Tennessee Valley Authority, 400 West Summit Hill Drive, Knoxville, Tennessee 37902-1499

November 4, 2009

Mr. Lakshminarasimh Raghaven
U.S. Nuclear Regulatory Commission
One White Flint North
11555 Rockville Pike
Mail Stop O-8H4A
Rockville, Maryland 20852-2738

Dear Mr. Raghaven:

DRAFT SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT (SEIS) FOR A SINGLE NUCLEAR UNIT AT THE BELLEFONTE SITE— JACKSON COUNTY, ALABAMA

The enclosed draft SEIS, which evaluates Tennessee Valley Authority's (TVA) proposal to complete or construct and operate a single nuclear generating unit at the Bellefonte Nuclear Plant (BLN) site located in Jackson County, Alabama. TVA is requesting your review of the draft SEIS and is accepting comments between November 13 and December 28, 2009.

TVA is considering a No Action Alternative and two Action Alternatives: completion and operation of a Babcock and Wilcox pressurized light water reactor or construction and operation of a Westinghouse AP1000 advanced pressurized light water reactor. Either of the two Action Alternatives would use licensing processes that are already underway. The draft SEIS also evaluates the impact of refurbishing, reenergizing, and upgrading existing electrical transmission infrastructure necessary to accommodate new power generation.

TVA has identified the need for additional base load generation in the 2018 to 2020 time frame. Completion or construction of one additional nuclear unit capable of generating between approximately 1,100 and 1,200 megawatt (MW) of power within this time frame would help address the need for additional base load generation in the TVA power service area and help meet TVA's goal to have at least 50 percent of its generation portfolio comprised of low or zero carbon-emitting sources by the year 2020. Both Action Alternatives proposed would also make beneficial use of existing assets at the BLN site.

This draft SEIS supplements TVA's original 1974 *Final Environmental Statement – Bellefonte Nuclear Plant Units 1 and 2* for the BLN project and updates other related environmental documents including a 2008 environmental report for the AP1000 for BLN Units 3 and 4. TVA will identify its preferred alternative in the final SEIS after receiving input from the reviewing agencies and the public.

The draft SEIS may be viewed at www.tva.gov/environment/reports/blnp, and comments may be provided to us online. Please note that any comments received, including names and addresses, will become part of the administrative record and will be available for public inspection. To provide written comments, please contact:

Ruth M. Horton
Senior NEPA Specialist
Tennessee Valley Authority
400 West Summit Hill Drive, WT 11D
Knoxville, Tennessee 37902

Phone: (865) 632-3719
E-mail: rmhorton@tva.gov.

Also, for general project information, contact:

Andrea L. Sterdis
Nuclear Project Manager
Tennessee Valley Authority
1101 Market Street, LP 5A
Chattanooga, Tennessee 37402

Phone: (423) 751-7119
E-mail: alsterdis@tva.gov

Sincerely,

Linda B. Shipp

Linda B. Shipp, Senior Manager
NEPA Compliance
Environmental Permitting and Compliance
Office of Environment and Research

Enclosure

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

DRAFT SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT

SINGLE NUCLEAR UNIT AT THE BELLEFONTE PLANT SITE

Jackson County, Alabama

PREPARED BY:
TENNESSEE VALLEY AUTHORITY

NOVEMBER 2009

Page intentionally blank

Draft Supplemental Environmental Impact Statement **November 2009**

Proposed project: Single Nuclear Unit at the Bellefonte Site
Jackson County, Alabama

Lead agency: Tennessee Valley Authority

For further information on the 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: 865-632-3415
E-mail: blnp@tva.gov

For general information on the project, contact:

Andrea L. Sterdis
Nuclear Project Manager
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 December 28, 2009

Abstract: TVA proposes to complete or construct and operate a single 1,100 to 1,200 MW 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 & Wilcox (B&W) pressurized light water reactors, or construct and operate a new Westinghouse AP1000 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 1974) for the BLN project and updates other related environmental documents including the 2008 Environmental Report for the construction and operation of Westinghouse 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, future power needs are not expected to change dramatically. TVA's medium forecast analysis of future demands for electricity from its power system has identified the need for approximately 2,000 megawatts (MW) of additional baseload capacity in the 2018-2020 time frame. At the same time, TVA has set a goal of reducing fossil-fuel emissions and lowering its delivered cost of power.

TVA proposes to complete or construct and operate a single 1,100 - 1,200 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 (1) assure future power supplies, (2) maximize the use of existing assets and licensing processes, (3) avoid larger capital outlays by using those existing assets; and (4) avoid the environmental impacts of siting and constructing new power generating facilities elsewhere. Completing a single nuclear unit at the BLN site would meet a substantial portion of TVA's future generating needs and would help meet the agency's goal of having 50 percent of its overall power supply from low or zero carbon-emitting sources by 2020. The single nuclear unit would provide a low-carbon-emitting power source at a significantly lower cost per installed kilowatt than other baseload power options.

Currently, there are two partially constructed Babcock and Wilcox pressurized light water reactors (B&W) with a rated capacity of about 1,200 MW each at the BLN site. TVA may choose to complete and operate either one of these partially constructed units, or construct and operate a new Westinghouse AP1000 advanced pressurized light water reactor (AP1000) using some of the existing infrastructure. Under any of the proposed 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 four previously proposed units. The considerable work that has been accomplished toward licensing the B&W and AP1000 technology would reduce the time and cost of bringing a single nuclear generating unit at BLN on line.

The purpose of this draft supplemental environmental impact statement (Draft SEIS) 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 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 2008 environmental report for the construction and operation of Westinghouse 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. In June 2009, TVA announced the preparation of a new Integrated Resource Plan (IRP) to replace Energy Vision 2020 which is scheduled to be completed in early 2011. Given the long lead time for bringing a nuclear plant online, completing the SEIS for BLN while simultaneously developing the new IRP will help ensure that a new generation unit could be built in time to meet the projected demand for base load energy.

NEED FOR POWER

TVA's high, medium, and low load forecasts all show the need for additional baseload 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 additional fuel diversity to reduce risk from volatile fuel prices, supply reliable, low-cost power from a proven high-energy producing resource, and afford increased operating flexibility in the face of increasing environmental constraints.

ALTERNATIVES

TVA considered a number of alternatives to constructing and operating BLN 1&2 in its 1974 FES, including various sources of baseload generation and alternative plant locations. Alternative sites and energy options were also included in the 2008 environmental report as part of the COLA process for locating Westinghouse AP1000 units (BLN 3&4) at the BLN site. In this Draft SEIS, 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 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

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. The decision 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 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 CFR Part 1502), this Draft SEIS 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 generation unit at the BLN site.

CHANGES IN THE AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

Under the No Action Alternative, 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 are anticipated to disturb approximately 185 additional acres within the 1,600-acre site.

Potential environmental impacts of the three nuclear generation alternatives are summarized in Table S-1 below. Potential environmental impacts of the two alternatives for transmission upgrades are summarized in Table S-2 below. TVA would implement various mitigation measures to reduce or avoid environmental impacts under all of the action alternatives.

MITIGATION

TVA has identified the following measures to mitigate the potential environmental impacts associated with completion or construction and operation of a nuclear unit at BLN: These measures go beyond those of earlier reviews which either have been met during construction or will be addressed by required permits and authorizations.

- Avoid disturbance of archaeological site 1JA111.
- Take appropriate steps to mitigate potential housing impacts during plant construction in Jackson County as needed.
- Implement any avoidance or mitigation measures resulting from the U. S. Fish and Wildlife Service Biological Opinion.
- For Alternative C, purchase wetland mitigation credits at an approved mitigation bank in compliance with a Section 404/401 permit.
- For Alternative C, mitigate for 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 address the potential impacts of the proposed transmission upgrades. Prior to implementing any ground-disturbing work, TVA would:

- Conduct botanical surveys to examine all sites in areas to be disturbed where listed plant species have been previously reported to determine if the rare species are still present and the full extent of the plants in the ROW. The location of any federally and state-listed species resources would be identified on construction plans and avoided by construction crew.
- Conduct wetlands surveys in the areas to be disturbed. Pending this review, specific commitments including avoidance, minimization measures, or mitigation measures may be placed on wetland areas to ensure no significant impacts or loss of wetland function occurs.

- Evaluate the presence of historic structures and archaeological sites in areas to be disturbed, in accordance with Memorandum of Agreements (MOA) for the treatment and protection of archaeological resources that TVA is developing with each of the affected states (Alabama, Tennessee, and Georgia). Under these MOA, if avoidance were not possible, mitigation (i.e., additional archaeological investigation and data recovery) may be required.

NEXT STEPS

This Draft SEIS will be available for 45 days following publication of the Notice of Availability in the Federal Register. At the close of the public comment period, TVA wil respond to the comments received and incorporate any required changes into the Final SEIS. TVA will also complete consultation with the U. S. Fish and Wildlife Service and the appropriate State Historic Preservation Officers. The completed Final SEIS will be transmitted to 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 NOA of the Final SEIS is published in the *Federal Register*. This decision will be based on the project purpose and need, anticipated environmental impacts, as documented in the Final SEIS, along with cost, schedule, technological, and other considerations. To document the decision, TVA will issue a Record of Decision (ROD).

Table S-1. Summary of the Environmental Impacts of the Three Nuclear Generation Alternatives

Resource	Attribute/Potential Effects	Alternative		
		A - No Action	B – 1 B&W Unit	C – 1 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 associated with construction. No long-term or cumulative impacts to water quality associated with cooling water discharge. No impacts are anticipated to water supply. Minor impacts from chemical discharges.	Minor effects similar to Alternative B, but less due to smaller amount of blowdown water withdrawal and discharge Temporary and minor impacts associated with construction. No long-term or cumulative impacts to water quality associated with cooling water discharge. No impacts to water supply. Minor impacts from chemical discharges.
Groundwater	Chemical impacts to groundwater quality; changes in use of groundwater	No impacts expected.	No impacts expected.	No impacts 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 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 Probable Maximum Flood (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 FRP elevations.
Wetlands	Destruction of wetlands or degradation of wetland functions	No impacts	No impacts	Loss of 12.2 acres of wetlands to be mitigated in-kind within watershed. No indirect or cumulative impacts.

