varied combinations of natural features and human alterations that shape landscape character also help define their scenic importance. The presence or absence of these features along with aesthetic attributes such as uniqueness, variety, pattern, vividness, and contrast make the visual resources of an area identifiable and distinct. The scenic value of these resources is based on human perceptions of intrinsic beauty as expressed in the forms, colors, textures, and visual composition seen in each landscape.

The existing transmission line routes traverse a variety of topography through several counties in Alabama, Tennessee, and Georgia. The existing 161-kV and 500-kV switchyards are located on the BLN site. The existing transmission lines and associated structures can be seen in the foreground distance (within 0.5 mile of the observer), middleground distance (between 0.5 and 4 miles), and background distance (4 miles to the horizon) by area residents and motorists along local roads. In some areas, views of the transmission lines and structures provide discordant contrast when seen as a focal point and standing alone. In other areas, the line route is visually similar to other transmission structures seen in the landscape.

4.12.2. Environmental Consequences

No Action Alternative
Under the No Action Alternative, the existing switchyards and transmission line ROWs would not be upgraded. Methods used to manage vegetation along the ROWs and maintain transmission infrastructure would be unchanged, and routine maintenance would continue. Thus, there would be no change in visual character, and visual resources would not be affected.

Action Alternative
Under the Action Alternative, the existing switchyards and transmission lines would be upgraded. For residents along Town Creek near BLN, upgrade of the existing switchyards and transmission lines would be visually insignificant. Views of the upgrades would be visually similar to existing views residents now have from foreground distances.

For residents, motorists, and lake-users along the existing line routes, most visual impacts would be temporary and minor. These groups would likely notice an increase in traffic and personnel along local roads and access roads. New conductors, structures, and height

extensions would add to the number of discordantly contrasting elements seen in the landscape. Visual impacts would likely decrease as viewing positions increase, in distance, from the transmission line upgrades. Details of views from background distances tend to merge into broader patterns and details become weak.

Upgrades to the transmission line route would require some limited reclearing of vegetation. These activities could include the use of heavy machinery and would increase the number of personnel seen in the area. These minor visual obtrusions would be temporary until the existing ROW and laydown areas have been restored through the use of TVA standard BMPs (Muncy 1999). Any nighttime lighting required would be temporary during the upgrade period and would be insignificant. There may be some minor visual discord during the upgrade period due to an increase in personnel and equipment and the use of laydown and materials storage areas. This would be temporary until all activities are complete.

4.13. Archaeological Resources and Historic Structures

4.13.1. Affected Environment

TVA's procedure for reviewing the operations and maintenance of transmission lines is called a Sensitive Area Review (SAR) (see Appendix D). Under this review procedure, all transmission line corridors, where routine operation and maintenance occur, are reviewed by TVA Cultural Resource staff for the potential to effect historic properties on or eligible for the National Register of Historic Places (NRHP). The regulatory guidance for the SAR concerning cultural resources is the same guidance for all cultural resource assessments: 36 CFR Part 800. Prior to conducting specific upgrades and other activities along the ROWs, TVA would determine the need for consultation with the respective State Historical Preservation Officer (SHPO) and, if needed, define an APE in coordination with the SHPO. That requirement would range from no investigations (area already surveyed) to resurvey (if past surveys were not deemed sufficient) to site avoidance, data recovery, or monitoring if a previously or newly identified cultural resource within the APE was determined eligible or potentially eligible for inclusion in the NRHP.

The archaeological record of the Tennessee River valley has documented five major prehistoric occupational periods that began with the Paleo-Indian (14,000 to 8000 B.C.); the Archaic (8000 to 900 B.C.); the Woodland (900 B.C to A.D. 1000); the Mississippian (A.D. 1000 to 1630); and Historic (1630 to present) periods. Prehistoric land use and settlement patterns vary during each period, but short- and long-term habitation sites are generally located on floodplains and alluvial terraces along rivers and tributaries. Specialized campsites tend to be located on older alluvial terraces and in the uplands. European interactions with Native Americans in this area began in the 17th and 18th centuries. European settlements vary throughout the regions in this study, but in general, Euro-American settlement increased in the early 19th century as the Historic tribes were forced to give up their land. Sites belonging to each period are differently distributed in the landscape of Tennessee, Alabama, and Georgia, but generally, habitation sites are found on floodplains and alluvial terraces along rivers and tributaries, while specialized campsites tend to be found on older alluvial terraces and in the uplands.

For the proposed transmission line upgrades associated with construction of a single BLN unit, the archaeological APE is all lands upon which the existing transmission line would be upgraded and includes all associated infrastructure, including the transmission line ROW, access roads, and staging areas. The APE for architectural studies includes a 0.8-kilometer (0.5-mile) buffer surrounding the subject transmission line ROWs.

Based on available data of previously recorded cultural resources, 25 archaeological sites are located within the APE. One of these sites located in Alabama (1MG785) is no longer extant. Seven sites, all located in Alabama (1MG116, 1MG115, 1MG667, 1MG758, 1MG757, 1JA304, 1JA694), were previously determined not eligible for inclusion on the NRHP. Two sites, one in Alabama (1MG735) and one in Georgia (9WA164) have been previously determined potentially eligible for the NRHP. The remaining 15 sites in Alabama (1JA637, 1JA650, 1JA453, 1JA452, 1JA304, 1JA377, 1JA518, 1JA532, 1JA524, 1JA617, 1JA558) and Tennessee (40MI246, 40MI247, 40HA0089, 40MI248) have not been assessed for NRHP eligibility. In Alabama, one previously recorded historic district (the City of Bridgeport) falls within the architectural APE. A portion (8 percent, 2.5 miles) of one transmission line proposed for upgrading, the Widows Creek-Oglethorpe #3 161-kV (ID: 5), has been subjected to a systematic cultural resources survey (Cleveland et al. 1995). This cultural resource survey identified one NRHP-eligible historic archaeological site (9WA164), one eligible Historic District (Happy Valley Farms in Walker County, Georgia) and two eligible historic structures (WA-WA-114 and WA-WA-642).

4.13.2. Environmental Consequences

No Action Alternative
Under the No Action Alternative, the transmission line upgrades would not take place, and there would be no additional impacts to cultural resources from ongoing maintenance of existing transmission lines and ROWs.

Action Alternative
Portions of the transmission line ROWs proposed for upgrading are located in areas having a potential for archaeological resources. In addition, 17 previously recorded archaeological sites have been determined eligible or have not been assessed for eligibility for the NRHP. Under the Action Alternative, the upgrade of the existing transmission lines and the construction and/or use of associated infrastructure (e.g., access roads, laydown areas) have the potential to affect archaeological resources located within the APE that may be eligible for the NRHP. The placement of new structures or project-related clearing within the existing transmission line ROW could potentially have a visual effect on historic structures eligible for the NRHP.

In letters dated September 10, 2009, TVA initiated consultation with the Tennessee, Alabama, and Georgia SHPOs regarding the proposed transmission line upgrades. Should the Action Alternative be selected, pursuant to Section 106 of the NHPA and its implementing regulations at 36 CFR Part 800 TVA would conduct surveys to better identify and evaluate historic properties (archaeological sites, historic structures, and historic sites) eligible for listing in the NRHP. The cultural resources investigations would be guided by MOAs with Georgia SHPO (executed April 29, 2010) and Alabama SHPO (pending). Instead of an entering into an MOA, the Tennessee SHPO has requested that TVA follow procedures to conduct a phased identification and evaluation of historic properties pursuant to 36 CFR Part 800.4(b)(2).

4.14. Socioeconomics

Socioeconomics is the combination of social and economic factors related to the proposed action. Socioeconomic impacts may be positive, such as increased income, or negative, such as traffic congestion or temporary increases in demand for medical services.

4.14.1. Affected Environment

The transmission lines proposed for upgrades associated with operations of the BLN site would cover 11 counties in three states, as shown in Figure 2-15.

4.14.2. Environmental Consequences

No Action Alternative
Methods used to manage vegetation along the ROWs and maintain transmission infrastructure would be unchanged, and routine maintenance would continue. Selection of the No Action Alternative would not affect local socioeconomic conditions because there would be essentially no change in current conditions.

Action Alternative
The actions required to reenergize the existing 500-kV lines and switchyard are discussed in the CLWR FEIS (DOE 1999), Subsection 5.2.3.9.1; the Conversion FEIS (TVA 1997); Subsection 4.2.18.2; and the COLA ER (TVA 2008a), Subsection 3.7.2.2. The transmission upgrades and refurbishments would be a small piece of the total construction effort for BLN, accounting for only a small share of expenditures and employment. In addition, as discussed in Subsection 2.6.2, these activities would be confined to the existing transmission line ROWs. Therefore, these impacts are considered to be minor.

Post-construction effects of reenergizing the 500-kV line and switchyard are discussed in the CLWR FEIS (DOE 1999), Subsection 5.2.3.9.1, and the Conversion FEIS (TVA 1997), Subsection 4.2.18.2. They are also discussed in the COLA ER (TVA 2008a), Subsections 5.8.1.4 and 5.6.3. Measures would be undertaken (see Subsection 2.6.2) to prevent or mitigate induced electric current and noise impacts, and to minimize public exposure to electric and magnetic fields. Therefore, these potential impacts are considered to be minor and insignificant.

4.15. Environmental Justice

4.15.1. Affected Environment

Environmental justice implies that low-income or minority populations will not incur a disproportionate share of adverse effects. Environmental justice analysis is mandated by EO 12898 *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*. TVA is not subject to this EO, but it assesses the impact of its actions on minority communities and low-income populations in the NEPA process as a matter of policy.

4.15.2. Environmental Consequences

No Action Alternative
Under the No Action Alternative there would be no upgrades to the subject transmission lines. Methods used to manage vegetation along the ROWs and maintain transmission infrastructure would be unchanged, and routine maintenance would continue. There would be no impacts on businesses, industries, and residences in the area. Therefore, no significant disproportionate impacts to low-income or minority populations would occur under this alternative.

Action Alternative
All work would involve existing facilities and ROWs. No businesses, industries, and residences in the area not already affected by the existing transmission system would be affected beyond the minor and temporary effects. Therefore, no significant disproportionate impacts to low-income or minority populations would occur should the Action Alternative be implemented.

4.16. Operational Impacts

4.16.1. Electric and Magnetic Fields

4.16.1.1. Affected Environment

Transmission lines, like all other types of electrical wiring, generate both electric and magnetic fields (EMF). The voltage on the conductors of the transmission line generates an electric field that occupies the space between the conductors and other conducting objects such as the ground, transmission line structures, or vegetation. A magnetic field is generated by the current (i.e., the movement of electrons) in the conductors. The strength of the magnetic field depends on the current, design of the line, and distance from the line.

The fields from a transmission line are reduced by mutual interference of the electrons that flow around and along the conductors and between the conductors. The result is dissipation of the already low energy. Most of this energy is dissipated on the ROW, and the residual very low amount is reduced to background levels near the ROW or energized equipment.

Magnetic fields can induce currents in conducting objects. Electric fields can create static charges in ungrounded, conducting materials. The strength of the induced current or charge under a transmission line varies with (1) the strength of the electric or magnetic field, (2) the size and shape of the conducting object, and (3) whether the conducting object is grounded. Induced currents and charges can cause shocks under certain conditions by making contact with objects in an electric or magnetic field.

The transmission lines subject to upgrades, like other transmission lines, have been designed to minimize the potential for such shocks. This is done, in part, by maintaining sufficient clearance between the conductors and objects on the ground. Stationary conducting objects, such as metal fences, pipelines, and highway guard rails that are near enough to the transmission line to develop a charge would be grounded by TVA to prevent them from being a source of shocks.

Under certain weather conditions, high-voltage transmission lines, such as 500-kV and 161-kV lines, may produce an audible low-volume hissing or crackling noise. This noise is generated by the corona resulting from the dissipation of energy and heat as high voltage is applied to a small area. Under normal conditions, corona-generated noise is not audible. The noise may be audible under some wet conditions, and the resulting noise level off the ROW would be well below the levels that can produce interference with speech. Corona is not associated with any adverse health effects in humans or livestock.

Other public interests and concerns have included potential interference with AM radio reception, television reception, satellite television, and implanted medical devices. If interference occurs with radio or television reception, it would be due to unusual failures of power line insulators or a poor alignment of the radio or television antenna and the signal source. Both conditions are correctable and would be repaired if reported to TVA.

Implanted medical devices historically had a potential for power equipment strong-field interference when they came within the influence of low-frequency, high-energy workplace exposure. However, the older devices and designs (i.e., more than five to 10 years old) have been replaced with different designs and different shielding that eliminate the potential for interference from external field sources up to and including the most powerful magnetic resonance imaging medical scanners. Unlike high-energy radio frequency devices that can still interfere with implanted medical devices, low-frequency, and low-energy powered electric or

magnetic devices no longer potentially interfere (Journal of the American Medical Association 2007).

Research has been done on the effects of EMF on animal and plant behavior, growth, breeding, development, reproduction, and production. This research has been conducted in the laboratory and under environmental conditions, and no adverse effects on health or the above considerations have been reported for the low-energy power frequency fields (World Health Organization [WHO] 2007a). Effects associated with ungrounded, metallic objects and static charge accumulation and discharge in dairy facilities have been found when the connections from a distribution line meter have not been properly installed on the farm side of a distribution circuit.

There is some public concern as to the potential for adverse health effects that may be related to long-term exposure to EMF. A few studies of this topic have raised questions about cancer and reproductive effects on the basis of biological responses observed in cells or in animals or on associations between surrogate measures of power line fields and certain types of cancer. Research has been ongoing for several decades.

The consensus of scientific panels reviewing this research is that the evidence does not support a cause-and-effect relationship between EMF and any adverse health outcomes (e.g., American Medical Association [AMA] 1994; National Research Council 1997; National Institute of Environmental Health Sciences [NIEHS] 2002). Some research continues of the statistical association between magnetic field exposure and a rare form of childhood leukemia known as acute lymphocytic leukemia. A review of this topic by the WHO (International Association for Research on Cancer 2002) concluded that this association is very weak, and there is inadequate evidence to support any other type of excess cancer risk associated with exposure to EMF.

TVA follows medical and health research related to EMF, along with media coverage and reports that may not have been peer-reviewed by scientists or medical personnel. No controlled laboratory research has demonstrated a cause-and-effect relationship between low-frequency electric or magnetic fields and health effects or adverse health effects even when using field strengths many times higher than those generated by power transmission lines. Statistical studies of overall populations and increased use of low-frequency electric power have found no associations (WHO 2007b).

Neither medical specialists nor physicists have been able to form a testable concept of how these low-frequency, low-energy power fields could cause health effects in the human body where natural processes produce much higher fields. To date, there is no agreement in the scientific or medical research communities as to what, if any, electric or magnetic field parameters might be associated with a potential health effect in a human or animal. There are no scientifically or medically defined safe or unsafe field strengths for low-frequency, low-energy power substation or line fields.

The current and continuing scientific and medical communities' position regarding the research and any potential for health effects from low-frequency power equipment or line fields is that there are no reproducible or conclusive data demonstrating an effect or an adverse health effect from such fields (WHO 2007c). In the United States, national organizations of scientists and medical personnel have recommended no further research on the potential for adverse health effects from such fields (AMA 1994; DOE 1996; NIEHS 1998).

Although no federal standards exist for maximum EMF strengths for transmission lines, two states (New York and Florida) have promulgated EMF regulations. Florida's regulation is the more restrictive of the two, with field levels being limited to 150 milligauss (mG) at the edge of the ROW for lines of 230-kV and less. The expected magnetic field strengths at the edge of the proposed ROW would fall well within these standards.

4.16.1.2. Environmental Consequences

No Action Alternative
Under the No Action Alternative, no new EMFs would be created from the proposed upgrading of the transmission lines; therefore, there would be no impacts to the environment.

Action Alternative
Magnetic fields would continue be produced along the length of the existing 161-kV transmission lines and new magnetic fields would be produced along the length of the reenergized 500-kV lines. The proposed transmission line upgrades would allow the subject line to carry higher current levels as system conditions require. The strength of the magnetic fields within and near the ROW would vary with the electric load on the line as well as with the terrain. Because line voltages would not change, there would be no increase in electric field strength. Some of the proposed upgrades would result in increased line height above ground during most system conditions, thus reducing the electric field levels. Public exposure to EMF would change over time after the line work is completed as adjacent land uses change. No significant impacts from EMF are anticipated from the upgrade, reenergizing, and operation of the transmission lines.

4.16.2. Lightning Strike Hazard

4.16.2.1. Affected Environment

TVA transmission lines are built with overhead ground wires that lead a lightning strike into the ground for dissipation. Thus, a safety zone is created under the ground wires at the top of structures and along the line for at least the width of the ROW. The National Electrical Safety Code is strictly followed when installing, repairing, or upgrading TVA lines or equipment. Transmission line structures are well grounded, and the conductors are insulated from the structure. Therefore, touching a structure supporting a transmission line poses no inherent shock hazard.

4.16.2.2. Environmental Consequences

No Action Alternative
Under the No Action Alternative, no new lighting strike hazards would be created from the proposed upgrading of the transmission lines; therefore, there would be no impacts to the environment.

Action Alternative
Transmission line structures are well grounded, and the conductors are insulated from ground. Therefore, touching a structure supporting a 161-kV transmission line poses no inherent shock hazard. Additionally, TVA transmission lines are built with overhead ground wires that would lead a lightning strike into the ground for dissipation. Thus, a safety zone is created under the ground wires at the top of structures and along a line for at least the width of the ROW. The National Electrical Safety Code is strictly followed when installing, repairing, or upgrading TVA

lines or equipment. None of the proposed actions would alter line grounding. Therefore, there would be no additional hazards from lightning strikes.

4.16.3. Noise and Odor

4.16.3.1. Affected Environment

During the proposed upgrade of the transmission lines, equipment would generate noise above ambient levels, for short periods of time. In the more densely populated areas along the ROW, techniques would be used to limit noise as much as possible. In residential areas, the need for periodic ROW vegetation maintenance, i.e., mowing, would be limited or nonexistent.

4.16.3.2. Environmental Consequences

No Action Alternative
Under the No Action Alternative, no new noise and odors would be created from the proposed upgrading of the transmission lines; therefore, there would be no impacts to the environment.

Action Alternative
Because of the general lack of nearby sensitive receptors and the short work period, noise-related effects are expected to be temporary and insignificant. For similar reasons, noise related to periodic line maintenance is also expected to be insignificant. Upgrading, reenergizing, and operating the lines are not expected to produce any noticeable odors.

Additionally, no significant long-term impacts related to noise are expected as a result of the operation of the transmission lines. None of the proposed upgrades would result in any increase in the potential for noise produced by the lines.

CHAPTER 5

5.0 OTHER EFFECTS

5.1. Unavoidable Adverse Environmental Impacts

This section describes principal unavoidable adverse environmental impacts for which mitigation measures are either considered impractical, do not exist, or cannot entirely eliminate the impact. Specifically, this section considers unavoidable adverse impacts that would occur for either of the Action Alternatives, i.e., completing and operating one partially completed B&W reactor or constructing and operating one Westinghouse AP1000 reactor at the BLN site, in addition to maintaining and operating associated transmission facilities. These unavoidable construction and operational effects are identified in Table 5-1.