Resource	Attribute/Potential Effects	Alternative		
		A - No Action	B – 1 B&W Unit	C – 1 AP1000 Unit
Aquatic Ecology	Destruction of aquatic organisms; degradation or destruction of aquatic habitat	No impacts	Minor impacts to benthos from dredging intake, 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 water volumes. No cumulative effects.
Terrestrial Ecology	Removal or degradation of terrestrial vegetation, wildlife habitat, and/or wildlife	No impacts	No impacts	Little to no direct impacts from removal of 50 acres of forest and native grass. No indirect or cumulative effects.
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 run-off. Adverse direct, indirect, and cumulative impacts to the pink mucket and sheepnose 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 run-off. 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 and sheepnose mussel 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
Natural Areas	Degradation of the values or qualities of natural areas	No impacts	No impacts	No impacts

Resource	Attribute/Potential Effects	Alternative		
		A - No Action	**B – 1 B&W Unit**	**C – 1 AP1000 Unit**
Recreation	Degradation or elimination of recreation facilities or opportunities	No impacts	Minor impacts from construction and operation noise and withdrawal of water.	Minor impacts from construction and operation noise and withdrawal of water.
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 hydro-demolition and other construction. Minor impacts during operation.	Small to moderate impacts from temporary noise during blasting and other construction. Minor impacts during operation.

Resource	Attribute/Potential Effects	Alternative		
		A - No Action	B – 1 B&W Unit	C – 1 AP1000 Unit
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 and services.	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.
	Public Services	No impact	Minor with the exception of significant increase in demand for schools during construction; moderate increase in demand for schools during operation.	Minor with the exception of significant increase in demand for schools during construction; moderate increase in demand for schools during operation.
	Changes in land use.	No impact	Minor indirect impact from increased residential use.	Minor indirect impact from increased residential use.
	Cumulative effects associated with Redstone Arsenal	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 offsite disposal in permitted facilities.	No direct or cumulative impacts; minor indirect impacts during construction and operation from offsite 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 of offsite disposal in permitted facilities.

Resource	Attribute/Potential Effects	Alternative		
		A - No Action	B – 1 B&W Unit	C – 1 AP1000 Unit
Seismology	Seismic adequacy	No change.	No adverse seismic effects anticipated.	No adverse seismic effects anticipated.
Air Quality	Emissions resulting in increases of air pollutants	No impacts expected	Minor impacts from emissions controlled to meet current applicable regulatory requirements. Minor impacts from vehicular emissions.	Minor impacts from emissions controlled to meet current applicable regulatory requirements. Minor impacts from vehicular emissions.
Radiological Effects	Effects to humans and non-human biota from normal radiological releases	No impacts expected	Annual doses to the public well within regulatory limits; no observable health impacts. Doses to non-human biota well below regulatory limits; no noticeable acute effects.	Annual doses to the public well within regulatory limits; no observable health impacts. Doses to non-human 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	No local or regional impacts
Endangered and Threatened Species	Mortality, harm, or harassment of federally listed or state-listed species	No impacts	No adverse impacts
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 MOAs developed in consultation with the appropriate 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, 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

Page intentionally blank

TABLE OF CONTENTS

LIST OF APPENDICES

LIST OF TABLES

LIST OF FIGURES

Page intentionally blank

ACRONYMS, ABBREVIATIONS, AND SYMBOLS

°C	Degree Celsius
°F	Degree Fahrenheit
±	Plus or Minus
§	Section
7Q10	Lowest flow over 7 consecutive days that occurs once every 10 years
ADCNR	Alabama Department of Conservation and Natural Resources
ADEM	Alabama Department of Environmental Management
AEC	Atomic Energy Commission
ALARA	As Low As Reasonably Achievable
AMA	American Medical Association
ANO	Arkansas Nuclear One
ANSI	American National Standards Institute
AP1000 Units	Bellefonte Units 3 and 4 or BLN 3&4
APE	Area of Potential Effect
AREOR	Annual Radiological Environmental Operating Report
ARPA	Archaeological Resources Protection Act
ASME	American Society of Mechanical Engineers
B&W	Babcock & Wilcox
B&W Units	Bellefonte Units 1 and 2 or BLN 1&2
BFN	Browns Ferry Nuclear Plant
BLN	Bellefonte Nuclear Plant
BMPs	Best Management Practices
BP	Containment Bypass
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 Failure Rupture after 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*
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
CTBD	Cooling Tower Blow Down
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
DSEP	Detailed Scoping, Estimating, and Planning
DO	Dissovled Oxygen
DOE	U.S. Department of Energy
DOI	U.S. Department of Interior
DOT	Department of Transportation
DSEIS	Draft Supplemental Environmental Impact Statement or Draft SEIS
DSEP	Detailed Scoping, Estimating, and Planning
DSM	Demand-Side Management
DSN	Discharge Serial Number
EAB	Exclusion Area Boundary
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
ER	Environmental Report
ERCW	Essential Raw Cooling Water
ESA	Endangered Species Act
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"
FAA	Federal Aviation Administration
FES	Final Environmental Statement
FEIS	Final Environmental Impact Statement of Final EIS
FERC	Federal Energy Regulatory Commission
FRP	Flood Risk Profile
FSEIS	Final Supplemental Environmental Impact Statement or Final SEIS
FSAR	Final Safety Analysis Report
ft^2	Square Feet
GDP	Gross Domestic Product
GEIS	Generic Environmental Impact Statement

gpm	Gallons per Minute
GWh	Gigawatthours
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
IC	Intact Containment
ICRP	International Commission of Radiological Protection
i.e.	Latin term, *id est,* meaning "that is"
IGCC	Integrated Gasification Combined Cycle
IPEEE	Individual Plant Examination for External Events
IRP	Integrated Resource Plan
ISFSI	Independent Spent Fuel Storage Installation
kg	kilogram
kV	Kilovolt
kW	Kilowatt
kWh	Kilowatthour
Ldn	Day-night Noise Level
LLRW	Low Level Radioactive Waste
LPZ	Low Population Zone
LWR	Light Water Reactor
M	Magnitude
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	Million gallons per day
MH	Murphy Hill Nuclear Plant
Min	Minimum
mrem	millirem
msl	Mean Sea Level
MTU	Metric Ton Uranium
MVA	Megavolts-Ampere
MW	Megawatt
MWD	Megawatt-Days
MWe	Megawatt electrical
MWt	Megawatt thermal
MWh/year	Megawatt Hours per Year
N/A	Not Applicable

NAAQS	National Ambient Air Quality Standards
NEI	Nuclear Energy Institute
NEPA	National Environmental Policy Act
NERC	North American Electric Reliability Corporation
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
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
PBN	Phipps Bend Nuclear Plant
PCB	Polychlorinated biphenyl
PCP	Process Control Program
Person-rem	Unit of collective radiation dose to a given population
PM	Particulate Matter
PM2.5	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
PPS	Protection Planning Site
PSA	Probabilistic Safety Assessment
psig	Pound-force per square inch gauge
PSAR	Preliminary Safety Analysis Report
PRA	Probabilistic Risk Assessment
PWR	Pressurized Water Reactor
Radwaste	Radioactive Waste
RBI	Reservoir Benthic Index
RCRA	Resource Conservation and Recovery Act
REMP	Radiological Environmental Monitoring Program
RFAI	Reservoir Fish Assemblage Index
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	Right-of way
RV	recreational vehicle
SAR	Sensitive Area Review
SCCW	Supplemental Condenser Cooling Water
SEIS	Supplement 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
SPCC	Spill Prevention Control and Countermeasure
SQG	Small Quantity Generator
SQN	Sequoyah Nuclear Plant
SRP	Standard Review Plan
SO_2	Sulfur Dioxide
SOW	Scope of Work
STO	Saltillo Nuclear Plant
SWPPP	Stormwater Pollution Prevention Plan
SWA	Small Wild Area
TBD	To Be Determined
TDEC	Tennessee Department of Environment and Conservation
TEDE	Total Effective Does Equivalent
Tenn.	Tennessee
TNC	The Nature Conservancy
TRM	Tennessee River Mile
TVA	Tennessee Valley Authority
TWRA	Tennessee Wildlife Resources Agency
U	Uranium
UO_2	Uranium Dioxide
U.S.	United States
USACE	U.S. Army Corps of Engineers
USGS	U.S. Geological Survey
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
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
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 1990-2008, 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, but future power needs are not expected to change dramatically. TVA's medium forecast analysis of future demands for electricity from its power system has identified the need for approximately 2,000 megawatts (MW) of additional baseload capacity in the 2018-2020 time frame (see Section 1.4).

TVA proposes to complete or construct and operate a single 1,100 -1,200 MW nuclear generation unit at the Bellefonte Nuclear Plant (BLN) site located in Jackson County, Alabama. As part of its proposal, TVA is seeking to (1) assure future power supplies; (2) maximize the use of existing assets and licensing processes; (3) avoid larger capital outlays by using those existing assets; and (4) avoid the environmental impacts of siting and constructing new power generating facilities elsewhere. Completing a single nuclear unit at the BLN site would meet a substantial portion of TVA's future generation needs and also help meet the agency's goal of having 50 percent of its overall power supply from low or zero carbon-emitting sources by 2020. The single nuclear unit would provide a low carbon-emitting power source at a significantly lower cost per installed kilowatt than other baseload power options.

Currently, there are two partially constructed Babcock and Wilcox pressurized light water reactors (B&W) with a rated capacity of at least 1,200 MW each at the BLN site. TVA may choose to complete and operate either one of these partially constructed units, or construct and operate a new Westinghouse AP1000 advanced pressurized light water reactor (AP1000) using some of the existing infrastructure. 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 and has applied for combined (construction and operating) licenses for two AP1000 units. TVA's current proposal is to complete only one nuclear generation 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 generation unit at BLN on line.

The purpose of this supplemental environmental impact statement (SEIS) 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 generation unit at the BLN site. This document supplements the original *Final Environmental Statement Bellefonte Nuclear Plant Units 1 and 2* (1974 FES) 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 for the construction and operation of Westinghouse AP1000 units at the BLN site. 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 generation unit at the BLN site. This SEIS tiers from TVA's Energy Vision 2020 Integrated Resource Plan (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 which is scheduled to be completed in early 2011. Given the long lead time for bringing a nuclear plant online, completing the SEIS for Bellefonte 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.

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 allow increased generation load from the BLN site.

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 currently operating in the U.S. The 205 fuel assembly model at BLN is larger and includes improvements over the earlier designs. Although larger, the basic design, operation, and maintenance philosophy is the same as the current fleet of PWRs operating in the United States. TVA issued an FES addressing the construction and operation of BLN 1&2 in May 1974 (TVA 1974), 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) and an Operating License Environmental Report (ER). 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 Fed. Reg. 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.

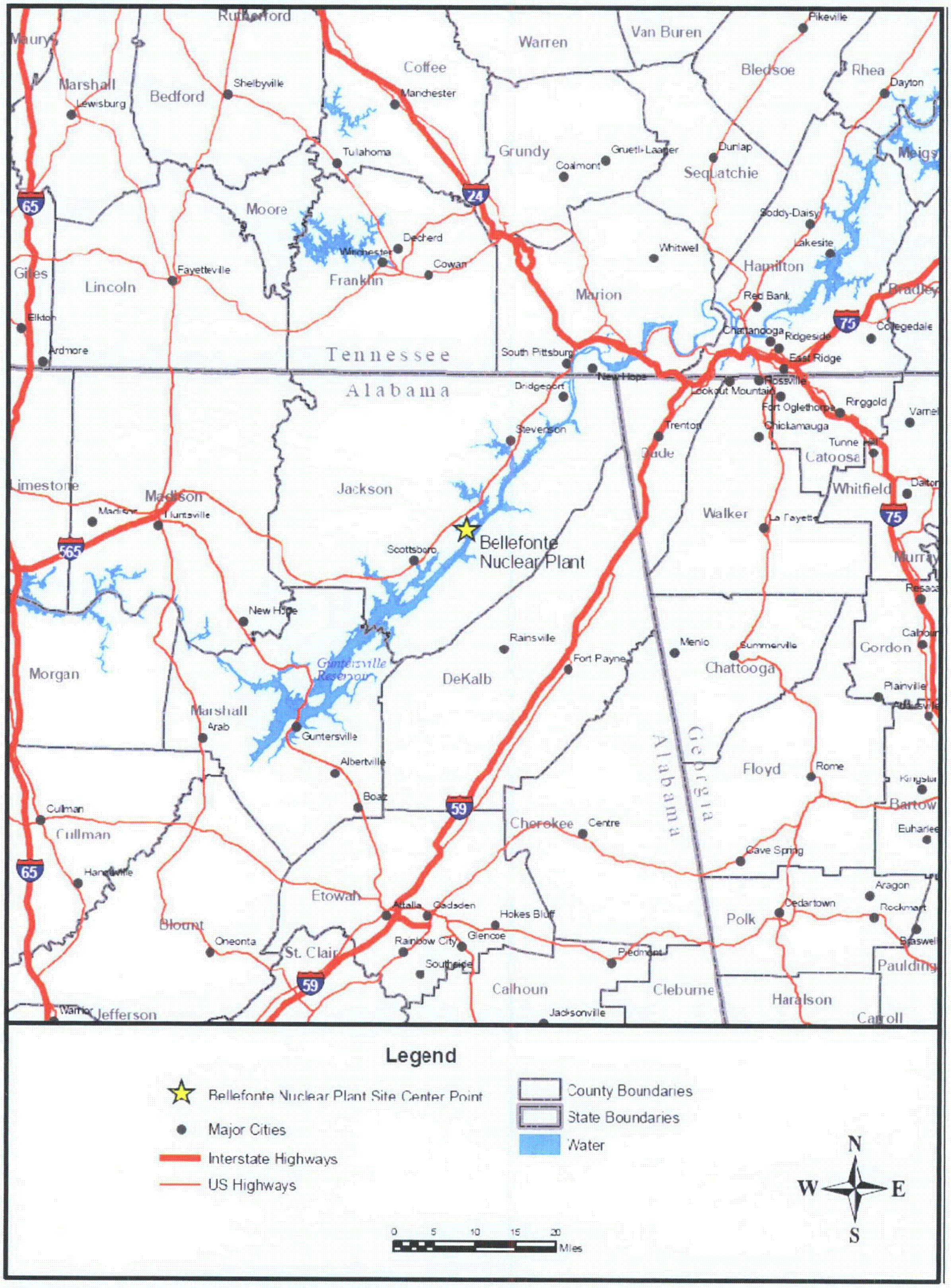

Figure 1-1. Bellefonte Locator Map

In 1993, TVA conducted a review of its 1974 FES, along with information on existing environmental conditions and prepared a white paper (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.

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 asset 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, and determine whether the completion of construction and operation of BLN 1&2 would be a viable option. The NRC reinstated TVA's construction permits for BLN 1&2 in terminated plant status in March 2009 pending re-establishment of the quality assurance 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 quality assurance oversight that occurred in the period from withdrawal of the construction permits through March 2009 was entered into the Corrective Action Program. Also, 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 NRC authorize placement of BLN 1&2 in deferred plant status in accordance with NRC's Order reinstating the construction permits. NRC conducted a BLN site inspection for deferred status the week of October 19, 2009. TVA anticipates a letter from NRC responding to the request for 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 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 a net output each of at least 1,100 megawatts electric (MW) at the BLN site. The BLN COLA included an FSAR and an ER. In October 2008, TVA submitted Revision 1 of the ER, and in January 2009, Revision 1 of the FSAR. 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 for BLN 3&4 to preserve future baseload generation options.

Reinstatement of the construction permits for BLN 1&2 and efforts to return the units to deferred plant status does not affect TVA's current plans to pursue a combined license 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, TVA would address the resulting impacts on the BLN COLA. Likewise, should TVA choose to complete an AP1000 unit, TVA would address the resulting impacts on its construction permit 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 158 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 the TVA power system to 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 co-firing 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. It cannot be stored in meaningful amounts, so 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, 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 reliably supply their power needs.

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 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 the Energy Vision 2020 (TVA 1995a).

Some terms used in this section may have different meanings to different individuals. As used in this document, they have the following meanings. Demand, also called load, is used to describe the amount of energy required in a specific time period and is measured in kilowatts (kW). Peak demand is the maximum load during a specific time period, which could be annually, seasonal, or monthly. Capacity is used to describe the output rating of a generator and is measured in MW. Generation is used to describe how much energy or electricity is produced, and it is measured in kilowatt-hours (kWh).

1.4.1. *Power Demand*

The primary factor affecting the demand for power is economic growth. The TVA Region benefits from its favorable location at the center of the southern U.S. auto industry, because a large portion of the economic growth is dependent on the manufacturing sector. 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 somewhat subdued by historical standards as a result of the current 2008-2009 recession. Increased financial market regulation, tighter credit conditions, as well as large federal budget deficits may all work towards restraining growth to a level lower than what was previously predicted. Although the TVA Region is expected to retain its comparative advantage in the auto 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 (GDP) 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 accurately predict future demand for electricity by using historical sales and announced plans of large industrial customers to use electric power, combined with state-of-the-art forecasting techniques 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. In order 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.

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

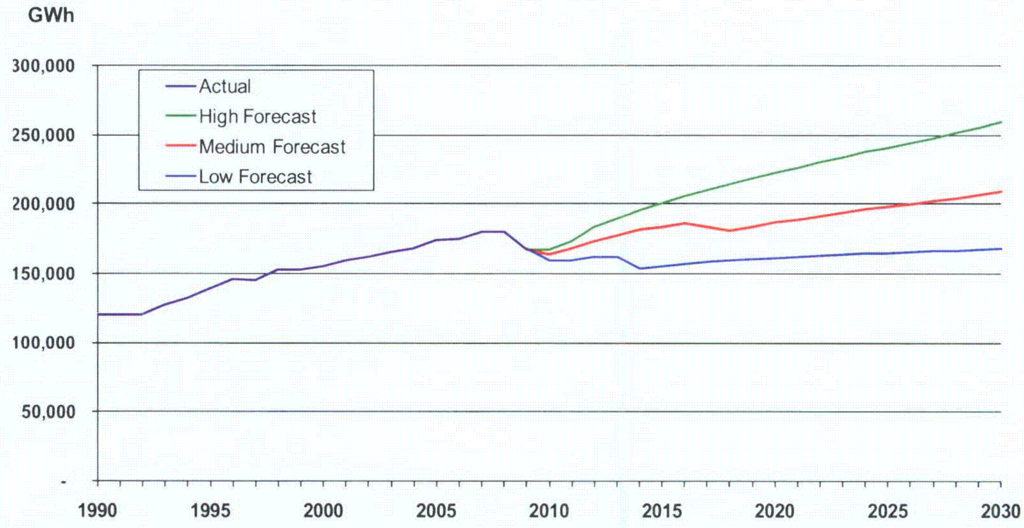

Figure 1-2.[1] **Actual and Forecast Net System Requirements by Fiscal Year**

Historically, net system requirements grew at an average rate of 2.3 percent (1990-2008). Projected requirements, as shown in the medium forecast in Figure 1-2, are expected to grow at an average rate of 0.2 percent through 2011, reflecting the loss of departing distributors and the weak economic conditions compounding over the last year. The average annual growth rate recovers to 1.0 percent in the longer term (2012-2028), but remains lower than the growth rate over the 18-year historical period. For comparison, long-term net system requirements in the low forecast grow at an average annual rate of 0.2 percent, whereas the high forecast shows average annual growth of 1.9 percent.

While TVA plans to the medium-load forecast, the high and low forecasts help TVA make more informed power supply decisions by considering 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 an expected economic growth rate. Distributor and direct-served customers who have not already given notice of departing[2] (i.e., receiving their electrical power from a non-TVA source) are assumed to continually renew their power supply contracts through the planning period. In addition, TVA considers changes in demand, based on input from its customers. TVA sales outside its service territory continue to be guided by the "fence" provisions of the TVA Act.[3]

- **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.

[1] Fiscal Year 2009 is a blend of actuals through July and forecast values for August and September.

[2] Distributors who have served notice and the date of termination are Monticello (November 2008), Paducah (December 2009) and Princeton (January 2010).

[3] 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.

- **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.

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 the 2009 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 the peak demand in the summer, a specified amount of additional capacity, beyond what is needed to meet the peak demand, is required. The additional capacity is called "reserve capacity" and consists of operating reserves and planning reserves. The two combined are commonly referred to as "total reserves." Operating reserve amounts must be large enough to cover the loss of the largest single operating unit (contingency resources), must be able to respond to moment-by-moment changes in system load (regulating reserves), and also must be able to replace the contingency reserves if they fail (replacement reserves). Planning reserve amounts must be large enough to cover unplanned unit outages, load forecasting error, and undelivered purchased capacity. Total reserves in the utility industry (including TVA) are typically between 12 and 20 percent of total system load, depending on the age of current resources. TVA plans for a minimum of 8.5 percent planning reserves, and maintains an additional amount of operating reserves required to meet North American Electric Reliability Corporation (NERC) Reliability Standards Requirements. TVA optimizes its mix of generating assets to meet these standards, which may require contracting with owners of generating assets in TVA's service territory.