Table 5-1. Construction- and Operation-Related Unavoidable Adverse Environmental Impacts

Issue Construction	Unavoidable Adverse Impact
Land Use	The BLN site is approximately 1600 acres in total. Approximately 400 acres of the 1600-acre BLN site were previously disturbed for the partially constructed BLN 1&2 and associated plant structures. Completion of a B&W unit would require reclearing and grading of previously disturbed ground. Construction of an AP1000 unit and associated structures is expected to require clearing and blasting of about 50 acres of forested land, and reclearing and grading of previously disturbed ground. There would be a long-term commitment of land for the existing transmission corridors. Potential for unanticipated disturbances to historic, cultural, or paleontological resources is mostly or entirely mitigated. Some land would be dedicated to long-term disposal of construction debris and not available for other uses.
Hydrologic & Water Use	A small amount of water is consumed during construction activities. Ground-disturbing activities along river banks or stream banks (in the case of the transmission line maintenance), on a short-term basis, introduce minor amounts of sediments and potentially chemicals into water bodies.
Aquatic Ecology	Construction at river's edge may cause direct, short-term, and minor loss of some organisms and temporary degradation of habitat. Existing transmission lines that cross streams may continue to cause minor disruption of some organisms and degradation of habitat.
Terrestrial Ecology	Operation of a BLN unit and transmission corridor would continue minor alterations to habitat and the suite of species which inhabit them. Construction, clearing, and grading of the BLN site could directly harm or displace a few animals. Construction noises may startle or scare animals. These minor impacts are intermittent and would continue throughout the construction phase.
Socioeconomics and Environmental Justice	Construction workers and local residents would be exposed to elevated levels of traffic through the course of the construction phase. The influx of construction workforce would cause short-term, minor effects on local housing, infrastructure, land use, and community services such as fire or police protection. In the short-term, there may be school crowding. Increased tax revenue would mitigate much of this impact. Construction workers and local residents would be exposed to elevated levels of dust, exhaust emissions, and noise from construction and equipment. These constitute minor unavoidable impacts. No unavoidable adverse construction impacts to minority populations are anticipated.

Issue Operational	Unavoidable Adverse Impact
Land Use	The commitment of land use described above would continue over the operational life of this project. Some of the land would be returned to its former state following the end of construction. The Uranium Fuel Cycle of a BLN unit would increase radioactive and nonradioactive wastes that would require land to be dedicated for the long-term disposal of hazardous and nonhazardous materials in permitted disposal facilities or permitted landfills. This land would not be available for most other uses. The viewscape of the BLN site and transmission facilities would continue to be impacted over the operational period, but no more so than at the present.
Hydrologic & Water Use	Normal plant operations result in discharge of small amounts of chemicals and radioactive effluents to Guntersville Reservoir throughout the life of a BLN unit. Compliance with the NPDES permit; applicable water quality standards; storm water pollution prevention (SWPPP) and SPCC plans; and discharge of radioactive effluents in compliance with applicable regulatory standards would ensure that the result would be little or no unavoidable adverse impacts. Discharge of cooling water results in a thermal plume in Guntersville Reservoir throughout the operational life of a BLN unit. The differences between plume temperature and ambient water temperature are maintained within limits set in the NPDES permit. Cooling towers mitigate much of the heat that would otherwise be discharged to the reservoir. Use of closed-cycle cooling would result in only minor adverse impacts. Water lost to evaporation represents consumption of water that would not be available for other uses. The maximum consumptive use of surface water, which would continue throughout the operational life of the plant, is less than 1 percent of 7Q10.
Aquatic Ecology	The effects of entrainment or impingement result in a loss of fish and other aquatic species. Because a closed-loop cooling system that substantively reduces the loss of fish and aquatic species is used, the impacts of entrainment or impingement on aquatic species would be minor and insignificant. Routine maintenance activities may result in rare episodic chemical or petroleum spills near water that could, in turn, affect aquatic life. Preparation and adherence to the SPCC plan would avoid/minimize contamination from any such spills. Although within NPDES permit limits, discharge of small amounts of chemicals to Guntersville Reservoir from outine plant operations could result in minor insignificant effects on aquatic life over the operational life of this project.
Terrestrial Ecology	Birds may periodically collide with the cooling towers or the existing transmission lines. Such occurrences are anticipated to be minor. Some minor clearing, maintenance, and upgrading of transmission lines could result in short-term disruption of wildlife, but no long-term changes would be expected from existing habitat conditions. Periodic noise, such as maintenance at the site or along the existing transmission line, may cause temporary and minor impacts to nearby wildlife over the operational life of this project.
Socioeconomics and Environmental Justice	Minor unavoidable adverse impacts are expected over the life of operating a unit at BLN. The transmission lines are built in accordance with applicable regulations and codes to minimize the risk of electric shock. However, over the life of the plant, the transmission line has the potential to produce electric shock to people working near the line or from fallen lines. Operation and outages of a BLN unit would increase traffic on local roads during shift change. Although emissions would be maintained within limits established in permits, air emissions from diesel generators and equipment, and vehicles would have a minor impact on workers and local residents over the operational life of this project. Unavoidable adverse operational impacts to minority populations are not expected to occur.

Issue – Operational (continued)	Unavoidable Adverse Impact
Radiological	Small radiological doses to workers and members of the public from releases to air and surface water would occur over the operational life of this project. Releases are well below regulatory limits. Effluents are treated according to applicable regulatory standards before being discharged into Guntersville Reservoir. While employees are potentially exposed over the long term, adherence to applicable regulatory standards, radiological safety procedures, work plans and safety measures reduce this exposure to a negligible impact. High-level radioactive spent fuel is stored and isolated from the biosphere for thousands of years. The impacts of high-level radioactive waste and spent fuel are reduced through specific plant design features in conjunction with a waste minimization program. Impacts are further reduced through employee safety training programs and work procedures, and by strict adherence to applicable regulations for storage, treatment, transportation, and ultimate disposal of this waste in a geological repository, or reprocessing. The mitigation measures reduce the risk of radioactive impacts, but there is still some residual risk. Waste disposal constitutes a commitment of land that continues for thousands of years into the future. Low-level radioactive and nonradioactive waste would be stored, treated, and disposed. Disposal of these materials represents a commitment of land for hundreds or thousands of years. The impacts of low-level radioactive and nonradioactive hazardous waste are reduced through waste minimization programs, employee training programs, and strict adherence to work procedures and applicable regulations.
Atmospheric & Meteorological	Diesel generators and equipment would contribute to minor air emissions over the course of this project. Burning of any material associated with maintaining transmission line rights-of way would contribute to short-term air pollution. As described in Chapter 3, minor radioactive emissions would occur from the proposed unit during normal operations. Compliance with permit limits and regulations for installing and operating air emission sources and monitoring of those air emissions would result in little or no adverse impacts. Cooling towers would emit a plume of water vapor resulting in a limited obstructed view of the sky, causing a shadowing effect on the ground that has a small effect on vegetation. The plumes present little environmental effect on humans or biota.

5.2. Relationship Between Short-Term Uses and Long-Term Productivity of the Human Environment

One of NEPA’s basic EIS requirements is to describe “the relationship between local short-term uses of man’s environment and the maintenance and enhancement of long-term productivity.” Unavoidable adverse impacts of construction and operation are discussed in Section 5.1, and the irreversible and irretrievable commitments of resources are discussed in Section 5.3. This section focuses on and compares the significant short-term benefit (e.g., principally generation of electricity) and uses of environmental resources which have long-term consequences on environmental productivity. Table 5-2 summarizes the proposed action's short-term uses and benefits versus the long-term consequences on environmental productivity. For the purposes of this section, the term “short term” represents the period from start of construction to end of plant life, including prompt decommissioning. In contrast, the term “long-term” represents the period extending beyond the end of plant life, including the period up to and beyond that required for delayed plant decommissioning. This discussion applies to the general ramifications of implementing either Action Alternative.

The short-term beneficial impacts of usage outweigh the adverse impacts on long-term environmental productivity. The principal short-term benefit from a BLN unit would be the production of a relatively clean and stable form of electrical energy. With respect to long-term

benefits, nuclear energy avoids carbon dioxide emissions that may have a significant long-term detrimental effect on global climate. Nuclear energy also reduces the depletion of fossil fuels. Chapter 3 describes effects associated with uranium fuel use. These impacts include radioactive waste, spent fuel storage, and transportation of radioactive materials. Subsection 5.2.2 and Section 5.3 describe the effects of mining and in-situ leaching, conversion, enrichment of uranium, fabrication of nuclear fuel, use of fuel, and disposal of the spent fuel.

There are two key long-term adverse impacts on productivity. Both of these environmental liabilities are governed by the half-lives of the respective radioisotopes. The first involves long-term radioactive contamination of the reactor vessel, equipment, and other material that are exposed to radioactive isotopes. The second involves irradiated fuel and high-level waste that must be safeguarded and isolated from the biosphere for thousands of years, or reprocessed for use as fuel.

5.2.1. Short-Term Uses and Benefits

There are a number of short-term benefits that are derived from construction and operation of a single nuclear generating unit at BLN. These short-term uses and benefits, as summarized below include the following:

- Electricity generation
- Fuel diversity
- Avoidance of air pollution and greenhouse gas emissions
- Land use
- Aquatic and terrestrial biota
- Socioeconomic changes and growth

As described in Chapter 1, the principal short-term benefit of a BLN unit would be the generation of electricity to meet the growing demand for electricity in TVA's power service area. Energy diversity is also an element fundamental to the objective of achieving a reliable and affordable electrical power supply system. Over-reliance on any one fuel source leaves consumers vulnerable to price spikes and supply disruptions. A BLN unit furthers the goal of creating new nuclear base load generating capacity. Operation of a reactor at BLN also advances the Congressional goal of obtaining a diversified mix of electrical generating sources. Upgrading the existing transmission lines would increase the short-term and long-term capacity and reliability of the power supply in TVA's service area.

Natural gas, and in particular, coal-fired electricity generating plants produce substantive amounts of air pollutant emissions. Fossil fuel air emissions, particularly carbon dioxide, are believed by many in the scientific community to contribute to the greenhouse effect and, consequently, global climate change. Beyond steam and water vapor, modern nuclear reactors produce virtually no air emissions during operation, and only very minor levels of radioactive emissions. The generation of significant air emissions is avoided by foregoing construction of a comparably sized coal- or gas-fired alternative, and instead constructing or completing a single unit at BLN. Even with contributions from the UFC, the net benefits of reduced emissions from nuclear over those of natural gas or coal-fired facilities are substantive.

Table 5-2. Summary of the Proposed Action's Principal Short-Term Benefits Versus the Long-Term Impacts on Productivity

Issue	Short-Term Uses and Benefits	Relationship to Maintenance and Enhancement of Long-Term Environmental Productivity
Land Use	Continued commitment of land use at the existing site. Some potential loss in agricultural productivity, or natural habitats and woodlands.	No long-term loss as the land could be released for other uses or returned to its natural state after the reactor is decommissioned.
Terrestrial and Aquatic Ecology	Disrupts or destroys some flora and fauna on and near the BLN site, and along the transmission corridor. No significant effect to species or habitats is expected to occur. After construction, some flora and fauna may recover in areas that are no longer affected by construction or plant operations.	No significant long-term detrimental disturbance to biota or their habitats.
Socioeconomic Growth	Injection of tax revenues, plant expenditures, and employee spending contributes to the growth of the local economy. In the short term, this growth may strain local infrastructure and services.	Tax revenues, plant expenditures, and employee spending leads to some long-term direct and secondary growth in the local economy, infrastructure, and services that may continue after the reactors are decommissioned.
Irradiated Spent Fuel	Provides a short-term supply of relatively clean energy.	Managed as a High-Level Radioactive Waste, and either reprocessed or isolated from the biosphere for thousands or tens of thousands of years. Long-term commitment of the local storage area and the underground geological repository.
Other Radioactive Waste	The radioactively contaminated reactor vessel and equipment are required for the short term production of nuclear energy.	Contaminated waste must be managed and isolated from the biosphere for hundreds or thousands of years.
Potential for Accident	Potential security consequences of a reactor accident could range from small to large. However, the probability or likelihood of a severe accident is deemed to be very remote. Because the probability or likelihood of such an event is so small, the overall risk of a nuclear accident is, likewise, considered to be so small as not to constitute a potentially significant impact upon the human environment.	In the advent of an accident, the impacts could be long-term and substantial.

Issue	Short-Term Uses and Benefits	Relationship to Maintenance and Enhancement of Long-Term Environmental Productivity
Depletion of Uranium	As a reactor fuel, the uranium provides a short-term supply of relatively clean energy.	Construction and operation of a BLN unit contributes to the long-term cumulative depletion of the global uranium supply.
Offset Usage of Finite Fossil Fuel Supplies	During operation, a BLN unit avoids the consumption of fossil fuels, albeit with some increase in the use of uranium. Consumption of fossil fuels in the UFC is substantively less than would occur for equivalently sized fossil fuel based generation.	Reduces the cumulative long-term depletion of global fossil fuel supplies.
Materials, Energy, and Water	In the short term, the energy used in operating the reactors results in far more electrical power generation than was used in their construction. The use of materials in constructing the BLN is also critical to the goal of producing a clean and reliable supply of electrical power. A relatively modest quantity of cooling water is lost through evaporation and drift.	Construction and operation of a BLN unit contributes to the cumulative long-term irretrievable use of materials, energy, and water used in the construction and operation of the reactors. However, the reactor provides far more energy than is consumed in its construction.
Air Pollution	Operation of a BLN unit avoids air pollutants that would likely be produced by fossil fuel plants if the reactor was not constructed.	Operation of the unit results in a long-term cumulative avoidance of greenhouse emissions that would likely be produced by fossil fuel plants if the unit were not constructed.
Social Changes	The project stimulates economic growth and productivity in the local area. In the short-term, however, this growth may strain local infrastructure and services, resulting in problems such as overcrowding of schools and traffic congestion. However, revenue derived from this project may fund increased infrastructure and social services.	Payments made in lieu of taxes by TVA, and wages spent by the operational staff may inject significant revenues into the local economy that have long-lasting economic growth and development effects, which may continue after a BLN unit is decommissioned. Socioeconomic changes such as transformation in the nature and character of the community likely continue long after a BLN unit has been decommissioned.

The construction and operation of a single unit at the BLN site would result in the continued commitment of land use at the existing site, as well as for the transmission corridor (i.e., there are not “new” long-term effects on land use within the existing rights-of-way). Land required for the corridor results in the continued loss of some agricultural or pastureland from transmission structures, or undeveloped habitats and woodlands. In the short term, the project results in some potential loss in agricultural productivity, or natural habitats and woodlands. However, this loss does not represent a long-term loss, as the land may be released for other uses or returned to its natural state after the BLN unit has been decommissioned. Construction and operation of a single unit at the BLN site also disrupts or destroys some flora and fauna on and near the site, as does maintenance along the transmission corridor. However, no significant effect to species or habitats is expected to occur. After construction is completed, some flora and fauna may recover in areas that are no longer affected by construction or plant operations.

Construction of a BLN unit is expected to stimulate economic growth and productivity in the local area. Wages spent by workers are expected to provide an economic boost locally and regionally. The construction and operation of a BLN Unit may also spur indirect or secondary socioeconomic growth. In the short-term, however, this growth may strain some local infrastructure and services, resulting in problems such as overcrowding of schools and increased traffic. However, tax revenue derived from this project may fund increased infrastructure and social services. TVA payments made in lieu taxes and wages spent by the operations staff would inject revenue into the local economy that may have long-lasting economic growth and developmental effects. In the long-term, some of this growth may continue even after the unit has been decommissioned. Socioeconomic changes brought about by the operation of the unit may also continue long after the plant has been decommissioned. This increased growth leads to long-term changes in the nature and character of the community that some may regard to be adverse.

5.2.2. Maintenance and Enhancement of Long-Term Environmental Productivity

Potential long-term effects on the productivity of the human environment are described below and summarized in Table 5-2. The assessment of long-term productivity impacts does not include the short-term effects related to construction and operation of a BLN unit.

Some of the adverse environmental impacts may remain after practical measures to avoid or mitigate them have been taken. As described in Chapter 1, the BLN site was originally designated for construction of nuclear reactors; therefore, siting and operating a single nuclear unit there represents a continuation of the originally planned land use of the site. After the reactor is shutdown, and the BLN unit is decommissioned to NRC standards, this land would be available for other industrial or nonindustrial uses. Therefore, land use impacts are not expected to constitute a long-term productivity issue. Similarly, impacts such as air emission, water effluents, and other impacts described in Chapter 3, but not specifically mentioned in this section are insignificant.

Exposure to Hazardous and Radioactive Materials and Waste

Workers may be exposed to low doses of radiation and trace amounts of hazardous materials and waste. Workplace exposures are carefully monitored to ensure that radioactive exposure is within regulatory limits. Local nonworkers also receive a very small incremental dose of radiation. Radiological monitoring and impacts related to operation of a BLN unit are described in Chapter 3. The persistence of radionuclides depends on the half-life of the radionuclides. The doses are in compliance with applicable regulatory standards and permits and do not significantly affect humans, biota, or air or water resources.

Radiological emissions are not expected to contaminate BLN property or the surrounding land. Once the plant ceases to operate and is decommissioned, radiological releases also cease. No future issues associated with the radiological emissions from operation of a nuclear unit are expected to affect the long-term uses of the BLN site.

Potential for Nuclear Accident
The risk of a potential accident is the product of the potential consequences, and the probability or likelihood that an event occurs. The potential consequences of an accident could range between small to large. However, the probability or likelihood of a major accident is very remote. Because the probability or likelihood of such an event is so small, the overall risk of a nuclear accident is likewise so small as not to constitute a potentially significant impact upon the human environment. The results of TVA's analysis in Section 3.19 indicate that the environmental risks due to postulated accidents are exceedingly minor.

Uranium Fuel Cycle and Depletion of Uranium
The principal use of uranium is as a fuel for nuclear power plants. With approximately 440 nuclear reactors operating worldwide, these plants currently produce approximately 16 percent of the world's electrical power generation. Global uranium fuel consumption is increasing as nuclear power generation continues to expand worldwide. A BLN unit would contribute to a small incremental increase in the depletion of uranium. The World Nuclear Association studies uranium supply and demand issues, and states that there is currently a 50-year supply of relatively low-cost uranium. Higher prices are expected to induce increased uranium exploration and production. A doubling in market price from the 2003 level might increase the supply of this resource tenfold. The introduction of fast breeder reactors and other technologies could further reduce the gap between supply and demand.

Offset Usage of Finite Fossil Fuel Supplies
Fossil fuels represent a finite geological deposit, the use of which constitutes a cumulative irreversible commitment of a natural energy resource. The construction and operation of a BLN unit helps offset the cumulative depletion of this limited resource.

Use of Materials, Energy, and Water
Construction and operation of a BLN unit result in the long-term, irreversible use of materials and energy for the construction and operation of the reactors. However, in the short-term, the reactors provide far more energy than is consumed in their construction. A small amount of water is consumed in the construction of a BLN unit. A relatively modest quantity of cooling water is also consumed as loss to the atmosphere through evaporation and drift.

5.3. Irreversible and Irretrievable Commitments of Resources

This section describes anticipated Irreversible and Irretrievable (I&I) commitments of environmental resources that would occur in either the construction and operation of an AP1000 advanced passive reactor, or the completion and operation of a partially completed B&W reactor at the BLN site. The I&I commitments are summarized in Table 5-3 below.

For the purposes of this analysis, the term "irreversible" applies to the commitment of environmental resources (e.g., permanent use of land) that cannot by practical means be reversed to restore the environmental resources to their former state. In contrast, the term "irretrievable" applies to the commitment of material resources (e.g., irradiated steel,

petroleum) that, once used, cannot by practical means be recycled or restored for other uses.