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/or 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 has been added to serve a specific purpose, and can be categorized into baseload, peaking, and intermediate uses.

Baseload generators[4] 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. This type of generation also provides needed capacity to meet TVA's peak summer demand, and typically comes from larger coal plants and nuclear plants that can provide continuous, reliable power. Some energy providers may consider combined-cycle plants for small incremental baseload generation needs; however, historically, natural gas prices, when compared to coal and nuclear prices, make combined-cycle an expensive option for larger continuous generation needs. Renewable resources (such as wind and

[4] Baseload capacity consists of all resources with expected capacity factors greater than 65 percent. Baseload 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).

solar) are intermittent in nature and have capacity factors typically well below 50 percent. There is uncertainty about when the wind and solar resources will be available. Because wind and solar generation potential is limited in the TVA region, TVA would need to transmit power generated by wind and solar sources from other regions to obtain meaningful amounts of power from these sources; transmission would further add to the power costs. These reasons render renewable resources unreliable sources of the continuous energy required to meet baseload needs. Section 2.4 includes a discussion of energy alternatives.

Peaking units, conversely, are only expected to operate during high-demand periods, and are essential for maintaining system reliability requirements, as they can ramp up quickly to meet sudden capacity shortages. Examples of peaking resources are 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. Renewable resources can also be considered a peaking resource. For reliability purposes, TVA considers only the portion of these resources likely to be generating during the peak hours as counting towards capacity needs.

Intermediate units, such as natural gas-fired combined cycle plants and smaller coal plants, fill the gap in generation between baseload and peaking needs.

In addition to electric-generating resources, energy efficiency and demand-side management (DSM) (i.e., energy conservation) options offer a potential way to help TVA manage intermediate and peaking needs, respectively, in the future (see Section 2.4.1 for additional discussion of DSM). TVA continues to invest in several programs for residential, commercial, and industrial customers to design and deliver products that will benefit customers, consumers, and the TVA system by reducing peak demand and overall energy needs in the future. Reducing peak demand and energy needs lowers the need for additional capacity.

Capacity

TVA's current (2010) and future (2019) expected capacity consists of a mix of coal, nuclear, hydro, natural gas, market purchases, and renewable resources are shown in Figures 1-3 and 1-4, respectively.

Nuclear and coal are used to meet baseload and some intermediate needs. Natural gas and oil, hydroelectric, and market purchases are used for peaking and additional intermediate needs. Non-hydroelectric renewable resources include solar, wind, and landfill gas resources. Purchases include a long-term baseload purchase from the Red Hills coal plant, a long-term lease of the Caledonia combustion turbine plant, and short-term purchases from the wholesale power market. Hydroelectric includes conventional hydroelectric generation, pump storage and a long-term hydroelectric purchase from Southeastern Power Administration (SEPA). Interruptible load, which includes contracts with industrial customers that allow TVA to reduce the flow of energy to them during high demand periods, is also included and counted toward reserve requirements.

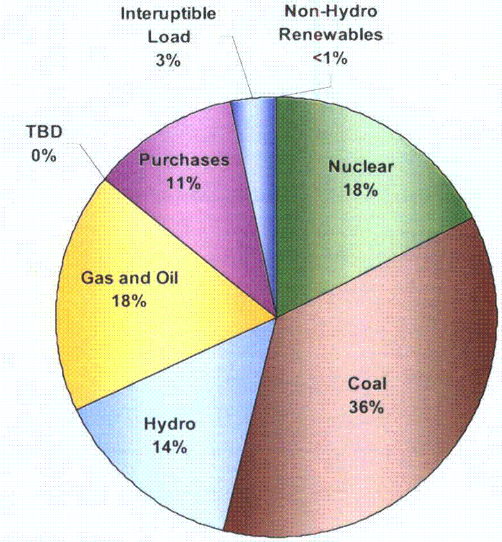

Figure 1-3. 2010 Estimated Capacity by Fuel Type, Based on Total Capacity Need of 37.6 GW

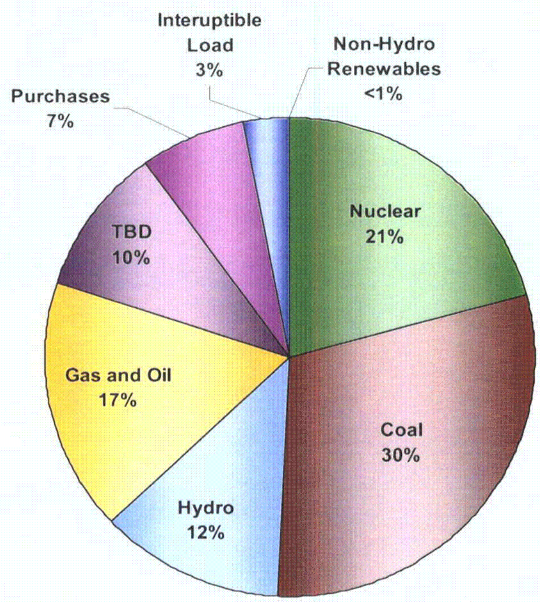

Figure 1-4. 2019 Estimated Capacity by Fuel Type Based on Total Capacity Need of 44.2 GW

The increase in nuclear capacity from 18 percent in 2010 to 21 percent in 2019 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 also included. The decrease in coal capacity from 36 percent in 2010 to 30 percent in 2019 is the result of lower capacity on units where air pollution control equipment has been installed[5], reduced coal contribution as more nuclear capacity is added, and the expected increased generation from the to-be-determined (TBD) category. The slight change in gas and oil is due to an increase from the natural gas combined cycle plant that is proposed to be located at John Sevier Fossil Plant, offset by a decreased contribution as more nuclear capacity is added. The TBD piece of the portfolio, which increases from 0 percent to 10 percent from 2010 to 2019, represents the additional required capacity for which the source is not yet determined. Renewable resources are being considered to meet a portion of this need as indicated by the October 22, 2009 announcement that TVA has entered into long-term contracts for the purchase of approximately 450 MW of renewable wind energy from outside the TVA region, contingent upon completion of environmental reviews and securing of appropriate transmission paths into TVA. The additional capacity needs are presently being evaluated in the new IRP (See Section 1.7).[6]

Generation

TVA's current and future expected energy mix consists of coal, nuclear, hydroelectric, natural gas, market purchases, and renewable resources for 2010 and 2019 are shown in Figures 1-5 and 1-6, respectively.

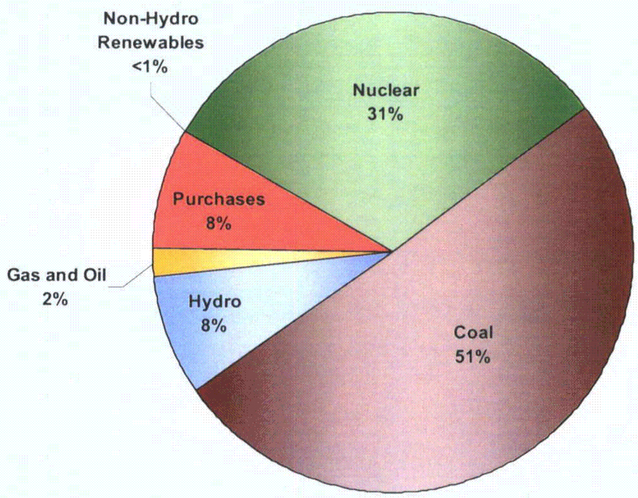

Figure 1-5. 2010 Estimated Generation by Fuel Type

The 2010 generation percentage by fuel type shows 82 percent of TVA's generation from coal and nuclear, with the other 18 percent made up mostly from hydroelectric and market purchases, along with some natural gas generation. Forty-one percent of TVA's generation is projected to be from low or zero carbon-emitting sources. Non-hydroelectric renewable resources including solar, wind, and landfill gas resources, constitute 0.05 percent of TVA's generation. As described earlier, purchases including a long-term baseload purchase from the Red Hills coal plant, a long-term lease of the Caledonia combustion turbine plant and short-term purchases from the market, make up for 8 percent of the total generation. Hydroelectric, including conventional hydroelectric generation, pump storage and a long-

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

[6] The need for power analysis for this Draft SEIS was performed prior to the signing of these contracts.

term hydroelectric purchase from SEPA, represents 8 percent of generation. Interruptible load contracts do not count toward generation.

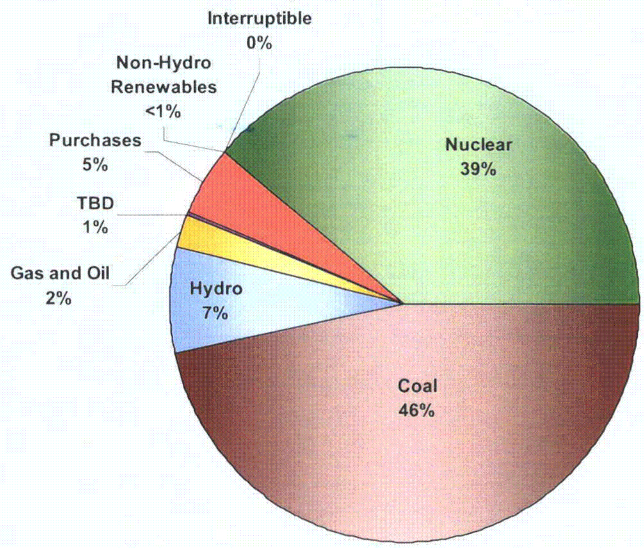

Figure 1-6. 2019 Estimated Generation by Fuel Type

The generation percentages differ from the capacity percentages 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., baseload, peaking). Capacity factor is the total energy the plant produced 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 leads to a higher contribution of nuclear generation than a coal plant with a 70 to 80 percent capacity factor, or a combined cycle at capacity factor of 20 to 70 percent, or a simple cycle combustion turbine at 5 percent or less.

The increase in nuclear generation from 31 percent in 2010 to 39 percent in 2019 (Figure 1-5) 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 also included. The decrease in coal generation is the result of reductions in generating capability of the units due to the addition of air pollution control equipment, as well as the decreased contribution as more nuclear generation replaces coal generation. The percentage of natural gas generation remains the same, but the actual amount of natural gas generation increases due to the natural gas combined cycle plant that is proposed to be located at John Sevier Fossil Plant. The addition of the nuclear units at Watts Bar and at the BLN site, combined with reduced coal generation, would help TVA meet its goal to have at least 50 percent of the generation portfolio composed of low or zero carbon-emitting sources by 2020.

1.4.3. Need for Additional Baseload Power

TVA employs sophisticated production cost models that consider many variables including fuel costs, variable operating and maintenance expenses, and the type of demand being met (e.g., baseload, peaking) 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 production cost modeling.

Once the need for additional capacity has been established, TVA then determines how much of the total capacity need should be baseload, intermediate, and peaking. This is done by comparing the expected generation of available resources to net system requirements (shown in Figure 1-2) to determine whether there is a surplus or deficit of energy. If a deficit of energy exists, some of the additional capacity needs would likely be met with new baseload resources, while remaining needs would be met with intermediate and/or peaking resources.

An analysis based upon July 2009 economic and operating assumptions shows that overall capacity needs before the proposed completion or addition of a BLN unit (not including reserves) increase approximately 6,600 MW from 2010 to 2019 in the medium-load case, approximately 11,000 MW in the high-load case, and approximately 1,700 MW in the low-load case. The corresponding additional generation needs are approximately 20,000 gigawatthours (GWh) in the medium-load case, approximately 33,000 GWh in the high-load case, and approximately 2,500 GWh in the low-load case.

Additional baseload generation is needed by the 2018-2020 time frame under the medium-load and high-load cases, and completing one nuclear unit at the BLN site with a capacity of approximately 1,100-1,200 MW (approximately 9,900 GWh of generation) would meet part of the projected needs. Under the low-load case, adding one nuclear unit at the BLN site would meet about 70 percent of the capacity needs and allows TVA to rely less on its carbon-emitting generation sources; this would help meet TVA's goal to have at least 50 percent of the generation portfolio composed of low or zero carbon-emitting sources by 2020. Under the low-load case, the additional nuclear generation at BLN would reduce reliance on coal generation by 5 percent, as indicated by the reduction in the capacity factor of the total coal fleet from 80 percent to 75 percent.

A nuclear unit at the BLN site also provides additional fuel diversity, which reduces the risks inherent with any particular kind of resource, and lowers the delivered cost of power as TVA accumulates more low-cost fuel options. TVA anticipates the use of a variety of resources, including a mix of demand-side reductions, energy efficiency and additional baseload, and peaking and intermediate generating resource options to address further shortfalls that remain even after one nuclear unit at the BLN site is completed. These resources are currently being evaluated in the IRP (see Section 1.7).

One of the benefits of a nuclear unit at the BLN site is being able to rely less on carbon-emitting sources. By relying less on carbon-emitting sources there are also reductions in other pollutants. Projected changes in emissions from the TVA system between 2010 and 2019 resulting from the addition of one nuclear unit at the BLN site are shown in Table 1-1.

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**
-6.2	-6.1	-5.1	-5.6

The effect of the addition of one BLN nuclear unit on TVA's delivered cost of power in 2018-2024 is shown in Table 1-2 below. Two different reactor technologies are being considered: a B&W design and an AP1000 design. The delivered cost of power (DCOP) is higher in 2018 with the addition of either design than without adding a nuclear unit at the BLN site. With the B&W design, the DCOP value increases to 8.06 cents/kWh, and with the AP1000 design, the DCOP value increases to 8.11 cents/kWh. The increase in 2018 results from the combination of construction and startup cost with startup generation levels. These additional costs are spread over low generation levels causing an increase in the DCOP for both technologies. This begins to change in 2020 as the DCOP begins to decrease from 9.07 cents/kWh to 9.02 cents/kWh for the B&W design. As the unit begins to reach its maximum generation level and the impact of construction costs decline, remaining costs are spread over more kilowatt hours, resulting in a lower cost of power. Due to higher construction costs and slightly lower capacity of the AP1000 design, the DCOP value does not decrease until 2023.

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

Scenario	(cents/kWh)						
	2018	2019	2020	2021	2022	2023	2024
Without a BLN Unit	8.03	8.43	9.07	9.55	9.96	10.59	10.99
BLN with B&W Technology	8.06	8.43	9.02	9.49	9.86	10.50	10.88
BLN with AP1000 Technology	8.11	8.51	9.09	9.56	9.97	10.58	10.96
Change with B&W	0.03	0.00	-0.05	-0.06	-0.10	-0.09	-0.11
Change with AP1000	0.08	0.08	0.02	0.01	0.01	-0.01	-0.03

Considering future capacity and generation needs, coupled with the strategic goal of having 50 percent of its overall power supply from low or zero carbon-emitting sources by 2020, TVA has determined that adding a nuclear unit at the BLN site would most effectively help to achieve these goals. A nuclear unit at the BLN site would (1) provide TVA's customers with additional fuel diversity to reduce risk from volatile fuel prices; (2) supply reliable, low-cost power from a proven high-energy producing resource; and (3) afford increased operating flexibility in the face of increasing environmental constraints. TVA will continue to evaluate how to best meet future needs in the TVA Region while adhering to its mission of serving the Tennessee Valley through energy, environment, and economic development.

1.5. The NEPA Process

The National Environmental Policy Act (NEPA) process, NEPA 42 USC §§4321 et seq., requires Federal agencies to consider the impact of their proposed actions on the environment before making any 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 environmental impact statements (40 CFR §1502.9). TVA is preparing this SEIS to update information in the 1974 BLN Final EIS 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 has prepared and made available a Notice of Intent (NOI) to prepare this SEIS. The NOI was published in the *Federal Register* on August 10, 2009. This notice briefly described the proposed action, reasonable alternatives, and probable environmental issues to be addressed in the SEIS.

After conducting an assessment of the potential environmental effects of the proposed action, TVA has prepared this Draft SEIS. Following distribution to reviewing agencies and posting on the Bellefonte SEIS webpage (http://www.tva.gov/blnp) for public notification and review, TVA will transmit the Draft SEIS to the U.S. Environmental Protection Agency (EPA) for publication of the notice of its availability (NOA) in the *Federal Register.*

The Draft SEIS public comment period begins with the publication of the NOA by EPA in the *Federal Register* and will last 45 days. During this public comment period, one public meeting will be held in December 2009 as a forum to obtain comments on the Draft SEIS. Notice of the public meeting date and location will be distributed through appropriate media and direct mailings, and will be posted on the above Bellefonte SEIS webpage. Comments may also be submitted by mail, email, and through the project webpage during the comment period (Addresses are provided on the first page of this document.).

At the close of the Draft SEIS public comment period, TVA will respond to the comments received and incorporate any required changes into the Final SEIS. TVA will also complete consultation with the U. S. Fish and Wildlife Service and the appropriate State Historic Preservation Officers. The completed Final SEIS will be sent to those who received the Draft SEIS or submitted comments on the Draft SEIS. It will also be transmitted to 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 NOA of the Final SEIS is published in the *Federal Register.* This decision will be based on the project purpose and need, anticipated environmental impacts as documented in the Final SEIS, 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. Scoping and Issues to be Addressed

NEPA regulations require an early and open process for deciding what should be discussed in an environmental review, known as the scope of the evaluation. 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 was conducted by a TVA interdisciplinary team including compilation and review of the documents listed in Table 1-3 and review of the COLA ER and NRC public scoping related to the COLA. In addition, TVA has considered records related to public review of the *TVA SEIS for Completion and Operation of Watts Bar*

Nuclear Plant Unit 2 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 following topics should be addressed in this SEIS:

- 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 and Environmental Justice
- Solid and Hazardous Waste
- Seismology (i.e., earthquakes)
- Meteorology, Climatology and Air Quality
- Radiological Effects of Normal Operations
- Uranium Fuel Use Effects (radioactive waste, spent fuel, and transportation)
- Nuclear Plant Safety and Security
- Decommissioning
- Transmission Line Upgrades

1.7. Other Pertinent Environmental Reviews and Tiering

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, and Table 1-3 provides a more complete listing of relevant environmental documents. 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 1974). 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 environmental impact statement (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 EIS 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 Final EIS 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 Final EIS 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 Section 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, this report 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 (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 Final EIS, 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 early 2011. In order to meet the anticipated demand for baseload power, TVA must make a decision on a single nuclear unit at BLN before the new IRP is completed, as provided for in 40 CFR §1506.1(2)(c). The proposal set out in this NOI supports TVA's goal of reducing its carbon footprint by 2020 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 Final EIS) 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 Final EIS 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 Final EIS was subsequently issued in May 2004. Although operation of a single nuclear unit was not included in the ROS Final EIS 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). Also, BLN's location on a mainstream reservoir ensures TVA control of flows. The assumptions for reservoir operations resulting from the ROS Final EIS 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 Section 3.1.2).

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

Document Type	Title	Date
FES	*Final Environmental Statement, Bellefonte Nuclear Plant Units 1 And 2* (TVA 1974)	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, Rev 30*	Original as updated through 1991
White Paper	*Environmental Impact Statement Review, Bellefonte Nuclear Plant* (TVA 1993a)	March 1993

Document Type	Title	Date
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	*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, Rev 1 (TVA 2008a)*	October 2008
FSAR	*Bellefonte Nuclear Plant Units 3 & 4, COL Application, Part 2, Final Safety Analysis Report, Rev 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 Approvals

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 Cancelled Since Year 2000

Type of Permit/Authorization	Expiration Date	Additional Information
NPDES Permit AL0024635	11/30/2009	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 MMBTU/Hr 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 kW diesel generators)	None	Still active
RCRA EPA ID 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) U.S. Fish and Wildlife Service	16 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.
National Historic Preservation Act of 1966 Alabama, Tennessee and Georgia Historical Commissions; State Historic Preservation Officer (SHPO); Federal Advisory Council on Historic Conservation	16 U.S.C. §§470 et seq.	Consultation with State Historic Preservation Officer for potential impacts to historic properties listed on 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 Bellefonte 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.

Statute/Agency	Authority	Activity Covered
U.S. Army Corps of Engineers (USACE)	33 U.S.C. §1344; 33 U.S.C. §1341	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 by 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/ 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	Stormwater runoff control for construction and individual sites
Resource Conservation and Recovery Act; 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.
Resource Conservation and Recovery Act; Alabama Hazardous Waste Management and Minimization Act	42 U.S.C. §6901 et seq.; Title 22, Alabama Code, Chapter 30	Permit for disposal of non-hazardous waste.
Resource Conservation and Recovery Act; 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 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 that the views of interested parties can be obtained.
Executive Order 11988 (Floodplain Management)	10 CFR §1022; 18 CFR Part 725	Requires federal agencies to avoid floodplain impacts to the extent practicable.
Executive Order 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 baseload generation and eight alternative plant locations. In subsequent environmental reviews, as part of the COLA process, TVA evaluated the construction and operation of Westinghouse AP1000 units (BLN 3&4) at the BLN site which also included alternative sites and energy resource options. In this Draft SEIS, TVA is considering 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 pressurized light water reactor. These alternatives are described in more detail below in Sections 2.1, 2.2, and 2.3. The transmission alternatives include: No Action and an Action Alternative. All of these alternatives are within the range of alternatives considered in previous environmental reviews or reports (see Section 1.7) which are incorporated herein by reference. These previous reviews also considered 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 demand-side management). Alternatives requiring new generating capacity (e.g., coal, natural gas, hydroelectric, and renewable sources) were also assessed, as were combinations of alternatives. A more in-depth discussion on alternative energy sources 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.