Table 5-3. Summary of Irreversible and Irretrievable Commitment of Environmental Resources

Environmental and Material Resource Issues	Irreversible	Irretrievable
Socioeconomic Changes	The project results in both short-term and long-term changes in the population and nature and character of the local community, and the local socioeconomic structure. Some impacts on infrastructure and services are temporary, while other changes represent a permanent and irreversible change in socioeconomic infrastructure.	None
Disposal of Hazardous and Radioactively Contaminated Waste	The generation of radioactive, hazardous, and nonhazardous waste that needs to be disposed. Land committed to the disposal of radioactive and nonradioactive wastes is an irreversible impact because it is committed to that use, and is largely unavailable for other purposes.	None
Commitment of Underground Geological Resources for Disposal of Radioactive Spent Fuel	High-level waste and spent nuclear fuel is isolated from the biosphere for thousands or tens of thousands of years in a deep underground geological repository. This long-term commitment makes the surrounding geological resources unusable for thousands or tens of thousands of years.	None
Destruction of Geological Resources During Uranium Mining and Fuel Cycle	None	Uranium mining can result in contamination and destruction of geological resources, and pollution of lakes, streams, underground aquifers, and the soil.
Contaminated and Irradiated Materials	None	Some of the materials used in the construction of a BLN unit are contaminated or irradiated over the life of the plant. Much of this material is not reused or recycled, and must be isolated from the biosphere for hundreds or thousands of years.
Land Use	None	The range of available land uses for the BLN site and existing transmission line ROW are now restricted for the life of the project and transmission lines, resulting in irretrievable lost production or use of renewable resources such as timber, agricultural land, or wildlife habitat during the period the land is used.

Environmental and Material Resource Issues	Irreversible	Irretrievable
Water Consumption	None	Relatively small amounts of potable water are used during construction and operation of a BLN unit. A small fraction of the cooling water taken from Guntersville Reservoir is lost through evaporation. The impact to surface water resources is relatively small, but represents a natural resource that is no longer readily available for use.
Consumption of Energy	None	Nonrenewable energy in the form of fuels (gas, oil, and diesel) and electricity is consumed in construction and to a lesser extent, operation of the BLN.
Consumption of Uranium Fuel	None	A BLN reactor would contribute a relatively small increase in the depletion of uranium that is used to fuel the reactors.

5.3.1. Irreversible Environmental Commitments

Irreversible environmental commitments resulting from the BLN project would relate primarily to those of the UFC: (1) land disposal of equipment and materials contaminated by hazardous and low-level radioactive waste and (2) UFC effects that include commitment of underground geological resources for disposal of high-level radioactive waste and spent fuel, and destruction of geological resources during uranium mining. Implementation of either Action Alternative would also result in both short-term and long-term minor changes in the population, the nature, and character of the local community, and the local socioeconomic infrastructure. Once the unit ceases operations, and the nuclear plant is decontaminated and decommissioned in accordance with NRC requirements, the land that supports the facility may be returned to other industrial or nonindustrial uses. However, the land may continue to be committed to use for other future electrical projects or other purposes.

Uranium Fuel Cycle

The UFC is defined as the total of those options and processes associated with the provision, utilization, and ultimate disposition of fuel for nuclear power reactors. Environmental effects are contributed from uranium mining and milling, the production of uranium hexafluoride, isotopic enrichment, fuel fabrication, use of the fuel, possible future reprocessing of irradiated fuel, transportation of radioactive materials, disposal of used (spent) fuel and management of low-level and high-level wastes.

The BLN unit would generate radioactive, hazardous, and nonhazardous wastes that require disposal. This waste is disposed of in permitted hazardous, mixed, or radioactive landfills or disposal facilities. Land committed to the disposal of radioactive and hazardous wastes represents an irreversible impact because it is committed to that use, and can be used for few other purposes.

Table 5.7-2 in the COLA ER (TVA 2008a) presents environmental data on the UFC. The UFC effects noted in Table 5.7-2 as permanent or comprising emissions for fuel production or storage of spent fuel would be considered irreversible. That ER analysis, which is herein incorporated by reference, described the UFC environmental effects from both a single 1,000-MW nuclear power reactor and two 1,150-MWe units operating at the BLN site. As described in the ER, the approach taken by NRC in estimating effects was intended to ensure that the actual environmental effects were less than the quantities shown for the 1,000 MWe reference plant and to envelope the widest range of operating conditions for light water reactors. That analysis concluded all resource impacts were small (i.e., not detectable or are so minor that they neither destabilize nor noticeably alter any important attribute of the resource). The effects from either of the current Action Alternatives for completing or constructing and operating a single 1,100 MWe unit at the BLN site are bounded by that analysis. As such, impacts would be even less than the two-unit analysis, which concluded only small effects.

5.3.2. Irretrievable Environmental Commitments

Irretrievable environmental commitments resulting from a BLN unit include the following:

- Construction and irradiated materials
- Water consumption
- Consumption of energy
- Consumption of uranium fuel
- Land Use
- Destruction of geological resources during uranium mining and fuel cycle

Construction and Irradiated Materials

Common irretrievable commitments of materials used either for completion of a partially completed B&W reactor (BLN Unit 1 or Unit 2) or construction of an AP1000 reactor include concrete, rebar, structural steel, power cable, small bore piping and large bore piping. A portion of these materials used in the construction of either type of reactor become contaminated or irradiated over the life of BLN operation. Much of this material cannot be reused or recycled, and must be isolated from the biosphere for hundreds or thousands of years. However, because some of this material may be reused (if uncontaminated) or decontaminated for future use, the recycled portion does not constitute an irretrievable commitment of resources. The estimated quantities of materials needed to construct an AP1000 reactor at BLN are concrete (77, 200 cu. yds.), rebar (10,000 T.), structural steel (6,400 T.), power cable(810,000 linear ft.), small bore piping (230,000 linear ft.) and large bore piping (68,000 linear ft.). Because the B&W units are partially complete, proportionally smaller amounts of materials would be needed to complete one of them compared to an AP1000 unit. Additionally, smaller amounts of materials would be required to complete Unit 1 than to complete Unit 2.

While the amount of construction materials is large, use of such quantities in large-scale construction projects such as nuclear reactors, hydroelectric and coal-fired plants, and many large industrial facilities (e.g., refineries and manufacturing plants) represents a relatively small incremental increase in the overall use of such materials. Even if this material is eventually disposed of, use of construction materials in such quantities has a small impact with respect to the national or global consumption of these materials. An additional irretrievable commitment of resources includes materials used during normal plant operations, some of which are recovered or recycled.

Irreversible commitments of resources generally occur through the use of nonrenewable resources that have few or no alternative uses at the termination of the proposed action. Transmission line reconductoring and upgrades also would require the irretrievable commitment of fossil fuels (diesel and gasoline), oils, lubricants, and other consumables used by construction equipment and by workers commuting to the site. Other materials used for construction of the proposed facilities would be committed for the life of the facilities. Some of these materials, such as ceramic insulators and concrete foundations, may be irretrievably committed, while the metals used in conductors, supporting structures, and other equipment could be and would likely be recycled. The useful life of the transmission structures is expected to be at least 60 years.

Water Consumption
Relatively small amounts of potable water are used during construction and operation of a BLN unit. Some of the cooling water taken from Guntersville Reservoir is lost through the cooling towers by way of drift and evaporation. The impact to surface water resources is relatively small, but represents a natural resource that may no longer be available for use. However, as part of the natural hydrologic cycle, this water is eventually recycled through the ecosystem.

Consumption of Energy Used in Constructing the Reactors
Nonrenewable energy in the form of fuels (gas, oil, and diesel) and electricity are consumed in construction and, to a much smaller extent, in the operation of a BLN unit. Beyond ancillary (e.g., vehicles, equipment) usage, nuclear reactors do not consume fossil fuels such as petroleum or coal.

The total amount of energy consumed during construction or operation of a BLN unit is very small in comparison to the total amount consumed within the United States. On net balance, the reactor produces far more energy (as measured in British Thermal Units) than is consumed in its construction and operation. For this reason, one of the key considerations related to the I&I requirement is that operation of a BLN unit helps conserve or helps avoid the consumption of finite fossil fuel supplies.

Uranium Fuel Cycle and Depletion of Uranium
The principal use of uranium is as a fuel for nuclear power plants. With approximately 440 nuclear reactors operating worldwide, these plants currently produce approximately 16 percent of the world's electrical power generation. Global uranium fuel consumption is increasing, as nuclear power generation continues to expand worldwide. A BLN reactor would contribute a relatively small increase in the depletion of uranium. Sources of uranium include primary mine production as well as secondary sources. Nuclear reactor uranium consumption now exceeds the supplies produced through mining. The resulting shortfall has been covered by several secondary sources including excess inventories held by producers, utilities, other fuel cycle participants, reprocessed reactor fuel, and uranium derived from dismantling Russian nuclear weapons.

The limited availability of uranium fuel may affect the future expansion of nuclear power. DOE uranium estimates indicate that sufficient resources exist in the United States to fuel all operating reactors and reactors being planned for the next 10 years at a U3O8 cost (1996 dollars) of $30.00/lb or less. The resource categories designated as reserves and estimated additional resources can supply these quantities of uranium.

The World Nuclear Association studies supply and demand for uranium and states that the world's present measured resources of uranium, in the cost category somewhat above present spot prices and used only in conventional reactors, at current rates of consumption, are sufficient to last for some 70 years. Very little uranium exploration occurred between 1985 and 2005, so the significant increase in exploration that is currently being witnessed might double the known economic reserves. On the basis of analogies with other metal minerals, a doubling in price from present levels could be expected to create about a tenfold increase in measured resources over time. The introduction of fast breeder reactors and other technologies may also reduce the supply-demand gap. The addition of a BLN unit increases consumption of uranium in the United States by approximately 2 percent and increases worldwide consumption of uranium by about 0.5 percent. Thus, the addition of BLN by itself does not create a significant impact on uranium resources.

5.4. Energy Resources and Conservation Potential

The total amount of energy consumed during construction or operation of the BLN is very small in comparison to the total amount consumed within the United States. On net balance, the reactor would produce far more energy (as measured in British Thermal Units) than would be consumed in its construction and operation. For this reason, one of the key considerations related to the I&I requirement is that operation of a BLN unit helps conserve or helps avoid the consumption of finite fossil fuels supplies.

Nonrenewable energy in the form of fuels (gas, oil, and diesel) and electricity would, however, be consumed in construction and, to a much smaller extent, in the operation of any of the Action Alternatives for the BLN site. An AP1000 reactor would require more off-site fabrication of components, transport of components, and on-site construction, and therefore more energy to build, than completing either the partially built BLN Unit 1 or Unit 2. Because the existing Unit 1 is more complete than Unit 2, of the two units, Unit 1 would require less energy to build.

Beyond ancillary (e.g., vehicles, equipment) usage and that required to support the UFC, nuclear reactors do not consume fossil fuels such as petroleum or coal during operation. Processing of nuclear fuel is, however, an energy-intensive activity. Existing uranium enrichment facilities are large and each facility services several nuclear generating plants. For comparative purposes, the energy required to process or enrich uranium using gaseous diffusion sufficient to fuel a single 1000-MW pressurized boiling water reactor nuclear plant (slightly smaller than the Action Alternatives for a single BLN unit) would be approximately that of the output from a 50-MW fossil-fueled (coal-fired) facility operating at 75 percent capacity factor. Newer technologies (e.g., centrifuge or atomic vapor laser isotope separation) currently, or becoming, commercially available for enrichment, utilize only 4-15 percent as much power as this gaseous diffusion example. As it is anticipated that these new, less energy intensive technologies will eventually become the norm for production of nuclear fuel, the processing portion of the UFC would likely use even less energy and become even more "carbon-friendly" in the future. The DOE has also released the Draft Programmatic EIS for the Global Nuclear Energy Partnership (GNEP) (DOE 2008) with the identified preferred alternative of implementing a "closed" cycle for nuclear fuel management in the United States (i.e., select among nuclear fuel reprocessing alternatives). If selected and implemented by DOE, this approach for GNEP could both expand the availability of nuclear fuel and potentially stabilize or reduce the worldwide GHG releases associated with mining and milling of uranium as a fuel source.

CHAPTER 6

6.0 LIST OF PREPARERS

6.1. NEPA Project Management

Amy Burke Henry
Position: NEPA Specialist
Education: M.S., Zoology and Wildlife; B.S., Biology
Experience: 12 years in Biological Surveys, Natural Resources Management Planning, and Environmental Reviews
Involvement: NEPA Compliance and Document Preparation

Ruth M. Horton
Position: Senior NEPA Specialist
Education: B.A., History
Experience: 30 years in Public Policy and Planning, including 12 years in Environmental Impact Assessment
Involvement: NEPA Project Manager

Anita E. Masters
Position: Senior NEPA Specialist
Education: M.S., Biology/Fisheries; B.S., Wildlife Management
Experience: 22 years in Fisheries Biology/Aquatic Community and Watershed Assessments, Protected Aquatic Species and Habitat Monitoring, and NEPA Compliance
Involvement: NEPA Compliance and Document Preparation

Loretta McNamee
Position: Contract Biologist
Education: B.S., Biology
Experience: 1 year NEPA Compliance
Involvement: Document Preparation and Comment Management

Charles P. Nicholson
Position: NEPA Program Manager
Education: Ph.D., Ecology and Evolutionary Biology; M.S., Wildlife Management; B.S., Wildlife and Fisheries Science
Experience: 31 years in Zoology, Endangered Species Studies, and NEPA Compliance
Involvement: NEPA Compliance and Document Preparation

Bruce L. Yeager
Position: NEPA Program Manager
Education: M.S., Zoology (Ecology); B.S., Zoology (Aquatic Ecology)
Experience: 33 years in Environmental Compliance for Water, Air, and Land Use Planning; Environmental Business Services
Involvement: NEPA Compliance, Climate Change, Other Effects

6.2. Other Contributors

Anne M. Aiken
Position: Senior Environmental Engineer
Education: M.S., Environmental Engineering; B.A., Environmental Studies
Experience: 19 years in Water Quality and Environmental Engineering Services
Involvement: Surface Water and Industrial Wastewater

John G. Albright
Position: Civil Engineer
Education: B.S., Civil Engineering
Experience: 29 years in Transmission Line Design/Construction, Fossil Waste Planning and Disposal, Fossil Site and Environmental Design, Fossil and Hydro Environmental Permitting, Fossil Railroad Inspection and Upgrade, Gas Transmission Pipeline Design, NEPA Environmental Reviews
Involvement: Transportation

Nolan D. Baier
Position: Senior Specialist
Education: B.S., Civil Engineering; MBA
Experience: 10 years Energy Industry Analytics
Involvement: Need for Power Analysis and Preparer

Jessica M. Baker
Position: Resource Planning Specialist
Education: M.B.A. and B.B.A., Finance
Experience: 8 years in Risk Management, Price Forecasting and Long-Term Planning
Involvement: Need for Power

Hugh S. Barger
Position: Environmental Engineering Specialist
Education: B.S., Engineering
Experience: 36 years in Transmission Line Planning and Preparation of Environmental Review Documents
Involvement: Project Coordination, Purpose and Need, Description of Alternatives

John (Bo) T. Baxter
Position: Specialist, Aquatic Endangered Species Act Permitting and Compliance
Education: M.S. and B.S., Zoology
Experience: 19 years in Protected Aquatic Species Monitoring, Habitat Assessment, and Recovery; 11 years in Environmental Review
Involvement: Aquatic Ecology/Threatened and Endangered Species

Francine Beck

Position:	Technical Specialist, ENERCON
Education:	Ph.D. and M.A., Geography; B.S. Land Use
Experience:	3 years in BLN COLA preparation; 9 years in Program Development/Project Management; 6 years in Technical Editing
Involvement:	Document Preparation; Contributing Author for AP1000 Information, Socioeconomics, Spent Fuel, and Chemical Additives

Ralph Berger

Position:	Technical Specialist, ENERCON
Education:	P.E., Ph.D., M.S. and B.S., Mechanical Engineering
Experience:	28 years in Nuclear Utility Industry
Involvement:	Cooling Tower Plume Impacts, Control Room Habitability, and Severe Accident Consequences

Susan H. Biddle

Position:	Senior Manager, Long-Term Resource Planning
Education:	M.S., Environmental Engineering, B.S., Civil Engineering
Experience:	14 years in Reservoir Operations and Power Supply Planning
Involvement:	Need for Power

Gary S. Brinkworth, P.E.

Position:	Senior Manager, New Generation and Portfolio Optimization System Planning (Strategy and Business Planning)
Education:	M.S. and B.S., Electrical Engineering
Experience:	28 years Electric Utility Experience (System Planning, DSM Analysis, Forecasting, and Rate Analysis)
Involvement:	Need for Power, Alternative Energy Sources

W. Nannette Brodie, CPG

Position:	Senior Environmental Scientist
Education:	B.S., Environmental Science; B.S., Geology
Experience:	14 years in Environmental Analyses, Surface Water Quality, and Groundwater Hydrology Evaluations
Involvement:	Groundwater/Surface Water

Michael G. Browman, P.E.

Position:	Environmental Engineer Specialist
Education:	Ph.D., M.S., and B.S., Soil Science; M.S., Environmental Engineering
Experience:	27 years in Environmental Control Technology Development and Environmental Impact Analysis
Involvement:	Groundwater and Surface Water Resources; Wastewater; Solid and Hazardous Waste

Jennifer M. Call
Position: Meteorologist
Education: M.S. and B.S., Meteorology/Geosciences
Experience: 7 years in Meteorological Forecasting, Air Quality Monitoring, Data Analysis, and Air Quality Research
Involvement: Air Resources

James S. Chardos
Position: Program Manager, Tritium Production, TVA Nuclear, WBN
Education: B.S., Physics; Executive MBA
Experience: 6 years in U.S. Nuclear Submarine Service; 40 years in Nuclear Plant Project Management
Involvement: Site Manager and Plant Technology

Edward L. Colston
Position: Senior Manager, Market & Program Analysis, Energy Efficiency & Demand Response
Education: B.S., Mechanical Engineering
Experience: 31 years in Design, Demonstration, Implementation, and Evaluation of Energy Efficiency and Demand Response Technologies and Programs, as well as Market Research
Involvement: Energy Conservation

Patricia B. Cox
Position: Botanist, Specialist
Education: Ph.D., Botany (Plant Taxonomy and Anatomy); M.S. and B.S., Biology
Experience: 31 years in Plant Taxonomy at the Academic Level; 6 years in Environmental Assessment and NEPA Compliance
Involvement: Threatened and Endangered Species Compliance, Invasive Plant Species, and Terrestrial Ecology

Elizabeth A. Creel
Position: General Manager, Resource Planning
Education: B.S., Mathematics
Experience: 33 years in System Planning and Bulk Power Trading Areas
Involvement: Need for Power Review

Thomas Cureton Jr.
Position: Civil Engineer
Education: M.S., Civil Engineering
Experience: 34 years in Power Plant Design and Inspection and Transmission Line and Substation Siting
Involvement: Project and Siting Alternatives

Adam J. Dattilo

Position:	Botanist
Education:	M.S., Forestry; B.S., Natural Resource Conservation Management
Experience:	8 years in Ecological Restoration and Plant Ecology; 5 years in Botany
Involvement:	Threatened and Endangered Plant Species, Botany, Plant Ecology, and Invasive Plant Species

Eric J. Davis, C.F.A.