To accommodate the delivery of power produced from a single nuclear unit at the BLN site, TVA conducted an Interconnection System Impact Study (TVA 2009b) and determined that transmission network upgrades would be required if overloading with the new generation is at least 3 percent greater than the loading without new generation at the BLN site. These network upgrades represent the Action Alternative for the transmission system (see Section 2.6 and Chapter 4).

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 identification of TVA's preferred alternative is addressed in Section 2.9.

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 onsite. TVA would continue to maintain selected plant systems and the physical plant in a state of nondeterioration, including major components such as the intake and discharge structures, cooling towers, and wastewater system. The switchyards and the transformer yard onsite would continue to be maintained in an active state. TVA would continue to use the simulator building and the environmental data station/meteorological tower. 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 onsite staff presently totals approximately 200 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 that includes, but would not be limited to the following actions:

- Testing and upkeep of fire protection equipment (hoses, valves, smoke detectors, etc.).
- Testing and upkeep of compressors, dehumidifiers, and heaters to maintain dry air in plant piping and other minor activities such as refilling the lube sumps with oil.
- Manual rotation of equipment to prevent freezing up and corrosion of bearings.

TVA would continue regulatory compliance activities that include monitoring and maintenance of equipment used to assure compliance with National Pollutant Discharge Elimination System (NPDES) and Spill Prevention Control and Countermeasures (SPCC) programs. In addition, division 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 Resource Conservation and Recovery Act 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. Accordingly, under the No Action Alternative, TVA would continue to pursue the BLN Units 3 & 4 licensing activities leading to the issuance of a combined license.

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 2, as described in TVA's 1974 FES (TVA 1974) and Bellefonte FSAR (TVA 1978a). The B&W facility descriptions provided in Section 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 electrical output of at least 1,200 MW. The station operating life is expected to be 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, a spent nuclear fuel storage pool, 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.

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.

The reactor core consists of 205 fuel assemblies, 72 control rod assemblies, and 8 axial power shaping rod assemblies. Each fuel assembly provides for 264 fuel rods, 24 rod guide tubes, and 1 instrumentation tube positioned in a 17 x 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 inleakage 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.

Page intentionally blank

Town Creek
Phosphate Pond
Perimeter Road
Meteorological Tower
Bellefonte Road
Training Bldg.
Simulator Building
Livewell
Holding Pond
Parking
Site Access, In Processing
Training, DLC
Yard Drainage Pond
Chemical Pond
Chemical Pond
Security Portal/ Offices and North Sally Port
Cafeteria Expansion
500-kV Switchyard
Office & Service Buildings
PMB
Fire Ops.
MPB
161-kV Switchyard
U1 Diesel Bldg.
Turbine Building
Control Building
Unit 1 Reactor Building
Fab Shop
Auxiliary
Elec. Vehicle Re-Charging
U2 Diesel Bldg.
Unit 2 Reactor Building
Service Road
Unit 2 Cooling Tower
Dry Cask
Crawler Bldg.
Plant Service Rd.
Construction Administration Building
Intake Pumping Station
Water Intake Channel
Desilting Pond
Unit 1 Cooling Tower
Receiving and Distribution
Alum Sludge Ponds
Supply Chain/IT
Laydown Maintenance Insulator, Parts, and Electrical Shops
Sump Ponds
Dock Road
Guntersville Reservoir
Barge Unloading Dock
Tennessee River
Legend
Structures
Existing Structure
Refurbished Building
New Area/Stucture
Security
Water Intake
Bellefonte Project Area
Switchyard
Road
Rail Spur
Vehicle Barrier System
Waterbody
N
W
E
S
0
500
1,000
1,500
2,000
Feet

Page intentionally blank

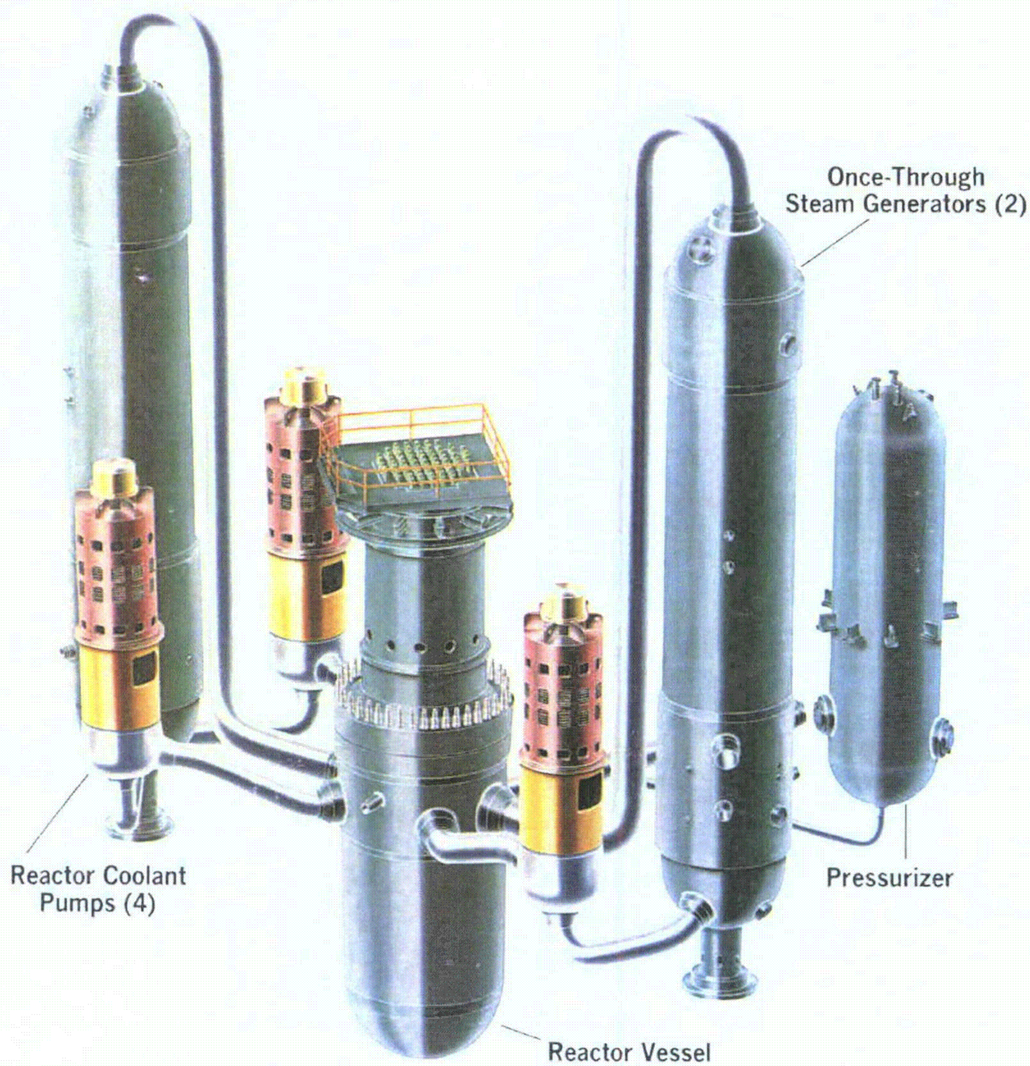

Figure 2-2. B&W Reactor Coolant System

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 turbo-generator is a tandem compound, four-flow, two-stage reheat, 1,800 rpm machine, manufactured by the Brown Boveri Corporation. The expected net generator electrical output is at least 1,200 MW at rated (licensed) power levels.

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.

Essential Raw Cooling Water System

The essential raw cooling water system is designed to remove heat loads from safety-related equipment and 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 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 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 manmade 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. A floating pontoon type structure (trash boom) across the intake channel at the shoreline would serve as a barrier against milfoil and other floating debris, and would discourage direct approach to the intake pumping station from the reservoir.

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 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.

Other Existing Structures

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.

A barge unloading dock is located just north of the blowdown vault on the west bank of Guntersville Reservoir approximately 4700 feet south of the intake channel. This facility was constructed with steel pilings to permit use of the facility throughout the operating life cycle of the plant.

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 three miles northwest of the BLN site.

The existing meteorological tower was built in 2006 to support the COLA. For a B&W unit, a taller tower would be needed, and either the height of the existing 55-meter tower would be increased or a new tower would be built that provides meteorological data sufficient to describe atmospheric transport and diffusion characteristics for operation of Unit 1 or 2. The existing instrumentation would be used on the taller tower. See Section 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.

2.2.2 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. A substantial amount of 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. This equipment, fuel, lubricant, and buildings 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 would be situated on previously disturbed land within the original plant footprint.

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

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. to assess the condition of selected plan 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.

TVA has initiated 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.

2.2.3 Proposed Plant Construction Activities

BLN Units 1&2 were being constructed on a staggered schedule, with Unit 1 scheduled for completion approximately 2 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 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.

This listing is based on the May 2008 cost and schedule update.

- 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 current steam generators had their piping cut and tubes removed and are damaged beyond repair. A more complete description of the steam generator replacement process is provided in Section 2.2.4.
- Refurbish and/or replace major turbine generator equipment such as bearings, rotors, generator, and controls.
- Replace various obsolete instrumentation and control systems for both the nuclear steam supply systems and secondary control systems.
- Replace major pumps, motors, heat exchangers, tanks, and piping removed 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 trash boom (a distance of approximately 1,200 feet), approximately 10,000 cubic yards of dredged material would be removed. From the trash boom to the main river channel (a distance of approximately 760 feet), approximately 11,100 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 this type at 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 (Long 2009).
- 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 American Society of Mechanical Engineers (ASME) standards.
- Install an intrusion barrier (most likely a simple boom) to provide security for the component cooling water system intake pumping station and intake channel.