Position:	Program Manager, Investment Trusts
Education:	M.B.A., General Management; B.S., Economics and Finance; A.S., Business Administration
Experience:	10 years in Treasury-Finance
Involvement:	Decommissioning

David C. DeLoach

Position:	Electrical Engineer
Education:	B.S., Electrical Engineering
Experience:	9 years in Bulk Transmission Planning
Involvement:	Transmission and Construction Power Supply

Britta P. Dimick

Position:	Wetlands Biologist
Education:	M.S., Botany-Wetlands Ecology Emphasis; B.A., Biology
Experience:	11 years in Wetlands Assessments, Botanical Surveys, Wetlands Regulations, and/or NEPA Compliance
Involvement:	Wetlands

James H. Eblen

Position:	Contract Economist
Education:	Ph.D., Economics; B.S., Business Administration
Experience:	41 years in Economic Analysis and Research
Involvement:	Socioeconomics and Environmental Justice

David A. Hankins

Position:	Geographic Analyst
Education:	B.S., Fish and Wildlife Management
Experience:	29 years in Geographic Information and Engineering
Involvement:	GIS Maps

Michelle S. Harle

Position:	Contract Archaeologist
Education:	ABD, M.A., B.A. in Anthropology
Experience:	11 years in Archaeology
Involvement:	Cultural Resource Analysis

Heather M. Hart
Position: Contract Natural Areas Biologist
Education: M.S., Environmental and Soil Science; B.S., Plant and Soil Science
Experience: 7 years in Surface Water Quality, Soil and Groundwater Investigations, and Environmental Reviews
Involvement: Managed Areas

Jeffrey W. Head
Position: Nuclear Engineer, ENERCON
Education: B.S., Nuclear Engineering
Experience: 2 Years in Nuclear Power Modifications and Analysis
Involvement: Transportation of Radioactive Materials, Atmospheric Dispersion. Radioactive Waste, Gaseous Doses

Travis Hill Henry
Position: Terrestrial Endangered Species Specialist
Education: M.S., Zoology; B.S., Wildlife Biology
Experience: 20 years in Zoology, Endangered Species, and NEPA Compliance
Involvement: Terrestrial Ecology, Threatened and Endangered Species

John M. Higgins, P.E.
Position: Water Quality Specialist
Education: Ph.D., Environmental Engineering; B.S. and M.S., Civil Engineering
Experience: 36 years in Environmental Engineering and Water Resources Management
Involvement: Surface Water and Wastewater

Paul N. Hopping
Position: Technical Specialist
Education: Ph.D., Civil and Environmental Engineering; M.S. and B.S, Civil Engineering
Experience: 26 years in Hydrothermal and Surface Water Analysis
Involvement: Hydrothermal and Surface Water Analysis

Charles S. Howard
Position: Aquatic Endangered Species Biologist
Education: M.S., Zoology (Aquatic Ecology); B.S., Biology
Experience: 17 years in Aquatic Ecology Research, Consulting, and Impact Assessment Specializing in Freshwater Mussels
Involvement: Aquatic Threatened and Endangered Species (Mollusks)

Nathan D. Jackson
Position: Nuclear Engineer, ENERCON
Education: B.S., Nuclear Engineering
Experience: 1 year in BWR Reactor Engineering, 4 months in Nuclear Power Modifications and Analysis
Involvement: Design Basis Accident Doses, Gaseous Doses

Walter M. Justice II

Position:	BLN Site Engineering Manager
Education:	B.S., Mechanical Engineering
Experience:	27 years in Commercial Nuclear Power, Engineering, and Analysis
Involvement:	B&W Plant Technology

T A Keys

Position:	Manager, Nuclear Fuel Supply
Education:	M.S., Nuclear Engineering; M.S., Engineering Administration; B.S., Physics
Experience:	32 years in Nuclear Fuel-Related Activities
Involvement:	Spent Fuel Storage

Holly G. Le Grand

Position:	Biologist/Zoologist
Education:	M.S., Wildlife; B.S., Biology
Experience:	6 years in Biological Surveys, Natural Resource Management, and Environmental Reviews
Involvement:	Terrestrial Ecology and Threatened and Endangered Species

Eric D. Loyd

Position:	Mechanical Engineer, Design
Education:	B.S., Mechanical Engineering; working toward M.S., Mechanical Engineering
Experience:	4 years in Mechanical Engineering
Involvement:	Performed Hydrothermal Simulations Using CORMIX

Robert A. Marker

Position:	Contract Recreation Planner
Education:	B.S., Outdoor Recreation Resources Management
Experience:	37 years in Recreation Resources Planning and Management
Involvement:	Recreation Resources

Norman M. Meinert, P.E.

Position:	Project Manager, ENERCON
Education:	B.S., Mechanical Engineering
Experience:	15 years Project Management and 10 years Mechanical Design and Analysis
Involvement:	Project oversight and SEIS Review

Roger A. Milstead, P.E.

Position:	Program Manager, Flood Risk
Education:	B.S., Civil Engineering
Experience:	34 years in Floodplain and Environmental Evaluations
Involvement:	Floodplains

Jared Monroe

Position:	Mechanical Engineer, ENERCON
Education:	B.S., Mechanical Engineering
Experience:	3 Years in Health Physics, Meteorology, and Mechanical Engineering
Involvement:	Routine Doses and Meteorology

Todd C. Moore

Position:	Civil Engineering Siting and Environmental
Education:	M.S. and B.S., Civil Engineering
Experience:	7 years in Civil Design, 4 years in Fossil Plant Maintenance; 4 years in Transmission Line Siting
Involvement:	Transmission Lines

Joanne Morris

Position:	Supervisor Mechanical Engineering, ENERCON
Education:	M.S., Mechanical Engineering, B.A., Physics
Experience:	25 years in Nuclear Utility Industry
Involvement:	Design Basis Accident Doses, Gaseous Doses, Liquid Doses, and Control Room Habitability

Marvin Morris

Position:	Supervisor Safety Analysis, ENERCON
Education:	B.S., Mathematics; M.S. Physics
Experience:	30 years in Nuclear Utility Industry
Involvement:	Design Basis Accident Doses, Gaseous Doses, Liquid Doses, Cooling Tower Plume impacts, Transportation, Control Room Habitability, and Severe Accident Consequences

Jeffrey W. Munsey

Position:	Civil Engineer
Education:	M.S. and B.S., Geophysics
Experience:	24 years in Geophysical and Geological Studies and Investigations, including Applications to Environmental Assessments
Involvement:	Seismology

Duane T. Nakahata

Position:	Senior Technical Specialist, ENERCON
Education:	Ph.D., Environmental Engineering; M.S., Nuclear Engineering; B.S., Chemical Engineering
Experience:	25 years in Thermal-Hydraulic, Nuclear and Radiological Analyses
Involvement:	Normal Liquid Doses and Atmospheric Dispersion Factor Analyses

R. Michael Payne

Position:	Chemistry Program Manager, Technical Programs Reliability
Education:	B.S., Chemistry
Experience:	6 years as Chemistry Program Manager; 4 years as Technical Services Analyst; 10 years as Field Technical Representative to the Chemical, Metals, and Paper Industries
Involvement:	Evaluation of Chemical Additives to Raw Water

W. Chett Peebles, RLA; ASLA

Position:	Specialist, Landscape Architect
Education:	Bachelor of Landscape Architecture
Experience:	21 years in Site Planning, Design, and Scenic Resource Management; 4 years in Architectural History and Historic Preservation
Involvement:	Visual Resources and Historic Architectural Resources

Erin E. Pritchard

Position:	Archaeologist
Education:	M.A., Anthropology
Experience:	10 years in Archaeology and Cultural Resource Management
Involvement:	Cultural Resources

William L. Raines

Position:	Technical Specialist
Education:	Ph.D., Chemistry (Nuclear/Radiochemistry)
Experience:	30 years in Radiological Environmental Monitoring and Radioanalytical Analysis
Involvement:	Radiological Environmental Monitoring Program

Jerry I. Riggs

Position:	GIS Specialist, ENERCON
Education:	B.S., Biochemistry; M.A., Geography
Experience:	5 years Nuclear Utility Industry
Involvement:	GIS, Socioeconomic Analysis, and Environmental Justice

Helen Robertson

Position:	Technical Specialist, ENERCON
Education:	Ph.D., Geography
Experience:	8 years Geographic Research and Teaching; 7 years Technical Writing, Editing, and Graphic Design
Involvement:	Socioeconomic Analysis

Rick Rogers

Position:	Mechanical Engineer, ENERCON
Education:	B.S., Mechanical Engineering
Experience:	2 years in Dose Analysis
Involvement:	Severe Accident and Design Basis Accident Analyses

Jeffrey W. Simmons

Position:	Aquatic Zoologist
Education:	M.S., Biology; B.S., Wildlife and Fisheries Science
Experience:	8 years in Aquatic Species (crayfish, fish, mussels, snails)
Involvement:	Aquatic Biology

Thomas E. Spink

Position:	Licensing Project Manager, Units 3 and 4
Education:	M.S. and B.S., Nuclear Engineering
Experience:	36 years in Nuclear Licensing, Engineering, Quality Assurance, Materials and Project Management, and Power System Planning
Involvement:	NGDC Project Manager

Kim Stapleton

Position:	Technical Specialist
Education:	M.S and B.S., Geography
Experience:	6 years in GIS and Socioeconomics
Involvement:	Socioeconomic Analysis

Andrea L. Sterdis

Position:	Senior Manager, NGD Project Development and Environmental
Education:	M.S., Engineering and Public Policy; B.S., Electrical Engineering
Experience:	29 years in Nuclear Plant Safety Analysis, Licensing, Regulatory, and Engineering; 8 years in Management
Involvement:	Bellefonte Project Coordination and Management Review

Kevin M. Stewart

Position:	Water Resources Engineer
Education:	M.S. and B.S., Civil and Environmental Engineering
Experience:	7 years in Hydrothermal and Surface Water Analysis
Involvement:	Hydrothermal and Surface Water Analysis

Jan K. Thomas

Position:	Contract Natural Areas Specialist
Education:	M.S., Human Ecology
Experience:	11 years in Health and Safety Research, Environmental Restoration, Technical Writing; 6 years in Natural Area Reviews
Involvement:	Natural Areas

Rachel E. Turney-Work
Position: Senior Technical Specialist
Education: M.A. and B.A., Geography
Experience: 8 years in Geography, GIS, Socioeconomic and Land Use Analyses
Involvement: Socioeconomic Analysis

Christopher D. Ungate
Position: Senior Principal Management Consultant, S&L
Education: B.S., M.S., Civil Engineering; MBA
Experience: 35 years Engineering, Planning, and Consulting
Involvement: Need for Power, Energy Alternatives

Kenneth G. Wastrack
Position: Meteorologist
Education: M.B.A.; B.S., Meteorology
Experience: 34 years in Meteorology
Involvement: Tornado Risk and General Meteorology

Cassandra L. Wylie
Position: Atmospheric Analyst
Education: M.S., Forestry and Statistics; B.S., Forestry
Experience: 21 years in Atmospheric Modeling and Effects of Air Pollution on Forests; 9 years in Noise Analysis
Involvement: Noise Impacts

W. Richard Yarnell
Position: Archaeologist
Education: B.S., Environmental Health
Experience: 38 years, Cultural Resource Management
Involvement: Cultural Resources

CHAPTER 7

7.0 DISTRIBUTION OF FSEIS

7.1. List of Agencies, Organizations, and Persons to Whom Copies of the FSEIS Were Sent and to Whom an E-Link was Provided

Following is a list of agencies, organization, officials, libraries and individuals to whom either published copies (bound or compact disc [CD]) of the FSEIS were provided, or Web links to an active TVA web site from which the document can be accessed were sent. Those names with an asterix (*) received copies of both the FSEIS and DSEIS.

Federal Agencies Receiving the FSEIS (Hard Copy or CD)

Natural Resources Conservation Service, Alabama State Conservationist*
Natural Resources Conservation Service, Georgia State Conservationist*
U.S. Army Corps of Engineers, Mobile District*
U.S. Army Corps of Engineers, Nashville District*
U.S. Army Corps of Engineers, Savannah District*
U.S. Department of the Interior*
U.S. Environmental Protection Agency*
U.S. Fish and Wildlife Service, Cookeville Field Office*
U.S. Fish and Wildlife Service, Daphne Field Office*
U.S. Fish and Wildlife Service, Refuge Office*
U.S. Fish and Wildlife Service, Southeast Region Office*
U.S. Forest Service, Chattahoochee-Oconee National Forests*
U.S. Forest Service, Region 8*
U.S. Nuclear Regulatory Commission*
National Park Service, Chickamauga-Chattanooga National Military Park National Park Service, Southeast Region Office*

State Agencies Receiving the FSEIS (Hard Copy or CD)

Alabama
Alabama Department of Conservation and Natural Resources*
Alabama Department of Environmental Management*
Alabama Department of Environmental Economic and Community Affairs*
Alabama Historical Commission*
North-Central Alabama Regional Council of Governments*
Top of Alabama Regional Council of Governments*

Georgia
Economic Development Administration*
Georgia Department of Natural Resources, Environmental Protection Division*
Georgia Department of Natural Resources, Historic Preservation Division*
Georgia Department of Natural Resources, Wildlife Resources Division*
Georgia State Clearing House*

Tennessee
Southeast Tennessee Development District*
South Central Tennessee Development District*
Tennessee Department of Economic and Community Development*
Tennessee Department of Environment and Conservation, Division of Air Pollution Control*

Tennessee Department of Environment and Conservation, Division of Ground Water Protection*
Tennessee Department of Environment and Conservation, Division of Water Supply*
Tennessee Department of Environment and Conservation, Resource Management Division*
Tennessee Historical Commission*
Tennessee Wildlife Resources Agency*

Federally Recognized Tribes (E-mail notification of availability)

Eastern Band of Cherokee Indians*
United Keetoowah Band of Cherokee Indians in Oklahoma*
Cherokee Nation*
Chickasaw Nation*
Muscogee (Creek) Nation of Oklahoma*
Thlopthlocco Tribal Town*
Kialegee Tribal Town*
Alabama-Quassarte Tribal Town*
Alabama-Coushatta Tribe of Texas*
Eastern Shawnee Tribe of Oklahoma*
Shawnee Tribe*
Absentee Shawnee Tribe of Oklahoma*
Seminole Tribe of Florida*
Jena Band of Choctaw Indians*
Poarch Band of Creek Indians*

Receiving Notification and FSEIS (Hard copy or CD)

David Bednar Jr.
Fort Smith, Arkansas

James E. Blackburn
Hollywood, Alabama

Faye and Wayne Bynum
Scottsboro, Alabama

Henry Cannon
Scottsboro, Alabama

Ken Ferrell
Scottsboro, Alabama

Professor Paul Friesema
Evanston, Illinois

Louise Gorenflo
Sierra Club
Tennessee Chapter

The Honorable Parker Griffith
Alabama State Representative
Washington, DC

James Guthrie
Scottsboro, Alabama

Charles Jones
Knoxville, Tennessee

Donald Kennamer
Scottsboro, Alabama

Larry E. Kirkland
Chamber of Commerce
Scottsboro, Alabama

Harley Martin
Aliceville, Alabama

B.J. Mitchell
Guntersville, Alabama

Garry Morgan
Scottsboro, Alabama

Everett Reed
Scottsboro, Alabama

Michelle Robertson
Scottsboro, Alabama

Goodrich A. Rogers
Jackson County EDA
Scottsboro, Alabama

Don Safer
Tennessee Environmental Council
Nashville, Tennessee

James Sandlin
Scottsboro, Alabama

Fred L Schaum
Alabama Development Office
Montgomery, Alabama

Lyle Sosrbee
Scottsboro, Alabama

William Stiles
Scottsboro, Alabama

Louise A. Zeller
Blue Ridge Environmental Defense League
Glendale Spring, North Carolina

John W. Woodall
Scottsboro, Alabama

George W. York
Dutton, Alabama

Receiving Notification of Availability

Gary Baran
Scottsboro, Alabama

Sara Barczak
Southern Alliance for Clean Energy
Savannah, Georgia

Mayor Virginia Bergman
City of Hollywood, Alabama

Jimmy D. Blevins
Scottsboro, Alabama

Ken Bonner
Scottsboro, Alabama

Tommy Bryant
Stevenson, Alabama

Laura Bundy
Fort Payne, Alabama

Jessie W. Craig, I.B.E.W
Henagar, Alabama

Wayne Cummins
Sand Mountain Concerned Citizens
Ider, Alabama

Frank DePinto
Chattanooga, Tennessee

Phil Dutton
Hollywood City Council
Hollywood, Alabama

Daryl Eustace
Scottsboro, Alabama

John Gay
Scottsboro, Alabama

Stewart Horn
New Hope, Alabama

Norman C. Johnson
Scottsboro, Alabama

Therrel Jones
Scottsboro, Alabama

Frances Lamberts
Jonesborough, Tennessee

Jack Livingston
Scottsboro, Alabama

Ross McCluney
Chattanooga, Tennessee

Robert McMaster
Marietta, Georgia

Mike Paris
Hollywood, Alabama

The Honorable Melton Potter
Mayor of Scottsboro
Scottsboro, Alabama

Tereia Sandifer
Dutton, Alabama

Shelia Sheppard
Jackson County EDA
Scottsboro, Alabama

Jimmy R. Spires
Scottsboro, Alabama

Gary Spradlin
Scottsboro, Alabama

David Thornell
Dutton, Alabama

David Trenkle
Huntsville, Alabama

Shonda Wall
Scottsboro, Alabama

Richard Warr
Hollywood City Council
Hollywood, Alabama

Coleman Wilkinson
Scottsboro, Alabama

Tony D. Williams
Meridionville, Alabama

Libraries

Scottsboro Public Library
Scottsboro, Alabama

Stevenson Public Library
Stevenson, Alabama

Lena Cagle Public Library
Bridgeport, Alabama

Huntsville-Madison County Public Library
Huntsville, Alabama

Decatur Public Library
Decatur, Alabama

Rainsville Public Library
Rainsville, Alabama

Cecil B. Word Learning Center
Northeast Alabama Community College
Rainsville, Alabama

Beene-Pearson Public Library
South Pittsburg, Tennessee

Chattanooga-Hamilton County Public Library
Chattanooga, Tennessee

7.2. DSEIS Press Release

TVA

NEWS RELEASE

TVA Seeks Comments on Draft Bellefonte Environmental Statement

SCOTTSBORO, Ala. – TVA will hold an open house Tuesday, Dec. 8, in Scottsboro to receive public comments on the environmental review of alternatives for completing and operating a nuclear reactor at the Bellefonte Nuclear Plant site near Hollywood, Ala.

TVA is asking for public comments on three proposed alternatives outlined in a draft supplemental environmental impact statement -- completing one of the existing units, building a new reactor or taking no action.

The environmental review also addresses transmission improvements required to support electric generation at the Bellefonte site. All transmission work would be on existing rights of way.

In 2007, TVA submitted applications to the Nuclear Regulatory Commission for construction and operation of two advanced technology Westinghouse AP1000 reactors at Bellefonte and is currently studying the feasibility of finishing partially constructed units at the site.

The open house will be held from 4 to 8 p.m. at the Goose Pond Civic Center, 876 Ed Hembree Drive in Scottsboro. During the open house, TVA staff will be available to discuss the alternatives and potential environmental impacts of completing and operating a nuclear unit at Bellefonte.

Under provisions of the National Environmental Policy Act, TVA prepared the draft supplemental environmental impact statement using reports previously prepared for the construction of the units, as well as new information.

Along with the detailed engineering and feasibility study, the environmental review will help TVA decide whether to complete one of the existing unfinished units at the plant or construct a new nuclear unit.

The draft supplemental environmental impact statement is available for review and comment online at www.tva.gov/environment/reports/blnp/index.htm. Comments may also be mailed to Ruth Horton, 400 Summit Hill Drive (WT-11D), Knoxville, TN 37902 or faxed to (865) 632-3451. All written comments must be received by Dec.28.