2.2.4 Steam Generator Replacement

For completion of either Unit 1 or Unit 2, two steam generators would have to be replaced. At approximately 490 tons each, the two steam generators would be the largest components to be delivered to the BLN site during construction. The steam generators would be transported from the fabrication facility by rail and/or barge to the BLN site. Once at the BLN site, the replacement steam generators would be off-loaded 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 river bank and then a multi-wheeled 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 multi-wheeled hauler vehicle to travel.

Because the BLN 1&2 reactors have not been irradiated, 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 HVAC inside containment just inside the equipment hatch would be cut to provide an opening approximately 14 feet x 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 a hydrodemolition equipment
- A rail system would be installed from the outside of containment to the inside of the reactor pool. A multi-wheeled 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 multi-wheeled 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 multi-wheeled 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 multi-wheeled 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 re-clearing, minor demolition and new construction, and equipment replacement. A hydro-demolition 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 Pressurized Light Water Reactor

Under Alternative C, TVA would construct and operate a single AP1000 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 content (TVA 2008a). Existing main structures that would be used under Alternative C are discussed in Section 2.3.2.

2.3.1 *Facility Description of Single Unit Operation*

The nuclear steam supply system for the AP1000 is a Westinghouse-designed 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 electrical output of at least 1,100 MW. The plant operating life cycle is expected to be 40 years.

An AP1000 power block complex is composed of five principal building structures: the nuclear island, turbine building, annex building, diesel generator building, and radwaste building (see Figure 2-4). 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 1.

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 contains 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 turbine building is a steel column and beam structure, which 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 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 accessways 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 fire wall. The diesel generators provide backup power for plant operation if normal power sources are disrupted.

Page intentionally blank

Figure 2-3. AP1000 Site Plan

Page intentionally blank

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 the 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 consists of 264 fuel rods in a 17 x 17 square array. The core is designed to operate approximately 18 months between refueling outages.

The AP1000 reactor coolant system (see Figure 2-5) 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, 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, 1800 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. Each turbine generator has an expected net generator electrical output of at least 1,100 MW for each reactor thermal output of 3415 MWt.

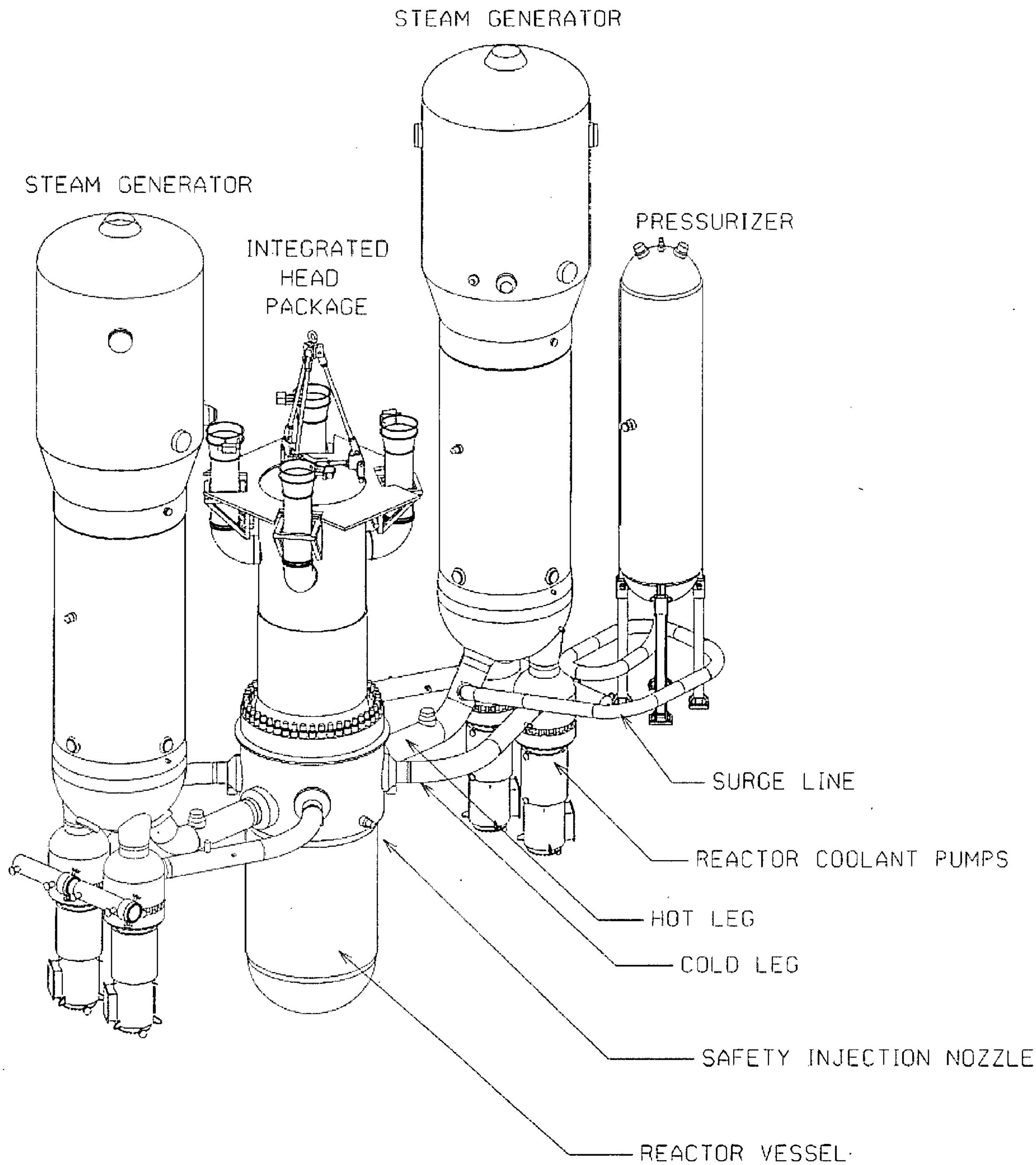

Figure 2-5. AP1000 Reactor Coolant System

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 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 Site 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 which 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, such as those in 10 CFR Part 100. The AP1000 engineered safety features are described below.

The containment vessel, an integral part of the overall containment system, contains the release of airborne release of 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 alternating current 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 exclusion area boundary is the same for both the B&W and AP1000 alternatives and is discussed in Section 2.2.1 (see Figure 2-3).

2.3.2 Use of Partially Constructed Facility

Approximately 400 acres of the 1600-acre BLN site were disturbed for the partially constructed BLN 1&2 and associated plant structures. Construction of one AP1000 unit and associated structures are anticipated to disturb an additional 185 acres on the site. 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 2-4). 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 the AP1000.

Intake Channel and Pumping Station

The intake channel and pumping station would provide make-up water to the AP1000. Removal of silt from the intake channel would be necessary. From the pumping station to the trash boom (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 Section 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 transmission lines and switchyards is provided in Section 2.6.1. No new transmission lines were proposed in the COLA ER.

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 a total of 34 barge shipments over a 3- to 4-month period. These shipments of pre-fabricated 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 used 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 to support the COLA. 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 include: 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 provides 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

Alternatives to nuclear-powered generation at the BLN site have been analyzed and discussed in earlier reviews. These alternatives are summarized below and include those that do not require new generating capacity (Section 2.4.1),alternatives that require new generating capacity (Section 2.4.2), as well as a combination of those alternatives (Section 2.4.3).

2.4.1 Alternatives Not Requiring New Generating Capacity

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 baseload purchase from the Red Hills coal-fired plant, a long-term lease of the Caledonia combustion turbine plant, a long-term hydroelectric purchase from Southeastern Power Administration (SEPA) 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 power planning process, (2) typically is subject to fuel volatility, (3) transfers environmental impacts to another location, and (4) involves additional potential impacts on transmission.

Repowering electrical generating plants is the process by which utilities update 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 baseload electricity. NRC has approved power uprates for TVA's Browns Ferry (BFN), Sequoyah (SQN), and Watts Bar (WBN) nuclear plants since 1998, and TVA is seeking additional uprates for its BFN units TVA continues to modernize its hydro generation which increases its hydro generation capacity. 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 baseload capacity needs of 6,600 MW from 2010 to 2019 (medium-load forecast).

Energy efficiency and demand side management (DSM) (i.e., energy conservation) offers a potential way to help TVA primarily manage intermediate and peaking needs, respectively. DSM generally affects peak demand. Since the 1970s, TVA has had residential and commercial programs to reduce peak demand and energy consumption. TVA continues to invest in DSM programs for residential, commercial, and industrial customers that will benefit customers, consumers, and the TVA system by reducing peak demand and overall energy needs. TVA also has interruptible load contracts with industrial customers that allow TVA to reduce the flow of energy to them during high demand periods. Reducing peak demand and energy needs lowers the need for additional capacity in the future. Energy Vision 2020 examined the potential merits of a large number of different energy efficiency and DSM measures and TVA is updating these analyses in its ongoing IRP process. These resource options could reduce demand, particularly peak demand, substantially in the future, but will take time to implement and their results are uncertain. .

As discussed in Section 1.4, TVA's generating supply already 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. Each type of generation has been added to serve a specific purpose, and can be categorized into baseload, peaking, and intermediate uses. TVA's baseload generators historically have been the larger coal plants and nuclear plants because they have lower operating costs and are expected to be available and operate continuously throughout the day. Depending on the cost of natural gas, natural gas combined cycle plants also may prove to be an economical means of meeting baseload needs. Coal and natural gas generation, however, each have uncertainties respecting their production costs and performance in the future as does nuclear generation. Based on the analyses in Energy Vision 2020, it was concluded that increasing the diversity of the TVA power system helped address the uncertainties associated with any one kind of energy resource. The proposed addition of another nuclear unit at the BLN site promotes TVA's diversity of energy resources.

2.4.2 Alternatives Requiring New Generating Capacity

Other 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 of these: air quality, waste management, land use, water use and quality, human health, ecology, socioeconomics, aesthetics, historic and cultural resources, and environmental justice. These assessments are based on the fact that many of the construction-related environmental impacts of a nuclear unit at the BLN site have already occurred. A coal-fired plant was found not to be environmentally preferable to a nuclear plant due primarily to impacts on air quality, waste management, and aesthetics. A natural-gas-fired plant was found not to be environmentally preferable to a nuclear unit due primarily to impacts on air quality.

Renewable resources (wind and solar) are intermittent in nature and have capacity factors typically well below 50 percent. There is uncertainty about when the wind and solar generation resources will be available. Wind and solar generation potential is limited in the TVA region. In order to obtain meaningful amounts of power from these sources, TVA would need to purchase wind and solar power generated in other regions and bear the increased transmission costs. For these reasons, renewable resources are not considered reasonable baseload alternatives.