TVA is the nation's largest public power provider and is completely self-financing. TVA provides power to large industries and 158 power distributors that serve

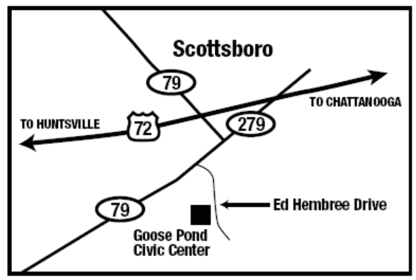
7.3. Information Open House Paid Advertisement

Notice of Public Meeting

TVA

TVA Open House on Bellefonte Nuclear Site Environmental Statement

TVA will hold an open house in Scottsboro, Alabama, to discuss the draft supplemental environmental impact statement (SEIS) for the possible completion of an existing nuclear unit or construction of a new reactor at Bellefonte Nuclear Plant site.



The public is invited to stop by anytime during the open house to provide comments or ask questions about the draft SEIS. Copies of the document will be available at the open house and are also available on the TVA website at the address below.

Three proposed alternatives are outlined in the draft document: completing one of the existing units, building a new reactor, or taking no action. The environmental review also addresses transmission system improvements that would be needed on existing rights of way to support power generation at Bellefonte.

Comments about the draft SEIS can be submitted during the open house or anytime before December 28, 2009. These comments will be considered and addressed in the final SEIS. Any comments received, including names and addresses, will become part of the administrative record and will be available for public inspection.

Along with the detailed engineering and feasibility study currently in progress, this environmental review will help TVA decide if one of the alternatives should be selected to meet the growing base-load power demand.

WHAT: **Public Open House**
DATE: **Tuesday, December 8, 2009**
TIME: **4 p.m. to 8 p.m. CST**
LOCATION: **Goose Pond Civic Center**
876 Ed Hembree Drive, Scottsboro, Alabama

The draft SEIS was made available for public review on November 4, 2009. It can be viewed and comments submitted at www.tva.gov/environment/reports/blnp. Comments may also be submitted by mail, fax, or e-mail to:

Ruth Horton, Senior NEPA Specialist
400 Summit Hill Dr., WT-11D, Knoxville, TN 37902
865-632-3719 Fax: 865-632-3451
blnp@tva.com

If you have special needs, please call Ruth Horton at least five days prior to the open house. You may also e-mail or call her to request a printed copy of the draft SEIS.

Newpapers That Published the Paid Advertisement

Wednesday, December 2, 2009
Chattanooga Times Free Press
Guntersville Advertiser
Huntsville Times

Thursday, December 3, 2009
Rainesville Weekly Post
Scottsboro Daily Sentinel

Friday, December 4, 2009
Chattanooga Hamilton County Herald

Monday, December 7, 2009
Stevenson North Jackson Progress

7.4. Open House Handout

Information Open House
Final Supplemental Environmental Impact Statement
Single Nuclear Unit at the Bellefonte Site
Goose Pond Civic Center, Scottsboro, AL
December 8, 2009

Meeting Purpose

Thank you for attending our information open house. The purpose of this meeting is to provide the opportunity for you to ask questions about the draft supplemental environmental impact statement (SEIS) and to make comments on TVA's analysis of the potential for environmental effects from completing or constructing, and operating a single nuclear unit at the Bellefonte Nuclear Plant (BLN) site in Jackson County, Alabama.

The following information stations are available to visit in the meeting room:

- NEPA Process
- Transmission Upgrades
- Socioeconomics /Air Quality & Meteorology
- Nuclear Plant Operation/Nuclear Plant Safety and Security
- Project Description
- Need for Power
- Water Quality
- Aquatic and Terrestrial Ecology

Under provisions of the National Environmental Policy Act (NEPA), TVA prepared the draft SEIS to supplement and update environmental documents previously prepared for the construction and operation of a nuclear power plant at the Bellefonte site. The TVA Board will use this information along with a detailed engineering and feasibility study currently underway as well as input provided by reviewing agencies and the public to make an informed decision about whether or not to complete an existing nuclear unit or to construct a new reactor. A decision is anticipated in spring 2010.

How to Comment

TVA encourages you to submit comments on the draft SEIS. Please note that to be included in the official project record, comments must be received by TVA during the 45-day comment period that began on November 13, 2009. ***Comments must be received no later than December 28, 2009.***

At today's meeting, comments can be made either orally to the court reporter, in writing on the attached comment form, or on TVA's Web site using one of our laptop computers. Comments can also be submitted at any time during the comment period through TVA's Web site, www.tva.gov/blnp by e-mail at blnp@tva.com, by fax to 865-632-3451, or by U.S. mail to the address below. All comments received, including names and addresses, will become part on the administrative record and will be available for public inspection.

Ruth Horton
TVA NEPA Compliance
400 West Summit Hill Drive (WT-11D)
Knoxville, TN 37902

Using any of these methods, you may also request to be notified of the publication of the Final SEIS on the TVA Web site or to receive a copy of it. The Final SEIS is expected to be available in February 2010.

Proposed Action

TVA proposes to complete or construct, and operate a single approximately 1,100 to 1,200 megawatt (MW) nuclear generating unit at the BLN site. TVA may choose to complete and operate one of the partially constructed Babcock and Wilcox (B&W) pressurized light water reactors, or to construct and operate a new Westinghouse AP1000 advanced pressurized light water reactor (AP1000), or to take no action. Under either of the Action Alternatives, construction activities would incorporate existing facilities and structures and use previously disturbed ground within the BLN site where possible. The existing transmission system would need to be upgraded to prevent overloading while transmitting electricity generated by a new reactor at the BLN site. No new electric transmission lines are proposed.

TVA is making this proposal to meet the need for additional baseload power capacity on the TVA system, maximize the use of existing assets and licensing processes, avoid larger capital expenses by using those existing assets and avoid the environmental impacts of siting and construction new power generating facilities elsewhere. The considerable work that has been accomplished toward licensing the B&W and AP1000 technologies at the BLN site will reduce the time and cost of bringing a single unit on line.

Background

The BLN site is located on a 1,600-acre peninsula on the western shore of Guntersville Reservoir at Tennessee River mile 392, near Hollywood, Alabama.

Construction on the B&W Units 1&2 began in 1974 and continued until 1988 when the Nuclear Regulatory Commission (NRC) granted BLN deferred status. At that time, Unit 1 was approximately 90 percent complete and Unit 2 was approximately 58 percent complete.

BLN Units 1&2 were maintained in deferred status until the project was cancelled and TVA's construction permits were relinquished in 2006. In August 2008, in response to changes in power generation economics, TVA requested reinstatement of the Unit 1&2 construction permits. NRC reinstated the construction permits in March 2009.

Additionally, in 2006 TVA joined NuStart Energy Development, LLC, a consortium consisting of utilities and reactor vendors, with the goal of demonstrating NRC's new combined license application (COLA) process. NuStart chose the BLN site as the demonstration site for the AP1000 technology and TVA submitted a COLA to NRC in October 2007.

TVA forecasts additional baseload generation will be needed in the 2018 to 2020 time frame. Using new nuclear generation will help TVA to meet its goal to have at least 50 percent of its generation portfolio comprised of low- or zero-carbon-emitting sources by the year 2020.

TVA is also currently updating its Integrated Resource Plan (IRP) for future power needs. TVA is proceeding with a decision for new generation at the BLN site because waiting until 2011 for the completion of the IRP before starting evaluation of Bellefonte options could delay availability of baseload generation when needed. Preparing this SEIS for evaluating nuclear options at Bellefonte does not limit the alternatives considered in the IRP.

Fact Sheet

Characteristics		Generation Alternative		
		A – No Action	Alternative B – B&W Unit	Alternative C – AP1000 Unit
Plant Design	Electrical output	Not applicable	At least 1,200 MW	At least 1,100 MW
	Number of fuel assemblies		205	157
	Lifespan		40 years	60 years
	Engineered safety features		Active shutdown and cooling system powered by AC generators.	Passive core cooling system based upon gravity, natural circulation, and compressed gasses.
	Cooling system		Closed-cycle	Closed-cycle
	Ultimate heat sink		Guntersville Reservoir	Atmosphere
Construction	Duration of construction	Not applicable	7.5 years	6.5 years
	Peak on-site workforce		3,015	2,933
	Plant footprint (approximate)	400 acres. Negligible clearing or regrading	400 acres – Minor re-clearing and grading of previously disturbed ground.	585 acres – 185 acres previously undisturbed ground cleared. Minor re-clearing and grading of previously disturbed ground.
	Completion or construction of facilities	No change – routine maintenance.	Activities include: replace steam generators, refurbish or replace instrumentation and various equipment, upgrade barge unloading dock, upgrade cooling tower. No major buildings demolished.	Off-site construction of modules delivered to BLN via barge and completed on site. Several buildings demolished, including turbine building and administration complex.
	Dredging	None	11,100 cubic yards dredged from 1,960 feet of intake channel.	10,000 cubic yards dredged from 1,200 feet of intake channel, and 240 cubic yards from barge unloading dock.
Operation	Typical amount of water withdrawn from Guntersville Reservoir for plant cooling	None withdrawn. Approximately 400,000 gallons per quarter year released.	34,000 gpm[1] withdrawn 22,650 gpm released	23,953 gpm withdrawn 7,914 gpm released
	Number of on-site staff	200	849	650
	Radiological effects of normal operations	None	Doses to the public from discharge of radioactive effluents would be a small fraction of the dose considered safe by the NRC. (10 CFR Part 50, Appendix I)	
	Number of fuel assemblies needed for 40-year operation	None	2,285	1,821
	Number of containers needed for long-term storage of spent fuel	None	96	76
Cost	Construction	Not applicable	\$3,120 – \$3,360/kWe[2]	\$3,300 – \$4,900/kWe
	Operation and maintenance	Not applicable	\$.0132/k5Wh[3]	\$.0126/kWh

[1] gpm = gallons per minute
[2] kWe = kilowatt electric, i.e. cost per unit of power capacity
[3] kWh = kilowatt hour, i.e. cost expressed per unit of power generated

COMMENTS:

continued on back

Please fold page along dotted line before mailing.

Single Nuclear Unit at the Bellefonte Site Draft SEIS Comment Card

Place Stamp Here

FROM (please print clearly)

Name Mr./Ms./Mrs.

Organization:

Address

City

State: Zip:

Telephone:

TO: Ruth Horton
TVA NEPA Compliance
400 West Summit Hill Drive
WT 11D-K
Knoxville, TN 37902

Please fold flap along dotted line before mailing and tape.

COMMENTS continued:

I would like to be notified by ☐ e-mail or ☐ U.S. mail (select one) when the FSEIS is available on the TVA website.

E-mail address____

For U.S. mail, please provide your name and address on the front side of this comment card

I would like to receive a printed copy of the FSEIS by U.S. mail.

I would like to receive a copy of the FSEIS on compact disc by U.S. mail.

CHAPTER 8

8.0 LITERATURE CITED

Advanced National Seismic System. 2010. *ANSS Catalog Search*. Retrieved from <http://www.ncedc.org/anss/catalog-search.html> (accessed March 25, 2010).

Alabama Department of Environmental Management (ADEM). 1998. *Alabama Department of Environmental Management Permit Rationale, Tennessee Valley Authority Bellefonte Nuclear Plant*. Prepared by David Butts, September 9, 1998.

———. 2008. *2008 Integrated Water Quality Monitoring & Assessment Report.* Retrieved from <http://www.adem.state.al.us/waterdivision/WQuality/305b/WQ305bReport.htm> (accessed October 21, 2009).

Alabama Department of Industrial Relations. 2010. Jackson County Civilian Labor Force. Retrieved from <http://www2.dir.state.al.us/LAUS/CLF/cntybyyear.aspx?area=000071> (accessed April 23, 2010).

Alabama Department of Transportation (ALDOT). 2006. Five Year Plan (includes Fiscal Years 2006 through 2010). Retrieved from <http://www.dot.state.al.us/TransPlanning/FYPlan/> (accessed November 17, 2006).

_____. 2009a. Transportation Planning, Alabama Traffic Monitoring Division, General Information, Construction Bulletin. Retrieved from <http://www.dot.state.al.us/Docs/Bureaus/Transportation+Planning/Traffic+Data/Index.htm> (accessed January 23, 2010).

_____. 2009b. Five Year Plan (includes Fiscal Years 2008 through 2012). Retrieved from <http://cpmsweb2.dot.state.al.us/TransPlan/FiveYearPlan/Five Year Plan.aspx> (accessed January 19, 2010).

Alabama Invasive Plant Council. 2006. *Alabama's 10 Worst Weeds.* Retrieved from <http://www.se-eppc.org/eddMapS/alabama.cfm> (accessed September 1, 2009).

Algermissen, S. T., and G. A. Bollinger, eds. 1993. *Hazard Assessment.* Monograph 1 presented at the 1993 National Earthquake Conference, Memphis, Tennessee, May 2-5.

American Medical Association. 1994. "Effects of Electric and Magnetic Fields." Chicago, Ill.: AMA, Council on Scientific Affairs (December 1994).

American Meteorological Society. 1959. *Glossary of Meteorology.* Boston, Mass.

AREVA NP, Inc. 2009a. Representation of the Coolant Reactor System for a Babcock & Wilcox Pressurized Light Water Reactor. Provided by P. Opsal, AREVA NP, Inc.

_____. 2009b. *Bellefonte Plant Site-Specific Seismic Assessment Report: 20004-015.* Document No.: 51-9115097-000-Proprietary. August 14, 2009.

Arkansas Nuclear One (ANO). 2000. *Environmental Report, Attachment G, Severe Accident Management Alternatives Analysis.*

Best, T. L., W. S. Cvilikas, A. B. Goebel, T. D. Haas, T. H. Henry, B. A. Milam, L. R. Saidak, and D. P. Thomas. 1995. *Foraging Ecology of the Endangered Gray Bat (Myotis grisescens) at Guntersville Reservoir, Alabama.* Joint Agency Guntersville Project Aquatic Plant Management.

Bohac, C. E., and M. J. McCall. 2008. *Water Use in the Tennessee Valley for 2005 and Projected Use in 2030.* Retrieved from <http://www.tva.gov/river/watersupply/watersupply_report_to_2030.pdf> (accessed October 21, 2009)

Bridges, E. 1984. Element Stewardship Abstract for *Scutellaria Montana*. Tennessee Natural Heritage Program files. Nashville, Tennessee.

Brown, M. A., J. A. Laitner, S. Chandler, E. D. Kelly, S. Vaidyanathan, V. McKinney, C. Logan, and T. Langer. 2009. "Energy Efficiency in Appalachia: How Much More is Available and at What Cost, and by When?" Appalachian Regional Commission. Prepared by Southeast Energy Alliance in partnership with the Georgia Institute of Technology, American Council for an Energy-Efficient Economy and Alliance to Save Energy. March 2009, revised May 2009. Retrieved from <http://www.arc.gov/research/researchreportdetails.asp?REPORT_ID=70> (accessed May 4, 2010).

Brown, M. A., E. Gumerman, X. Sun, Y. Baek, J. Wang, R. Cortes, and D. Soumonni. 2010. "Energy Efficiency in the South." Atlanta, Ga: Southeast Energy Efficiency Alliance. April 12, 2010. Retrieved from <http://www.seealliance.org/se_efficiency_study/full_report_efficiency_in_the_south.pdf> (accessed May 4, 2010).

Burleigh, T. D. 1958. *Georgia Birds*. Norman, Okla.: University of Oklahoma Press.

Center for Invasive Plant Management. 2009. *Weed Management: Prevention.* Retrieved from <http://www.weedcenter.org/index.html> (accessed September 1, 2009).

CE-QUAL-W2, 1995. *A Two-Dimensional, Laterally Averaged, Hydrodynamic and Water Quality Model, Version 2.0: Users Manual.* Edited by T. M. Cole and E. M. Buchak. Vicksburg, Miss.: USACE Waterways Experiment Station, Instruction Report EL-95-1.

Chandler, S., and M.A. Brown. 2009. "Meta-Review of Efficiency Potential Studies and Their Implications for the South." Georgia Tech, Ivan Allen College, School of Public Policy, Working Paper #51. Atlanta, Ga.: Georgia Institute of Technology. August 2009. Retrieved from <http://www.spp.gatech.edu/faculty/workingpapers/wp51.pdf> (accessed May 4, 2010).

Cleveland, M. T., R. W. Stoops, and J. Holland. 1995. *Archaeological and Architectural Surveys for the Proposed Widows Creek-Oglethorpe #3 Transmission Line, Walker County, Georgia*. Report submitted to Tennessee Valley Authority, Knoxville, Tennessee, by Garrow and Associates.

Cooper, J. E. 1968. "The Salamander *Gyrinophilus palleucus* in Georgia, With Notes on Alabama and Tennessee Populations." *Journal of the Alabama Academy of Science* 39:182-185.

Cowardin, L. M., V. Carter, F. C. Golet, and E. T. LaRoe. 1979. *Classification of Wetland and Deepwater Habitats of the United States.* Washington, D.C.: U.S. Fish and Wildlife Publication FWS/OBS-79/31.

Christy, J. R. 2009. “Comments on Electric Power Research Institute’s ‘Potential Impact of Climate Change on Natural Resources in the Tennessee Valley Authority Region’” (November 2009).

Deter-Wolf, A. 2007. *Phase I Archaeological Survey of 606 Acres at the Bellefonte Nuclear Site, Jackson County, Alabama.* Report submitted to Tennessee Valley Authority, Knoxville, Tennessee, by TRC Inc.

Dunning, J. B., Jr., and B. D. Watts. 1990. “Regional Differences in Habitat Occupancy by Bachman’s Sparrow.” *Auk* 107:463-72.

“EIS No. 20090385, Draft Supplement, TVA, AL, Bellefonte Site Single Nuclear Unit Project, Proposes to Complete or Construct and Operate a Single 1,100–1, 200 MW Nuclear Generation Unit, Jackson County, AL.” *Federal Register* 74:58626 (13 November 2009).

Electric Power Research Institute (EPRI). 2002. *Site Selection and Evaluation Criteria for an Early Site Permit Application.* Palo Alto, California: EPRI Technical Report 1006878.

_____. 2009a. “Assessment of Achievable Potential from Energy Efficiency and Demand Response Programs in the U.S. (2010-2030).” Technical Report 1016987. January 2009.

_____. 2009b. “Potential Impact of Climate Change on Natural Resources in the Tennessee Valley Authority Region.” Palo Alto, CA.

Environmental Laboratory. 1987. *Corps of Engineers Wetland Delineation Manual*. Vicksburg: U.S. Army Corps of Engineers Waterways Experiment Station, Technical Report Y-87-1.

Federal Interagency Committee on Noise. 1992. *Federal Agency Review of Selected Airport Noise Analysis Issues.* Fort Walton Beach, Fla.: Spectrum Sciences and Software Inc., August 1992.

Geological Survey of Alabama. 2003. “Fort Payne Earthquake, April 29, 2003.” *Earthquakes in Alabama.* Retrieved from <http://www.gsa.state.al.us/gsa/geologichazards/earthquakes/ftpayne.html> (accessed January 2009).

Global Climate Change Impacts in the United States. 2009. Karl, T. R, J. M. Melillo, and T. C. Peterson, (eds.). Cambridge University Press.

Griffith, G. E., J. M. Omernik, and S.H. Azevedo. 1998. Ecoregions of Tennessee. (two-sided color poster with map, descriptive text, summary tables, and photographs). Reston, Virginia, U.S. Geological Survey (map scale 1:940,000).

Griffith, G. E., J. M. Omernik, J. A. Comstock, S. Lawrence, G. Martin, A. Goddard, V. J. Hulcher, and T. Foster. 2001. Ecoregions of Alabama and Georgia, (color poster with map, descriptive text, summary tables, and photographs): Reston, Virginia, U.S. Geological Survey (map scale 1:1,700,000).

Hickman, G. H., and T. A. McDonough. 1996. "Assessing the Reservoir Fish Assemblage Index—a Potential Measure of Reservoir Quality" in *Reservoir Symposium – Multidimensional Approaches to Reservoir Fisheries Management.* Edited by D. DeVries. Bethesda, Md.: American Fisheries Society, Southern Division, Reservoir Committee.

Highlands Medical Center. 2010. Highlands Health & Rehab. Retrieved from <http://www.highlandshealthandrehab.com/> (accessed February 23, 2010).

Intergovernmental Panel on Climate Change (IPCC). 2007. *Climate Change 2007: Synthesis Report.*

International Association for Research on Cancer. 2002. "Non-Ionizing Radiation, Part 1; Static and Extremely Low-Frequency (ELF) Electric and Magnetic Fields." *Monographs on the Evaluation of Carcinogenic Risks to Humans.* IARC, Working Group on the Evaluation of Carcinogenic Risks to Humans.

International Atomic Energy Agency (IAEA). 1992. *Effects of Ionizing Radiation on Plants and Animals at Levels Implied by Current Radiation Standards*, Technical Report Series No. 332.

International Commission on Radiological Protection (ICRP). 1959. *Report of Committee II on Permissible Dose for Internal Radiation*. ICRP Publication 2. New York: Pergamon, Adopted July 1959.

Jenkins, E. 2008. *Historic Resource Survey for the Bellefonte Nuclear Site in Jackson County, Alabama.* Report submitted to Tennessee Valley Authority, Knoxville, Tennessee, by TRC, Atlanta.

Jennings, M. J., L. S. Fore, and J. R. Karr. 1995. *Biological Monitoring of Fish Assemblages in Tennessee Valley Reservoirs.* Regulated Rivers: Research and Management.

Jirka, G. H., R. L. Doneker, and S. W. Hinton. 2007. *User's Manual for CORMIX: A Hydrodynamic Mixing Zone Model and Decision Support System for Pollutant Discharges into Surface Waters.* Washington, D.C.: U.S. Environmental Protection Agency, EPA-823-K-07-001, Dec. 2007.

Journal of the American Medical Association. 2007. "Implantable Cardioverter-Defibrillators." JAMA 297(17), May 2, 2007.

Julian, H. E. 1996. *Assessment of Groundwater Impacts from Releases of Diesel Fuel Oil at Bellefonte Nuclear Plant.* Norris, Tenn.: Tennessee Valley Authority, Engineering Laboratory, Report No. WR28-1-88-120.

———. 1999. *Natural Attenuation of Diesel Fuel Oil at Bellefonte Nuclear Plant.* Norris, Tenn.: Tennessee Valley Authority, Engineering Laboratory, Report No. WR99-2-88-122.

Keiser, E. D., G. O. Dick, and R. M. Smart. 1995. *Turtle Populations in Guntersville Reservoir, Alabama.* Joint Agency Guntersville Project Aquatic Plant Management.

Kim, W. 2009. Lamont-Doherty Earth Observatory of Columbia University, New York, New York. *29 April 2003 Fort Payne, Alabama Earthquake Page.* Retrieved from <http://www.ldeo.columbia.edu/LCSN/Eq/20030429/20030429_0859.html> (accessed November 2, 2009).

Kingsbury, J. A. 2003. *Shallow Groundwater Quality in Agricultural Areas of Northern Alabama and Middle Tennessee, 2000-2001*. U.S. Geological Survey Water-Resources Investigations Report 2003-4181.

Lindquist, K. 1990. *Bellefonte Groundwater Impacts of Trisodium Phosphate Land Application*. Norris, Tenn.: Tennessee Valley Authority, Engineering Laboratory, Report No. WR28-1-88-112.

Loyd, E. 2009. Bellefonte Nuclear Plant – Plant Discharge Diffuser Hydrothermal Analysis for the Evaluation of Alternatives Presented in the Supplemental Environmental Impact Statement for Single Unit Operation at the Bellefonte Site. Tennessee Valley Authority, Office of Environment and Research.

Lloyd, O. B., Jr., and W. L. Lyke. 1995. *Groundwater Atlas of the United States,* Segment 10. Reston, Va.: United States Geological Survey.

McDonough, T. A., and G. D. Hickman. 1999. "Reservoir Fish Assemblage Index Development: A Tool for Assessing Ecological Health in Tennessee Valley Authority Impoundments," 523-540 in *Assessing the Sustainability and Biological Integrity of Water Resources Using Fish Communities*. Edited by T. P. Simon. Boca Raton, Fla.: CRC Press.

Meier, P. J. 2002. Life-Cycle Assessment of Electricity Generation Systems and Applications for Climate Change Policy Analysis. Fusion Technology Institute of University of Wisconsin.

Menzel, M. A., J. M. Menzel, T. C. Carter, W. M. Ford, and J.W. Edwards. 2001. *Review of the Forest Habitat Relationships of the Indiana Bat (Myotis sodalis).* Newton Square, Pa.: U.S. Department of Agriculture, Forest Service, Northeastern Research Station, Gen. Tech. Rep. NE-284.

Miller, B. A., V. Alavian, M. D. Bender, D. J. Benton, L. L. Cole, L. K. Ewing, P. Ostrowski, et al. 1993. *Sensitivity of the TVA Reservoir and Power Supply Systems to Extreme Meteorology*. Norris, Tenn.: Tennessee Valley Authority, Engineering Laboratory, Report No. WR28-1-680-111. June 1993

Miller, J. A. 1990. Groundwater Atlas of the United States. U.S. Geological Survey Hydrologic Investigations Atlas 730-G.

Miller, N. E., R. D. Drobney, R. L. Clawson, and E. V. Callahan. 2002. "Summer Habitat in Northern Missouri," 165-171 in *The Indiana bat: Biology and Management of an Endangered Species.* Edited by A. Kurta and J. Kennedy. Austin, Tex.: Bat Conservation International.

Muncy, J. A. 1999. *A Guide for Environmental Protection and Best Management Practices for Tennessee Valley Authority Transmission Construction and Maintenance Activities*, revised edition. Edited by C. Austin, C. Brewster, A. Lewis, K. Smithson, T. Broyles, and T. Wojtalik. Norris: Tennessee Valley Authority, Technical note TVA/LR/NRM 92/1.

National Climate Data Center (NCDC). 2010. Storm Events, Jackson County, Alabama. Retrieved from <http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwEvent~Storms> (accessed February 22, 2010).

National Institute of Environmental Health Sciences (NIEHS). 1998. *Report on Health Effects From Exposure to Power Line Frequency Electric and Magnetic Fields*. Research Triangle Park: NIEHS, Publication No. 99-4493.

———. 2002. *Electric and Magnetic Fields Associated With the Use of Electric Power.* Retrieved from <http://www.niehs.nih.gov/about/visiting/index.cfm> (n.d.)

National Renewable Energy Laboratory. 2005. *A Geographic Perspective on the Current Biomass Resource Availability in the United States.* NREL/TP 560-39181, December 2005.

National Research Council. 1997. *Possible Health Effects of Exposure to Residential Electric and Magnetic Fields.* NRC, Committee on the Possible Effects of Electromagnetic Fields on Biologic Systems. Washington National Academy Press.

NatureServe. 2009. NatureServe Explorer: An Online Encyclopedia of Life, Version 7.1. Arlington, Va.: NatureServe. Retrieved from <http://www.natureserve.org/explorer> (accessed September 4, 2009).

Nuclear Energy Institute (NEI). 2002. *Aircraft Crash Impact Analyses Demonstrate Nuclear Power Plant's Structural Strength.*

_____. 2007. Final Industry Ground Water Protection Initiative – Final Guidance Document. August 2007.

_____. 2008. Generic FSAR Template Guidance for Life-Cycle Minimization of Contamination. December 2008.

Oakley, C. B. 1972. *An Archaeological Survey of the Bellefonte Power Plant.* Report on file at TVA Cultural Resources Office, Knoxville, Tennessee.

Osborne, W. E., M. W. Szabo, T. L. Neathery, and C. W. Copeland Jr. 1988. Geologic Map of Alabama, Northeast Sheet, Geological Survey of Alabama Special Map 220.

Reed, P. B., Jr. 1997. *Revised National List of Plant Species That Occur in Wetlands: National Summary*. U.S. Fish and Wildlife Service Biological Report 88(24).

Romme, R. C., K. Tyrell, and V. Brack Jr. 1995. "Literature Summary and Habitat Suitability Index Model: Components of Summer Habitat for the Indiana Bat, *Myotis sodalis*" in *3/D Environmental*, Federal Aid Project E-1-7, Study No. 8.

"Safety Goals for the Operations of Nuclear Power Plants." *Federal Register* 51:28044 (04 August 1986).

SERC Reliability Corporation (SERC). 2008. *SERC Power System Stabilizer Guideline*. Revision 1. November 15, 2008.

Simmons, J. W. and C. F. Walton. 2009. Results of Biological Monitoring in the Vicinity of Bellefonte Nuclear Plant During Spring and Summer 2009, with an Analysis of Fish Species Occurrences in Guntersville Reservoir- A Comparison of Historic and Recent Data. TVA Aquatic Monitoring and Management, Chattanooga. 47 pp +appendix.

Spencer, R. W. 2008. Global Warming as a Natural Response to Cloud Changes Associated with the Pacific Decadal Oscillation. Retrieved from <http://www.drroyspencer.com/research-articles/global-warming-as-a-natural-response/> (accessed April 13, 2010).

"Supplemental Environmental Impact Statement for a Single Nuclear Unit at the Bellefonte Site." *Federal Register* 74:40000 (10 August 2009).

Tennessee Department of Environment and Conservation (TDEC). 2002. *Tennessee Groundwater 305b Water Quality Report*. TDEC, Division of Water Supply.

"Tennessee Valley Authority (Bellefonte Nuclear Plant, Units 1 and 2), Receipt of Application for Facility Operating Licenses; Availability of Applicant's Environmental Report; and Consideration of Issuance of Facility Operating Licenses and Opportunity for Hearing." *Federal Register* 43:30628 (17 July 1978).

Tennessee Valley Authority (TVA). 1974a. *Final Environmental Statement, Bellefonte Nuclear Plant Units 1 and 2*.

———. 1974b. Effects of Widows Creek Steam Plant on the Fish Populations of Guntersville Reservoir. Division of Forestry, Fisheries, and Wildlife Development, Norris, Tennessee. 36 p.

———. 1975a. *Final Environmental Statement, Hartsville Nuclear Plants*.

———. 1975b. Impingement at Widows Creek Steam Plant. Division of Forestry, Fisheries, and Wildlife Development, Norris, Tennessee.

———. 1976. *Bellefonte Nuclear Plant Units 1 and 2, Environmental Report, Operating License Stage,* Tennessee Valley Authority, Volume 1, January 1, 1976.

———. 1977a. *Environmental Report, Phipps Bend Nuclear Plant Units 1 and 2*.

———. 1977b. *Submerged Multiport Diffuser Design for Bellefonte Nuclear Plant*. TVA Report No. 81-13, September 1977.

———. 1977c. *Diffuser Mixing Zone and Far Field Dispersion Bellefonte Nuclear Plant.* TVA Report No. WM28-2-88-002, November 1977.

———. 1978a. *Bellefonte Nuclear Plant Final Safety Analysis Report, Amendment 16*.

———. 1978b. *Final Environmental Statement, Yellow Creek Nuclear Plant Units 1 and 2.*

———. 1978c. *Environmental Radioactivity Levels, Bellefonte Nuclear Plant, Annual Report, 1977.* TVA Radiological Health Staff.

———. 1979. *Environmental Radioactivity Levels, Bellefonte Nuclear Plant, Annual Report, 1978.* TVA Radiological Health Staff.

———. 1980a. *Final Safety Analysis Report, Bellefonte Units 1 and 2, Amendment 19*.

———. 1980b. *Environmental Radioactivity Levels, Bellefonte Nuclear Plant, Annual Report, 1979.* TVA Radiological Health Staff.

———. 1981a. *Final Environmental Impact Statement, Coal Gasification Project*. July 1981

———. 1981b. *Environmental Radioactivity Levels, Bellefonte Nuclear Plant, Annual Report, 1980.* TVA Radiological Health Staff.

———. 1982a. *Predicted Effects for Mixed Temperatures Exceeding 30^{o}C (86^{o}F) in Guntersville Reservoir, Alabama, in the Vicinity of the Diffuser Discharge, Bellefonte Nuclear Plant.* TVA Report No. TVA/ONR/WRF 82/5, February 1982.

———. 1982b. *Environmental Radioactivity Levels, Bellefonte Nuclear Plant, Annual Report, 1981.* TVA Radiological Health Staff.

———. 1982c. *Final Safety Analysis Report, Bellefonte Units 1 and 2. Amendment 22*

———. 1983a. *Environmental Radioactivity Levels, Bellefonte Nuclear Plant, Annual Report, 1982.* TVA Radiological Health Staff.

———. 1983b. *Procedures for Compliance with the National Environmental Policy Act: Instruction IX Environmental Review*. Retrieved from <http://www.tva.gov/environment/reports/pdf/tvanepa_procedures.pdf> (n.d.).

———. 1983c. First Preoperational Assessment of Water Quality and Biological Resources of Guntersville Reservoir in the Vicinity of the Proposed Murphy Hill Coal Gasification Project. Office of Natural Resources, Division of Air and Water Resources. Knoxville, Tennessee.

———. 1984. *Environmental Radioactivity Levels, Bellefonte Nuclear Plant, Annual Report, 1983.* TVA Radiological Health Staff.

———. 1985a. *Bellefonte Nuclear Plant Construction and Operational Employee Survey Results and Mitigation Summary April 30, 1984*. Knoxville, Tenn.: Tennessee Valley Authority, June 1985.

———. 1985b. Preoperational Assessment of Water Quality and Biological Resources of Guntersville Reservoir in the Vicinity of Bellefonte Nuclear Plant, 1974 Through 1984. Office of Natural Resources and Economic Development, Division of Air and Water Resources.

———. 1986. *Final Safety Analysis Report, Bellefonte Units 1 and 2. Amendment 27.*

———. 1991. *Bellefonte Nuclear Plant Units 1 and 2 Final Safety Analysis Report, Amendment 30.*

———. 1992. *A Guide for Environmental Protection and Best Management Practices for Tennessee Valley Authority Transmission Construction and Maintenance Activities.* Norris, Tenn.: TVA.

———. 1993a. *Environmental Impact Statement Review, Bellefonte Nuclear Plant White Paper*. March 1993.

———. 1993b. *Sensitivity of the TVA Reservoir and Power Supply Systems to Extreme Meteorology.* TVA Report No. WR28-1-680-111, June 1993.

———. 1995. *Energy Vision 2020 - Integrated Resource Plan and Final Programmatic Environmental Impact Statement and Record of Decision*. December 1995.

———. 1997. *Final Environmental Impact Statement for the Bellefonte Conversion Project.* October 1997.

———. 2000. *Record of Decision and Adoption of the Department of Energy Final Environmental Impact Statement for the Production of Tritium in a Commercial Light Water Reactor.* May 19, 2000.

———. 2001. *Guntersville Reservoir Land Management Plan, Jackson and Marshall Counties, Alabama, and Marion County, Tennessee*. August 2, 2001.

———. 2004. *Reservoir Operations Study Final Programmatic Environmental Impact Statement and Record of Decision*. Prepared in cooperation with the U.S. Army Corps of Engineers and the U.S. Fish and Wildlife Service, May 19, 2004.

———. 2006. *Final Environmental Assessment Bellefonte Plant Redress, Jackson County, Alabama*. January 2006.

———. 2007a. *Final Supplemental Environmental Impact Statement, Completion and Operation of Watts Bar Nuclear Plant Unit 2, Rhea County, Tennessee.* June 2007.

———. 2007b. Fish Impingement at Widows Creek Fossil Plants A and B During 2005 Through 2007. Aquatic Monitoring and Management, Knoxville, Tennessee. 18 p.

———. 2008a. *Bellefonte Nuclear Plant, Units 3&4, COL Application, Part 3, Environmental Report, Revision 1.*

———. 2008b. *Activities at Bellefonte Nuclear Plant Related to Future Site Use, Jackson County Alabama*. July 2008.

———. 2008c. *Descriptions of Existing Facilities and Infrastructure for Alternative Sites to the Selected Bellefonte Site*. White paper submitted to NRC, dated June 26, 2008.

———. 2008d. *Criteria and Basis for Comparative Ratings Among Alternative Brownfield and Greenfield Sites, Rev 1*. White paper submitted to NRC, dated August 22, 2008.

———. 2008e. *Site Screening Process: Information Complementary to Section 9.3.2 of the Bellefonte Nuclear Plant, Units 3 and 4, COLA Applicant's Environmental Report.* White paper submitted to NRC, dated August 12, 2008.

_____. 2008f. Bellefonte Nuclear Plant Environmental Justice Impact Assessment Methodology and Findings. Bellefonte Nuclear Plant (BLN – Response to Environmental Report (ER) Sufficiency Review Comments. Letter submitted to NRC, dated May 2, 2008.

———. 2008g. *Supplemental Environmental Assessment for the Potential Upgrade of the Tenaska Site for Establishing a Simple-Cycle or Combined-Cycle Electric Generation Facility*. TVA, Knoxville, TN.

———. 2009a. Bellefonte *Nuclear Plant, Units 3 & 4, COL Application, Final Safety Analysis Report, Revision 1.*

———. 2009b. *Interconnection System Impact Study Report for Bellefonte Nuclear Plant Unit 1.* August 2009.

———. 2009c. Biological Assessment: Effects of Condenser Cooling Water Withdrawal on the Larval Fish Community Near Bellefonte Nuclear Plant Intake, 2009. Tennessee Valley Authority Aquatic Monitoring and Management. Knoxville, TN.

———. 2009d. Biological *Assessment: Proposed Single Unit Nuclear Plant Development at Bellefonte Nuclear Site and Associated Transmission Line Upgrades, Alabama, Tennessee, and Georgia.* Office of Environmental and Research, Environmental Permitting & Compliance. November 2009.

———. 2010a. *Detailed Scoping, Estimating, and Planning Ground Water Intrusion Assessment, Unit 0.* Performed by Sargent and Lundy LLC, Project 12054. Feb. 9, 2010.

———. 2010b. *Bellefonte Combined License Application – Revision to Part 2 – Final Safety Analysis Report Section 2.4.* Letter Submitted to NRC and Enclosure Providing Voluntary Revisions to TVA's COL Application, dated January 15, 2010.

Thomas, D. P., and T. L. Best. 2000. "Radiotelemetric Assessment of Movement Patterns of the Gray Bat (*Myotis grisescens*) at Guntersville Reservoir, Alabama." *Occasional Papers of the North Carolina Museum of Natural Sciences and the North Carolina Biological Survey*, 12:50-66.

U.S. Atomic Energy Commission (AEC). 1972. *The Environmental Survey of Transportation of Radioactive Materials to and from Nuclear Plants.* WASH-1238.

_____. 1974. *Final Environmental Statement Related to Construction of Bellefonte Nuclear Plant Units 1 and 2.* Docket Nos. 50-438 and 50-439, June 4, 1974.

U.S. Census Bureau (Census), 2000a. *Total Population.* Retrieved from <http://factfinder.census.gov/home/saff/main.html?_lang=en> (accessed October 9, 2009).

———. 2000b. *Minority Population by Race*. Retrieved from <http://factfinder.census.gov/home/saff/main.html?_lang=en> (accessed October 9, 2009 and April 21, 2010).

———. 2000c. *Poverty Status*. Retrieved from <http://factfinder.census.gov/home/saff/main.html?_lang=en> (accessed April 21, 2010).

———. 2000d. QT-H1. General Housing Characteristics: 2000. Census 2000 Summary File 1 (SF-1) 1000 Percent Data, Jackson County, Alabama. Retrieved from <http://www.factfinder.census.gov/servlet/QTTable?_bm=y&-geo_id=05000US01071&-qr_name=DEC_2000_SF1_U_QTH1&-ds_name=DEC_2000_SF1_U&-redoLog=false> (accessed November 29, 2006).

———. 2008a. State and County QuickFacts, Jackson County, Alabama. Last revised February 23, 2010. Retrieved from <http://quickfacts.census.gov/qfd/states/01/01071.html> (accessed April 21, 2010).

———. 2008b. People and Households, Small Area Income and Poverty Estimates. Estimates for Alabama Counties, 2008. Final release date: November 2009. Retrieved from <http://www.census.gov/cgi-bin/saipe/saipe.cgi> (accessed April 20, 2010).

———. 2009. County Population Estimates, Annual Estimates of the Resident Population for Counties: April 1, 2000 to July 1, 2009. Release date: March 2010. Retrieved from <http://www.census.gov/popest/counties/CO-EST2009-01.html> (accessed 4/21/10).

———. 2010. Selected Housing Characteristics: 2006-2008, 2006-2008 American Community Survey 3-Year Estimates, Jackson County, Alabama. Retrieved from <http://factfinder.census.gov/servlet/DatasetMainPageServlet?_program=ACS> (accessed February 20, 2010).

U.S. Department of Agriculture (USDA). 2007. *Invasive and Noxious Weeds.* Retrieved from <http://plants.usda.gov/java/noxiousDriver> (accessed September 1, 2009).

U.S. Department of Agriculture, Natural Resource Conservation Service (USDA-NRCS). 2009. Soil Survey Geographic Database (SSURGO). Retrieved from <http://soils.usda.gov/survey/geography/ssurgo/> (accessed September 13, 2008).

U.S. Department of Commerce, Bureau of Economic Analysis (BEA). 2010a. Regional Economic Information System (REIS), April 2010. Personal Income and Employment Summary, Jackson County, Alabama, 1999-2008. Retrieved from <http://www.bea.gov/regional/reis/> (accessed April 23, 2010).

_____. 2010b. Total Full-Time and Part-Time Employment by NAICS, Jackson County, Estimates for 2007 and 2008. Regional Economic Information System (REIS), April 2010. Retrieved from <http://www.bea.gov/regional/reis/> (accessed April 23, 2010).

_____. 2010c. Regional Economic Information System (REIS), April 2010. Economic data estimates for 2008. Retrieved from <http://www.bea.gov/regional/reis/> (accessed April 22, 2010).

Total Full-Time and Part-Time Employment by NAICS Industry for Jackson County, Alabama, and the United States (2008 data).

Personal Income by Major Source and Earnings by NAICS Industry for Jackson County, Alabama, and the United States (2008 data).

U.S. Department of Defense and U.S. Environmental Protection Agency. 2003. "Advance Notice of Proposed Rulemaking on the Clean Water Act Regulatory Definition of Waters of the United States." *Federal Register* 68:9613 (15 January 2003).

U.S. Department of Energy (DOE). 1996. "Questions and Answers; EMF in the Workplace." *Electric and Magnetic Fields Associated With the Use of Electric Power.* National Institute for Occupational Safety and Health, National Institute of Environmental Health Sciences, Report No. DOE/GO-10095-218, September 1996.

_____. 1999. *Final Environmental Impact Statement for the Production of Tritium in a Commercial Light Water Reactor.* Washington, D.C.: DOE EIS – 0288, March 1999.

———. 2006. *Feasibility Assessment of the Water Energy Resources of the United States for New Low Power and Small Hydro Classes of Hydroelectric Plants.* U.S. Department of Energy, Energy Efficiency and Renewable Energy, Wind and Hydropower Technologies. DOE-ID-11263, January 2006. Retrieved from <http://www1.eere.energy.gov/windandhydro/pdfs/doewater-11263.pdf> (accessed April 22, 2010).

_____. 2010. Office of Energy Efficiency and Renewable Energy, Wind and Water Power Program, Wind Powering America, Tennessee Wind Map and Resource Potential. Retrieved from <http://www.windpoweringamerica.gov/wind_resource_maps.asp?stateab=tn> (accessed April 26, 2010).

_____. 2008. *Global Nuclear Energy Partnership, Draft Programmatic Environmental Impact Statement*. October 2008.

U.S. Department of Labor, Bureau of Labor Statistics. 2010. Local Area Unemployment Statistics, Unemployment Rates for States. Retrieved from <http://www.bls.gov/lau/lastrk09.htm> (accessed April 23, 2010).

U.S. Environmental Protection Agency (EPA). 1971. *Noise From Construction Equipment and Operations, Building Equipment, and Home Appliances.* Washington, D.C.: EPA Office of Noise Abatement and Control.

_____. 1997. Area Designations for 1997 Fine Particle (PM2.5) Standards, 1997 PM 2.5 Standards – Region 4 State Designations. Retrieved from <http://www.epa.gov/pmdesignations/1997standards/final/region4desig.htm> (accessed May 3, 2010).

———. 2006. *Area Designations for 2006 24-Hour fine Particle (PM2.5) Standards.* Retrieved from <http://www.epa.gov/pmdesignations/2006standards/final/region4.htm> (accessed October 21, 2009).

———. 2008a. "Oil Pollution Prevention." *Code of Federal Regulations,* Chapter 40, Part 112. Washington, D.C.: U.S. Government.

———. 2008b. Ground-level Ozone Standards – Region 4 Recommendations and EPA Responses. Retrieved from <http://www.epa.gov/ozonedesignations/2008standards/rec/region4R.htm> (accessed October 21, 2009).

———. 2009. Local Drinking Water Information. Retrieved from <http://www.epa.gov/safewater/dwinfo/index.html> (accessed October 23, 2009)

U.S. Fish and Wildlife Service (USFWS). 1980. *Selected Vertebrate Endangered Species of the Seacoast of the United States: The Red-Cockaded Woodpecker*. Washington, D.C.: U.S. Fish and Wildlife Laboratory, FWS/OBS 80/01.7.

———. 1996. *National List of Vascular Plant Species That Occur in Wetlands: 1996 National Summary*.

———. 2002. "Reclassification of *Scutellaria Montana* (Large-Flowered skullcap) from Endangered to Threatened." *Federal Register* 67:1662 (14 January 2002).

U.S. Forest Service (USFS). 2007. Southern Research Station Timber Product Output Report. Retrieved from <http://srsfia2.fs.fed.us/php/tpo_2009/tpo_rpa_int1.php> (accessed May 4, 2010).

_____. 2008. *Eastern Forest Environmental Threat Assessment: Invasive Plants.* Retrieved from <http://www.forestthreats.org/invasive-plants> (accessed June 11, 2009).

U.S. Geological Survey (USGS). 2003. Poster of the Fort Payne, Alabama Earthquake of 29 April 2003 - Magnitude 4.6. Retrieved from <http://earthquake.usgs.gov/eqcenter/eqarchives/poster/2003/20030429_image.php> (accessed January 5, 2009).

_____. 2010. Earthquake Hazards Program, Glossary of Terms on EQ Maps. Retrieved from <http://earthquake.usgs.gov/earthquakes/glossary.php> (accessed March 28, 2008).

U.S. Nuclear Regulatory Commission (NRC). 1973. *Design Response Spectra for Seismic Design of Nuclear Power Plants, Revision 1.* Regulatory Guide 1.60. Directorate of Regulatory Standards, December 1973.

———. 1975. *Environmental Survey of Transportation of Radioactive Materials To and From Nuclear Power Plants, Supplement 1*. NUREG-75/038.

———. 1976. *Calculation of Releases of Radioactive Materials in Gaseous and Liquid Effluents from Pressurized Water Reactors*. Washington, D.C.: Office of Standards Development, NUREG-0017.

———. 1977a. *Calculation of Annual Doses to Man From Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance With 10 CFR Part 50, Appendix I, Revision 1.* Regulatory Guide 1.109. October 1977.

———. 1977b. *Methods for Estimating Atmospheric Transport and Dispersal of Gaseous Effluents in Routine Releases from Light-Water-Cooled Reactors, Revision 1.* Regulatory Guide 1.111. Office of Standards Development, July 1977.

———. 1982a. *Atmospheric Dispersion Models for Potential Accident Consequence Assessments at Nuclear Power Plants, Revision 1*. Regulatory Guide 1.145. Office of Nuclear Regulatory Research, November 1982.

———. 1982b. XOQDOQ: Computer Program for the Meteorological Evaluation of Routine Effluent Releases at Nuclear Power Stations. NUREG/CR-2919, September 1982.

———. 1986, *LADTAP II - Technical Reference and User Guide.* NUREG/CR-4013, PNL-5270, April 1986.

———. 1987. *GASPAR II—Technical Reference and User Guide*. NUREG/CR-4653, March 1987.

———. 1990. *Severe Accident Risks: An Assessment for Five U.S. Nuclear Power Plants, Final Summary Report.* NUREG-1150. Washington, D.C.: Office of Nuclear Regulatory Research.

———. 1996. *Generic Environmental Impact Statement for License Renewal of Nuclear Plants.* NUREG-1437, Washington, D.C.

———. 1998. *Code Manual for MACCS2*. NUREG/CR-6613, SAND97-0594. May 1998.

———. 1999. *Environmental Standard Review Plan*. NUREG 1555. October 1999.

———. 2002. *Subpart D - Radiation Dose Limits for Individual Members of the Public*. 10 CFR Part 20.1301. October 2002. Retrieved from <http://www.nrc.gov/reading-rm/doc-collections/cfr/part020/part020-1301.html> (n.d.).

———. 2007a. *A Performance-Based Approach to Define the Site-Specific Earthquake Ground Motion*. Regulatory Guide 1.208. Office of Nuclear Regulatory Research, March 2007.

———. 2007b. *Numerical Guides 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*. Appendix I to 10 CFR Part 50. Retrieved from <http://www.nrc.gov/reading-rm/doc-collections/cfr/part050/part050-appi.html> (accessed October 21, 2009).

_____. 2007c. *Additional Comments on SECY-06-0219, Final Rulemaking to Revise 10 C.F.R. 73.1, Design Basis Threat Requirements,* NRC Commissioner McGaffigan. January 29, 2007.

______. 2008. *Supplemental Environmental Impact Statement for the Combined License (COL) for North Anna Power Station Unit 3*. NUREG-1917, Washington, D.C.

______. 2010. Office of Public Affairs Fact Sheet: Buried Pipes at Nuclear Reactors. February 2010.

Westinghouse Electric Company (WEC). 2008. *AP1000 Design Control Document, APP-GW-GL-700, Revision 17.*

______. 2009. Representation of the Westinghouse AP1000 Simplified Design. Retrieved from <http://www.ap1000.westinghousenuclear.com/ap1000_glance.html> (accessed May 2, 2010).

Whitaker, J. O., Jr. and W. J. Hamilton. 1998. *Mammals of the Eastern United States,* 3rd edition. Ithaca, N.Y.: Cornell University Press.

World Health Organization (WHO). 2007a. *Electromagnetic Fields and Public Health.* WHO EMF Task Force Report, WHO Fact Sheet No. 299, March 2007.

———. 2007b. *Extremely Low Frequency Fields.* Environmental Health Criteria Monograph No. 238, August 2007.

———. 2007c. *Electromagnetic Fields and Public Health Exposure to Extremely Low Frequency Fields.* WHO Fact Sheet No. 322, June 2007.

GLOSSARY

A-weighted decibel (dBA) - A unit of weighted sound pressure level, measured by the use of a metering characteristic and the "A" weighting specified by American National Standard Institute SI.4-1971(R176). (See decibel).

Accident - One or more unplanned events involving materials that have the potential to endanger the health and safety of workers and the public. An accident can involve a combined release of energy and hazardous materials (radiological or chemical) that might cause prompt or latent adverse health effects.

Accident sequence - With regard to nuclear facilities, an initiating event followed by system failures or operator errors, which can result in significant core damage, confinement system failure, and/or radionuclide releases.

Ambient air - The surrounding atmosphere as it exists around people, plants, and structures. Air quality standards are used to provide a measure of the health-related and visual characteristics of the air.

Archaeological sites (resources) - Any location where humans have altered the terrain or discarded artifacts during either prehistoric or historic times.

Area of potential effects (APE) - Geographic area or areas within which an undertaking may directly or indirectly cause changes in the character or use of historic properties, if such properties exist. For this SEIS, the archaeological APE is the same as the “Bellefonte Project Area” as identified on the B&W and AP100 site plans.

Artifact - An object produced or shaped by human workmanship of archaeological or historical interest.

As Low as Reasonably Achievable (ALARA) - A concept applied to ensure the quantity of radioactivity released to the environment and the radiation exposure of onsite workers in routine operations, including "anticipated operational occurrences," is maintained as low as reasonably achievable. It takes into account the state of technology, economics of improvements in relation to benefits to public health and safety, and other societal and economic considerations in relation to the use of nuclear energy in the public interest.

Background radiation - Ionizing radiation present in the environment from cosmic rays and natural sources in the Earth; background radiation varies considerably with location.

Baseline - A quantitative expression of conditions, costs, schedule, or technical progress to serve as a base or standard for measurement during the performance of an effort; the established plan against which the status of resources and progress of a project can be measured. For this environmental impact statement, the environmental baseline is the site environmental conditions as they exist or have been estimated to exist in the absence of the proposed action.

Base Load - The minimum amount of electric power or natural gas delivered or required over a given period of time at a steady rate. The minimum continuous load or demand in a power system over a given period of time usually not temperature sensitive.

Base load capacity - The generating equipment normally operated to serve loads on an around-the-clock basis.

Basemat - Reinforced concrete foundation. The AP1000 basemat meets the functional requirements of a building foundation by providing the strength and stability necessary for design loads to transmit safely from the structure onto the underlying rock and soil substrata.

Benthic - Plants and animals dwelling at the bottom of oceans, lakes, rivers, and other surface waters.

Benthic macroinvertebrate - Organisms that are large enough to be seen without the aid of magnification and that live in close association with bottom of flowing and nonflowing bodies of water.

Best management practices (BMP) - A practice or combination or practices that is determined by a state (or other planning agency) after problem assessment, examination of alternative practices, and appropriate public participation to be the most effective, practicable means of preventing or reducing the amount of pollution generated by nonpoint sources to a level compatible with air or water quality goals.

Beta particle - A charged particle emitted from the nucleus of an atom during radioactive decay. A negatively charged beta particle is identical to an electron; a positively charged beta particle is called a "positron."

Beta radiation - Consists of an elementary particle emitted from a nucleus during radioactive decay; it is negatively charged, is identical to an electron, and is easily stopped by a thin sheet of metal.

Block groups - U.S. Bureau of the Census term describing a cluster of blocks generally selected to include 250 to 550 housing units.

Blowdown - A maintenance procedure to remove sediment in power plant components.

Burnup - The total energy released through fission by a given amount of nuclear fuel; generally measured in megawatt-days.

CE-QUAL-W2 - Two-dimensional, laterally averaged, hydrodynamic and water quality model for reservoirs

Cancer - The name given to a group of diseases characterized by uncontrolled cellular growth with cells having invasive characteristics such that the disease can transfer from one organ to another.

Capacity factor - The ratio of the annual average power production of a power plant to its rated capacity.

Canister - A stainless-steel container in which nuclear material is sealed.

Cladding - The metal tube that forms the outer jacket of a nuclear fuel rod or burnable absorber rod. It prevents the release of radioactive material into the coolant. Stainless steel and zirconium alloys *are* common cladding materials.

Consumptive water use - The difference in the volume of water withdrawn from a body of water and the amount released back into the body of water.

Container - With regard to radioactive wastes, the metal envelope in the waste package that provides the primary containment function of the waste package and is designed to meet the containment requirements of 10 CFR Part 60.

Containment structure - A gas-tight shell or other enclosure around a nuclear reactor to confine fission that otherwise might be released to the atmosphere in the event of an accident. Such enclosures are usually dome-shaped and made of steel-reinforced concrete.

Containment design basis - For a nuclear reactor, those bounding conditions for the design of the containment, including temperature, pressure, and leakage rate. Because the containment is provided as an additional barrier to mitigate the consequences of accidents involving the release of radioactive materials, the containment design-basis may include an additional specified margin above those conditions expected to result from the plant design-basis accidents to ensure that the containment design can mitigate unlikely or unforeseen events.

Conductors - A wire or combination of wires not insulated from one another, suitable for carrying electric current.

Cooling water - Water pumped into a nuclear reactor or accelerator to cool components and prevent damage from the intense heat generated when the reactor or accelerator is operating.

CORMIX – Cornell Mixing Zone Expert System (CORMIX), an EPA-supported mixing zone model for assessment of regulatory mixing zones resulting from steady, continuous point source discharges.

Cultural resources - Archaeological sites, historical sites, architectural features, traditional use areas, and Native American sacred sites.

Cumulative impacts/effects - In an environmental impact statement, the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions, regardless of what agency (Federal or nonfederal), private industry, or individual(s) undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time (40 CFR §1508.7).

Current - The movement of electrons in the conductors or transmission lines.

Decay heat (radioactivity) - The heat produced by the decay of certain radionuclides.

Decay (radioactive) - The decrease in the amount of any radioactive material with the passage of time due to the spontaneous transformation of an unstable nuclide into a different nuclide or into a different energy state of the same nuclide; the emission of nuclear radiation (alpha, beta, or gamma radiation) is part of the process.

Decibel (dB) - A logarithmic unit of sound measurement which describes the magnitude of a particular quantity of sound pressure power with respect to a standard reference value, in general, a sound doubles in loudness for every increase of 10 decibels.

Decibel, A-weighted (dBA) - A unit of frequency-weighted sound pressure level, measured by the use of a metering characteristic and the "A" weighting specified by the American National Standards Institute (ANSI) Si .4-1983 (RI 594), that accounts for the frequency response of the human ear.

Decommissioning - The removal from service of facilities such as processing plants, waste tanks, and burial grounds, and the reduction or stabilization of radioactive contamination. Decommissioning includes decontamination, dismantling, and return of the area to original condition without restrictions or partial decontamination, isolation of remaining residues, and continuation of surveillance and restrictions.

Decontamination - The actions taken to reduce or remove substances that pose a substantial present or potential hazard to human health or the environment, such as radioactive or chemical contamination from facilities, equipment, or soils by washing, heating, chemical or electrochemical action, mechanical cleaning, or other techniques.

Depleted uranium - A mixture of uranium isotopes where uranium-235 represents less than 0.7 percent of the uranium by mass.

Derate - Reduction in operating power production level.

Design-basis accident - For nuclear facilities, information that identifies the specific functions to be performed by a structure, system, or component and the specific values (or ranges of values) chosen for controlling parameters for reference bounds for design. These values may be (l) restraints derived from generally accepted state-of-the-art practices for achieving functional goals; (2) requirements derived from analysis (based on calculation and/or experiments) of the effects of a postulated accident for which a structure, system, or component must meet its functional goals; or (3) requirements derived from Federal safety objectives, principles, goals, or requirements.

Design-basis events - Postulated disturbances in process variables that can potentially lead to design-basis accidents.

Distribution (electrical) - The system of lines, transformers, and switches that connect the transmission network and customer load. The transport of electricity to ultimate use points such as homes and businesses. The portion of an electric system that is dedicated to delivering electric energy to an end user at relatively low voltages.

Dose - The energy imparted to matter by ionizing radiation. The unit of absorbed dose is the rad.

Dose equivalent - The product of absorbed dose in rad (or Gray) and a quality factor, which quantifies the effect of this type of radiation in fissue. Dose equivalent is expressed in units of rem or Sievert, where 1 rem equals 0.01 Sievert.

Dose rate - The radiation dose delivered per unit time (e.g., rem per year).

Dosimeter - A small device (instrument) carried by a radiation worker that measures cumulative radiation dose (e.g., film badge or ionization chamber).

Drift - Effluent mist or spray carried into the atmosphere from cooling towers.

Drinking water standards - The level of constituents or characteristics in a drinking water supply specified in regulations under the Safe Drinking Water Act as the maximum permissible.

Effective dose equivalent - The sum of the products of the dose equivalent received by specified tissues of the body and a tissue-specific weighting factor. This sum is a risk-equivalent value and can be used to estimate the health effects risk to the exposed individual. The tissue-specific weighting factor represents the fraction of the total health risk resulting from uniform whole-body irradiation that would be contributed by that particular tissue. The effective dose equivalent includes the committed effective dose equivalent from internal deposition of radionuclides, and the effective dose equivalent due to penetrating radiation from sources external to the body. Effective dose equivalent is expressed in units of rem or Sievert.

Effluent - A gas or fluid discharged into the environment.

Endangered species - Any species which is in danger of extinction throughout all or significant portions of its range. The Endangered Species Act of 1973, as amended, establishes procedures for placing species on the Federal lists of endangered or threatened species.

Endangered Species Act of 1973 - The Act requires Federal agencies, with the consultation and assistance of the Secretaries of the Interior and Commerce, to ensure that their actions likely will not jeopardize the continued existence of any endangered or threatened species, or adversely affect the habitat of such species.

Engineered safety features - For a nuclear facility, features that prevent, limit, or mitigate the release of radioactive material from its primary containment.

Entrainment - The involuntary capture and inclusion of organisms in streams of flowing water; a term often applied to the cooling water systems of power plants/reactors. The organisms involved may include phyto-and zooplankton, fish eggs and larvae (ichthyoplankton), shellfish larvae, and other forms of aquatic life.

Environment - The sum of all external conditions and influences affecting the life, development, and ultimately the survival of an organism.

Environmental justice - The fair treatment of people of all races, cultures, incomes, and educational levels with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. Fair treatment implies that no population of people should be forced to shoulder a disproportionate share of the negative environmental impacts of pollution or environmental hazards due to a lack of political or economic influence.

Exposure to radiation - The incidence of radiation on living or inanimate material by accident or intent. Background exposure is the exposure to natural background ionizing radiation. Occupational exposure is the exposure to ionizing radiation that occurs at a person's workplace. Population exposure is the exposure to a number of persons who inhabit an area.

Exposure pathway - The course a chemical or physical agent takes from the source to the exposed organism. The pathway describes a unique mechanism by which an individual or population is exposed to chemicals or physical agents at or originating from the site. Each exposure pathway includes a source or release from a source, an exposure point, and an exposure route. If the exposure point differs from the source, a transport/exposure medium (e.g., air) is included.

Fission (fissioning) - The splitting of a nucleus into at least two other nuclei and the release of a relatively large amount of energy. Two or three neutrons are usually released during this type of transformation.

Fission products - Nuclei formed by the fission of heavy elements (primary fission products); also, the nuclei formed by the decay of the primary fission products, many of which are radioactive.

Floodplain - The lowlands adjoining inland and coastal waters and relatively flat areas.

Fuel assembly - A cluster of fuel rods (or plates), also called a fuel element. Approximately 200 fuel assemblies make up a reactor core.

Fuel rod - Nuclear reactor component that includes the fissile material.

Gamma rays - High-energy, short-wavelength, electromagnetic radiation accompanying fission and either emitted from the nucleus of an atom or emitted by some radionuclide or fission product. Gamma rays are very penetrating and can be stopped only by dense materials (such as lead) or a thick layer of shielding materials.

Habitat - The environment occupied by individuals of a particular species, population, or community.

Hazardous material - A material, including a hazardous substance, as defined by 49 CFR §171.8, which poses a risk to health, safety, and property when transported or handled.

Hazardous/toxic air pollutants - Air pollutants known or suspected to cause serious health problems such as cancer, poisoning, or sickness, and may have immunological, neurological, reproductive, developmental, or respiratory effects.

Hazardous waste - Any solid waste (can also be semisolid or liquid, or contain gaseous material) having the characteristics of ignitability, corrosivity, toxicity, or reactivity, defined by the Resource Conservation and Recovery Act, and identified or listed in 40 CFR Part 261 or by the Toxic Substances Control Act.

Heat exchanger - A device that transfers heat from one fluid (liquid or gas) to another.

High efficiency particulate air filter (HEPA) - A filter used to remove very small particulates from dry gaseous effluent streams.

High(ly) enriched uranium - Uranium that is equal to or greater than 20 percent uranium-235 weight. Many of the fuels discussed in this EIS are based primarily on highly enriched uranium.

Historic resources - Archaeological sites, architectural structures, and objects produced after the advent of written history dating to the time of the first Euro-American contact in an area.

Hybernacula - Places, e.g., caves or other protected areas, where bats hibernate during the winter.

Icthyoplankton - The early life stages of fish (eggs and larvae) that spend part of their life cycle as free-floating plankton.

Impingement - The process by which aquatic organisms too large to pass through the screens of a water intake structure become caught on the screens and are unable to escape.

Interim storage - Safe and secure storage for spent nuclear fuel and radioactive wastes until the materials are treated and/or disposed of).

Ion - An atom that has too many or too few electrons, causing it to be electrically charged; an electron that is not associated (in orbit) with a nucleus.

Ion exchange - A unit physiochemical process that removes anions and cations, including radionuclides, from liquid streams (usually water) for the purpose of purification or decontamination.

Ionizing radiation - Alpha particles, beta particles, gamma rays, neutrons, high-speed electrons, high-speed protons, and other particles or electromagnetic radiation that can displace electrons from atoms or molecules, thereby producing ions.

Irradiation - Exposure to radiation.

Isotope - An atom of a chemical element with a specific atomic number and atomic mass. Isotopes of the same element have the same number of protons, but different numbers of neutrons and 'different atomic masses. Isotopes are identified by the name of the element and the total number of protons and neutrons in the nucleus. For example, plutonium-239 is a plutonium atom with 239 protons and neutrons.

Laydown - Area of construction site used to sort and store construction materials.

Licensee amendment - Changes to an existing reactor's operating license that are approved by the U.S. Nuclear Regulatory Commission.

Light water - The common form of water (a molecule with two hydrogen atoms and one oxygen atom, H_20) in which the hydrogen atom consists completely of the normal hydrogen isotope (one proton).

Light water reactor - A nuclear reactor in which circulating light water is used to cool the reactor core and to moderate (reduce the energy of) the neutrons created in the core by the fission reactions.

Long-term lay-up - The shutdown of a generating facility to store or reserve for future use.

Low-level waste - Waste that contains radioactivity, but is not classified as high-level waste, transuranic waste, spent nuclear fuel, or by-product material as defined by Section lie (2) of the Atomic Energy Act of 1954, as amended. Test specimens of fissionable material irradiated for research and development only, and not for the production of power or plutonium, may be classified as low-level waste, provided the concentration of transuranic waste is less than 100 nanocuries per gram. Some low-level waste is considered classified because of the nature of the generating process and/or constituents, because the waste would tell too much about the process.

Macrophyte - An aquatic plant that grows in or near water and is emergent, submergent, or floating.

Makeup water - Replacement for water lost through drift, blowdown, or evaporation (as in a cooling tower).

Man-rem - Unit of radiation dose to an individual.

Maximally exposed individual - A hypothetical person who could potentially receive the maximum dose of radiation or hazardous chemicals.

Megawatt (MW) - A unit of power equal to 1 million watts. "Megawatt-thermal" is commonly used to define heat produced, while "megawatt-electric" defines electricity produced.

Millirem - One thousandth of a rem.

Minority population - A population classified by the Bureau of the Census as Black, Hispanic, Asian and Pacific Islander, American Indian, Eskimo, Aleut, and other nonwhite persons, the composition of which is at least equal to or greater than the state minority average of a defined area of jurisdiction.

National Ambient Air Quality Standards (NAAQS) - Uniform, national air quality standards established by the Environmental Protection Agency under the authority of the Clean Air Act that restrict ambient levels of criteria pollutants to protect public health (primary standards) or public welfare (secondary standards), including plant and animal life, visibility, and materials. Standards have been set for ozone, carbon monoxide, particulates, sulfur dioxide, nitrogen dioxide, and lead.

National Historic Preservation Act (NHPA) - This Act provides that property resources with significant national historic value be placed on the national Register of Historic Places. It does not require any permits, but, pursuant to Federal code, if a proposed action might impact an historic property resource, it mandates consultation with the proper agencies.

National Pollutant Discharge Elimination System (NPDES) - Federal permitting system required for water pollution effluents under the Clean Water Act, as amended.

National Register of Historic Places (NRHP) - A list maintained by the Secretary of the Interior of districts, sites, buildings, structures, and objects of prehistoric or historic local, state, or national significance under Section 2(b) of the Historic Sites Act of 1935(16 U.S.C. 462) and Section IOI(a) (1) (A) of the National Historic Preservation Act of 1966, as amended.

Nuclear reactor - A device that sustains a controlled nuclear fission chain reaction, which releases energy in the form of heat.

Nuclear Regulatory Commission (NRC) - The Federal agency that regulates the civilian nuclear power industry in the United States.

Nuclide - A species of atom characterized by the constitution of its nucleus and, hence, by the number of protons, the number of neutrons, and the energy content.

Outfall- The discharge point of a drain, sewer, or pipe as it empties into a body of water.

Peaking capacity - The capacity of facilities or equipment normally used to supply incremental gas or electricity under extreme demand conditions. Peaking capacity is generally available for a limited number of days at a maximum rate.

Peak load - The maximum load consumed or produced by a unit or group of units in a stated period of time.

Pellets - One configuration of the reactive material in a target rod.

Person-rem - The unit of collective radiation dose to a given population; the sum of the individual doses received by a population segment.

Plume - A flowing, often somewhat conical, trail of emissions from a continuous point source.

Plume immersion - With regard to radiation, the situation in which an individual is enveloped by a cloud of radiation gaseous effluent and receives an external radiation dose.

Pressurized water reactor - A light water reactor in which heat is transferred from the core to an exchanger by water kept under pressure in the primary system. Steam is generated in a secondary circuit. Many reactors producing electric power are pressurized water reactors.

Primary system - With regard to nuclear reactors, the system that circulates a coolant (e.g., water) through the reactor core to remove the heat of reaction.

Probabilistic risk assessment - A comprehensive, logical, and structured methodology to identify and quantitatively evaluate significant accident sequences and their consequences.

Probabilistic safety assessment - A systematic and comprehensive methodology of determining the risks associated with the operation of a nuclear plant.

Probable maximum flood - The hypothetical flood (peak discharge, volume, and hydrograph shape) that is considered to be the most severe reasonably possible, based on comprehensive hydrometeorological application of Probable Maximum Precipitation, and other hydrologic factors favorable for maximum flood runoff, such as sequential storms and snowmelt.

Probable maximum precipitation - The theoretically greatest depth of precipitation for a given duration that is physically possible over a particular drainage area at a certain time of year. (Reference: American Meteorological Society, 1959).

Processing (of spent nuclear fuel) - Applying a chemical or physical process designed to alter the characteristics of the spent fuel matrix.

Project area - The area within the BLN site where all construction activity would occur for either Alternative B or C. The project area includes the south security check point on Bellefonte Road shown in the map inset. The project area for the nuclear generation alternatives is shown on the B&W and AP1000 site plans (Figures 2-1 and 2-12, respectively).

Radiation - The emitted particles or photons from the nuclei of radioactive atoms. Some elements are naturally radioactive; others are induced to become radioactive by bombardment in a reactor. Naturally occurring radiation is indistinguishable from induced radiation.

Radiation shielding - Radiation-absorbing material that is interposed between a source of radiation and organisms that would be harmed by the radiation (e.g., people).

Radioactive waste - Materials from nuclear operations that are radioactive or are contaminated with radioactive material and for which use, reuse, or recovery are impractical.

Radioactivity - The spontaneous decay or disintegration of unstable atomic nuclei, accompanied by the emission of radiation.

Radiological - Related to radiology, the science that deals with the use of ionizing radiation to diagnose and treat disease.

Radwaste - Radioactive materials at the end of their useful life or in a product that is no longer useful and requires proper disposal.

Raw water – Untreated water from the plant intake supplied to the circulating water system and the service water system to make up for water which has been consumed and discharged as part of the system operations.

Reactor - A device or apparatus in which a chain reactor of fissionable material is initiated and controlled; a nuclear reactor.

Reactor accident - See "design basis accident; severe accident."

Reactor coolant system - The system used to transfer energy from the reactor core either directly or indirectly to the heat rejection system.

Reactor core - In a heavy water reactor: the fuel assemblies including the fuel and target rods, control assemblies, blanket assemblies, safety rods, and coolant/moderator. In a light water reactor: the fuel assemblies including the fuel and target rods, control rods, and coolant/moderator. In a modular high-temperature gas-cooled reactor: the graphite elements including the fuel and target elements, control rods, and other reactor shutdown mechanisms, and the graphite reflectors.

Reactor facility - Unless it is modified by words such as containment, vessel, or core, the term reactor facility includes the housing, equipment, and associated areas devoted to the operation and maintenance of one or more reactor cones. Any apparatus that is designed or used to sustain nuclear chain reactions in a controlled manner, including critical and pulsed assemblies and research, tests, and power reactors, is defined as a reactor. All assemblies designed to perform subcritical experiments that could potentially reach criticality are also to be considered reactors.

Record of decision (ROD) - A document prepared in accordance with the requirements of the Council on Environmental Quality and National Environmental Policy Act regulations 40 CFR §1505.2, that provides a concise public record of the decision on a proposed Federal action for which an environmental impact statement was prepared. A Record of Decision identifies the alternatives considered in reaching the decision, the environmentally preferable alternative(s), factors balanced in making the decision, whether all practicable means to avoid or minimize environmental harm have been adopted, and if not, why they were not.

Regolith - A layer of loose, heterogeneous material covering solid rock.

Repository - A place for the disposal of immobilized high-level waste and spent nuclear fuel in isolation from the environment.

Reprocessing (of spent nuclear fuel) - Processing of reactor-irradiated nuclear material (primarily spent nuclear fuel) to recover fissile and fertile material, in order to recycle such materials primarily for defense programs or generation of electricity. Historically, reprocessing has involved aqueous chemical separations of elements (typically uranium or plutonium) from undesired elements in the fuel.

Resin - An ion-exchange medium; organic polymer used for the preferential removal of certain ions from a solution.

Risk - In accident analysis, the probability-weighted consequence of an accident, defined as the accident frequently per year multiplied by the dose. The term "risk" also is used commonly in other applications to describe the probability of an event occurring.

Risk assessment (chemical or radiological*)* - The qualitative and quantitative evaluation performed in an effort to define the risk posed to human health and/or the environment by the presence or potential presence and/or use of specific chemical or radiological materials.

Runoff - The portion of rainfall, melted snow, or irrigation water that flows across the ground surface and eventually enters streams.

Safety analysis report (SAR) - A safety document that provides a complete description and safety analysis of a reactor design, normal and emergency operations, hypothetical accidents and their predicted consequences, and the means proposed to prevent such accidents or mitigate their consequences.

Safety evaluation report - A document prepared by the U.S. Nuclear Regulatory Commission that evaluates documentation (i.e., technical specifications, safety analysis reports, and special safety reviews and studies) submitted by a reactor licensee for its approval. This ensures that all of the safety aspects of part or all of the activities conducted at a reactor are formally and thoroughly analyzed, evaluated, and recorded.

Scoping - The solicitation of comments from interested persons, groups, and agencies at public meetings, public workshops, in writing, electronically, or via fax to assist in defining the proposed action, identifying alternatives, and developing preliminary issues to be addressed in an environmental impact statement.

Secondary system - The system that circulates a coolant (water) through a heat exchanger to remove heat from the primary system.

Seismic Category I - Safety-related structures, systems, and components that are designed and built to withstand the maximum potential earthquake stresses for the particular region where a nuclear plant is sited, without loss of capability to perform their safety functions.

Seismicity - The tendency for earthquakes to occur.

Severe accident - An accident with a frequency rate of less than 106 per year that would have more severe consequences than a design-basis accident, in terms of damage to the facility, off-

site consequences, or both. Also called "beyond design-basis reactor accidents" for this environmental impact statement.

Shutdown - For a U.S. Department of Energy (DOE) reactor, that condition in which the reactor has ceased operation and DOE has declared officially that it does not intend to operate it further (see DOE Order 5480.6, - Safely of Department of Energy-Owned Nuclear Reactors).

Source term - The estimated quantities of radionuclides or chemical pollutants released to the environment.

Spanned - Those areas of high relief where the transmission is high above the canopy such that ROW clearing is not necessary.

Spent nuclear fuel - Fuel that has been withdrawn from a nuclear reactor following irradiation, the constituent elements of which have not be separated.

Threatened species - Any species designated under the Endangered Species Act as likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.

Tier - To link to another in a hierarchical chain. An upper-tier document might be programmatic to the entire DOE complex of sites; a lower-tier document might be specific to one site or process.

Transient - A change in the reactor coolant system temperature, pressure, or both, attributed to a change in the reactor's power output. Transients can be caused by (1) adding or removing neutron poisons, (2) increasing or decreasing electrical load on the turbine generator, or (3) accident conditions.

Tritiated (liquid) - Tritiated liquid is water that contains tritium. The most common form of tritium is in water, because both radioactive tritium and nonradioactive hydrogen react with oxygen in the same way to form water. When this happens, tritium replaces one of the stable hydrogens in the water molecule, H2O, creating tritiated water, which is colorless, odorless, and radioactive.

Tritium - A radioactive isotope of the element hydrogen with two neutrons and one proton. Common symbols for the isotope are "H-3" and "T." Tritium has a half-life of 12.3 years.

Underbuilt - When one or more lines are strung on an existing transmission structure.

Uprate – The process of increasing the maximum power level a commercial nuclear power plant may operate.

Uranium - A heavy, silvery-white metallic element (atomic number 92) with several radioactive isotopes that is used as fuel in nuclear reactors.

Vault - A reinforced concrete structure for storing strategic nuclear materials used in national defense or other programmatic purposes, or for disposing of radioactive or hazardous waste.

Wetlands - Land or areas exhibiting the following: hydric soil conditions, saturated or inundated soil during some portion of the year, and plant species tolerant of such conditions; also, areas

that are inundated or saturated by surface water or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas.

Whole-body dose - With regard to radiation, the dose resulting from the uniform exposure of all organs and tissues in a human body. (Also see effective dose equivalent.)

χ/Q (Chi/Q) - The relative calculated air concentration due to a specific air release and atmospheric dispersion; units are (seconds per cubic meter). For example (Curies per cubic meter)/(Curies per second)= (seconds per cubic meter) or (grams per cubic meter)/(grams per second) = (seconds per cubic meter).

INDEX