Hydropower is a contributor to TVA's current total power generation mix, but it is used primarily as a peaking resource and to help regulate the system. However, development of major new hydropower sites in the Tennessee River Valley or TVA power service area is not considered a reasonable alternative to address the need for baseload power, because of the low capacity factors of hydroelectric plants, the environmental impacts, and limited availability of feasible new

TVA considered the conversion of the BLN site to an Integrated Gasification Combined Cycle (IGCC) facility, as described in Energy Vision 2020 and analyzed in a subsequent site-specific EIS (TVA 1997). An IGCC facility is not a reasonable alternative to new nuclear generation, because IGCC technology currently is not cost-effective and requires further research to achieve an acceptable level of reliability. It would also fail to use existing assets at the BLN site to the same substantial degree as a nuclear unit.

2.4.3 Consideration of Other Alternatives and Combination of Alternatives

Some of the alternatives that require new generating capacity were eliminated from further consideration based on their lack of availability in the region, overall lack of feasibility, inability to supply baseload power, or environmental consequences. Other alternatives to nuclear-powered electrical generation at the BLN site are coal-fired generation and natural-gas-fired generation. TVA assessed several types of impacts for both of these: air quality, waste management, land use, water use and quality, human health, ecology, socioeconomics, aesthetics, historic and cultural resources, and environmental justice. This assessment is based on the fact that many of the construction-related environmental impacts of a nuclear plant at BLN have already occurred. A coal-fired plant was found not environmentally preferable to a nuclear plant due primarily to impacts on air quality, waste management, and aesthetics. A natural-gas-fired plant was found not environmentally preferable to a nuclear plant due primarily to impacts on air quality.

A combination of energy sources that would be an alternative to nuclear generation is composed of a baseload-capable energy source, coupled with a renewable non-baseload capable source. TVA expects a nuclear plant to be baseload capable in its capacity planning (i.e., provide power in a predictable, consistent manner). Any combination of alternatives would have the same requirement: provide full dependability of a consistent baseload supply, but reduce environmental impacts. The renewable part of the combination of energy alternatives is any combination of renewable technologies that could produce power equal to or less than a nuclear plant, when that resource is available. TVA considered wind and solar as the renewable sources of power able to supplement the baseload capable source.

For the environmental comparison, natural gas was used as the fossil fuel for baseload capacity in combination with the renewable source, because a natural-gas-fired plant has a smaller environmental impact than a coal-fired plant. The natural-gas-fired facility alone has impacts that are greater than nuclear, particularly those related to the emissions of air pollutants and greenhouse gases. In addition, some of the environmental impacts of wind and solar energy (e.g. large sites required, aesthetic and scenic value concerns) are equal to or greater than those of a nuclear plant. As a result, the combination of a natural-gas-fired plant and wind or solar facilities would have environmental impacts that are equal to or greater than those of a nuclear facility. Therefore, a combination of alternatives would not be environmentally preferable to a nuclear plant at the BLN site.

For the economic comparison, coal was used as the fossil fuel for baseload capacity in combination with the renewable power source, because a coal-fired power plant can generate electricity at a lower cost than a natural-gas-fired power plant. The costs of a combination of alternatives would largely be driven by the costs of coal-fired or natural-gas-fired plants, and only a small fraction of the energy needed by the combination would be obtained from the renewable source. TVA considered a range of levelized costs (which reflect construction and operating costs, financing and other economic factors) for nuclear, coal-fired, and natural-gas-fired generation reported in recently published studies. TVA concluded the range of costs associated with nuclear generation of electricity at the BLN site is anticipated to be similar to, and within, the range of costs associated with a combination of other viable forms of electricity generation.

In summary, while other combinations of the various alternatives were not analyzed, the lower capacity factors, higher environmental impacts, immature technologies, and a lack of cost competitiveness have not been found to assemble into a viable, competitive, alternative combination that is either environmentally equivalent or preferable to nuclear generation.

Wind and solar generation in combination with fossil-fuel-fired facilities could be used to generate baseload power and would serve the equivalent purpose of nuclear generation. However, wind and solar generation in combination with fossil-fuel-fired facilities would have equivalent or greater environmental impacts as compared to a new nuclear facility at the BLN site. The electrical generating costs associated with wind generation in combination with fossil-fuel-fired facilities would be comparable to a new nuclear facility at the BLN site. However, the environmental impacts related to the combinations of alternatives are equal to or greater than the environmental impacts of a nuclear plant. Therefore, wind and solar generation in combination with fossil-fuel-fired facilities are not environmentally preferable to a nuclear plant at the BLN site.

Based on environmental impacts, the analyses demonstrate that either a coal-fired or a natural-gas-fired plant would entail an appreciably greater environmental impact on air quality than would a nuclear plant. In addition, a combination of either coal-fired or natural-gas-fired generation with renewable sources of energy, such as wind or solar, is possible. However, to achieve a smaller impact on the air qualify, a moderate-to-large impact on land would be required. Equally important, these alternatives do not help achieve the purpose of maximizing the beneficial use of existing assets at the BLN site nor the goal of generating 50 percent of TVA's power from zero or low-carbon emitting sources by 2020. Therefore, TVA concluded that neither a coal-fired, nor natural-gas-fired plant, nor a combination of alternatives would be environmentally preferable to a B&W or AP1000 nuclear plant at the BLN site.

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 1974). The COLA ER 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 2008d).
- Criteria and Basis for Comparative Ratings Among Alternative Brownfield and Greenfield Sites, August 2008 (TVA 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, August 2008 (TVA 2008f).

2.5.1 Identification and Screening of Potential Sites

The consideration of alternatives is required by NEPA and Section 51.45 of Title 10 of the Code of Federal Regulations (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 SEIS.

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 areas, 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: Bellefonte (BLN), Yellow Creek (YCN), Hartsville (HVN), Phipps Bend (PBN), Watts Bar (WBN), Browns Ferry (BFN), Sequoyah (SQN), Murphy Hill (MH), and Saltillo (STO).

TVA constructed multi-unit nuclear generation facilities at three of the above sites: BFN near Athens, Alabama; SQN near Chattanooga; 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 also was 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 2017-2020 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 2017-2020 time frame.

Because TVA concluded that co-location at existing nuclear sites (Browns Ferry, Sequoyah or Watts Bar Nuclear Plants) is not an acceptable alternative for reasons related to thermal issues, unavailability of adequate land the inability to make beneficial use of existing assets at BLN, 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 their ROI for potential siting of a new nuclear facility in the COLA ER, which also reviews 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 1974).
- *Final Environmental Statement – Hartsville Nuclear Plants* (TVA 1975).
- *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 towns of Hollywood and Scottsboro. Construction activities at BLN were deferred in 1988. The BLN site is reviewed at length in this SEIS and the COLA ER.

The former Hartsville Nuclear Plant site is situated on the north shore of Old Hickory Reservoir on the Cumberland River in Smith and Trousdale counties, Tennessee. The HVN site nuclear units were cancelled in 1982 and 1984, respectively.

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

The former Yellow Creek Nuclear Plant 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 Murphy Hill 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 a Final EIS. 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 sites to determine whether any alternative sites 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 2008d, TVA 2008e, and TVA 2008f).

The alternative sites analysis compared the BLN site with the four alternative sites to determine if there were any obviously superior sites among the candidate sites. A simultaneous comparison considered the additional economics, technology, and institutional factors among the candidate sites to see if any are obviously superior. Based on the comparison there were no obviously superior sites among the candidate sites, and 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 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 updated in 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 line upgrades. Prior to conducting transmission line upgrades, site-specific reviews would be conducted to 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 de-energized for a number of years. Four 500-kV transmission lines (the Widows Creek – Bellefonte 500-kV #1 and #2, 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. These 500-kV lines 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 the Bellefonte – Madison 500-kV line, are energized and currently connect Widows Creek Fossil Plant generation to the TVA transmission system. No power is being transmitted from the BLN site.

The Widows Creek – Bellefonte 500 kV #1 and #2 lines would require uprating (see Section 2.6.4). The Bellefonte-Madison 500-kV and Bellefonte-East Point 500-kV only need to be connected and re-energized. Right-of way (ROW) vegetation management on the de-energized 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 Bellefonte-Scottsboro 161-kV lines would not need to be changed to support operation of a BLN nuclear plant.

In addition to the lines coming into the switchyard, there are six 161 kV lines and one additional 500kV line that are located elsewhere. These lines would be reconductored and/or uprated, as described in Section 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 facilities 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.

TVA identified two options for addressing the projected line overloading: (1) upgrade the electrical capacity of the overloaded transmission lines or (2) construct new transmission lines, as well as upgrade some of the existing overloaded lines. The estimated cost of Option 2 is about 200 percent of the estimated cost of Option 1. In addition, the purchase, clearing, and construction of new transmission lines on new ROWs would add substantially to the environmental effects of the proposed action. Therefore, Option 2 has been eliminated from further consideration. As a result, the two alternatives for the transmission line system are the No Action Alternative and the Action Alternative.

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 which 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 of "danger trees" adjacent to the cleared ROW, and control of 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 3 to 5 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, technical specialists in the TVA Regional Natural Heritage Project, and TVA Cultural Resources group 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 SAR is contained in Appendix G. 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. The TVA Regional Natural Heritage Project 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 records that are present, or are potentially present, in transmission line ROWs are taken into consideration when conducting these transmission line reviews. Wetland information is maintained by TVA Resource Services and includes National Wetland Inventory (NWI) wetland maps for the entire PSA. Soil survey maps are also used to identify potential wetland areas. The TVA Cultural Resources group maintains records of known archaeological sites, and routinely gathers information from the seven-state power service area.

Heritage staff examine the transmission line corridors (using video available to them on TVA InsideNet computer files) to "see" 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 from the TVA Natural Heritage database, 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 the TVA Natural Heritage database for 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 Heritage 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 re-clearing plan would be developed for each transmission line segment based upon the periodic inspections described above. The two principle 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 U.S. Environmental Protection Agency (EPA) would be used.

Where transmission lines cross Natural Areas, TVA uses 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 restriction class. Examples of restrictions include hand-clearing only and selective spraying of herbicides to shrubs or tree saplings.

The construction, maintenance, and operation of TVA transmission lines all constitute undertakings and as such are 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 re-energized, and other existing transmission lines would be refurbished and upgraded as described in Section 2.6.4. The decision to approve and fund a single nuclear generation unit would be made first. 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 2-6.

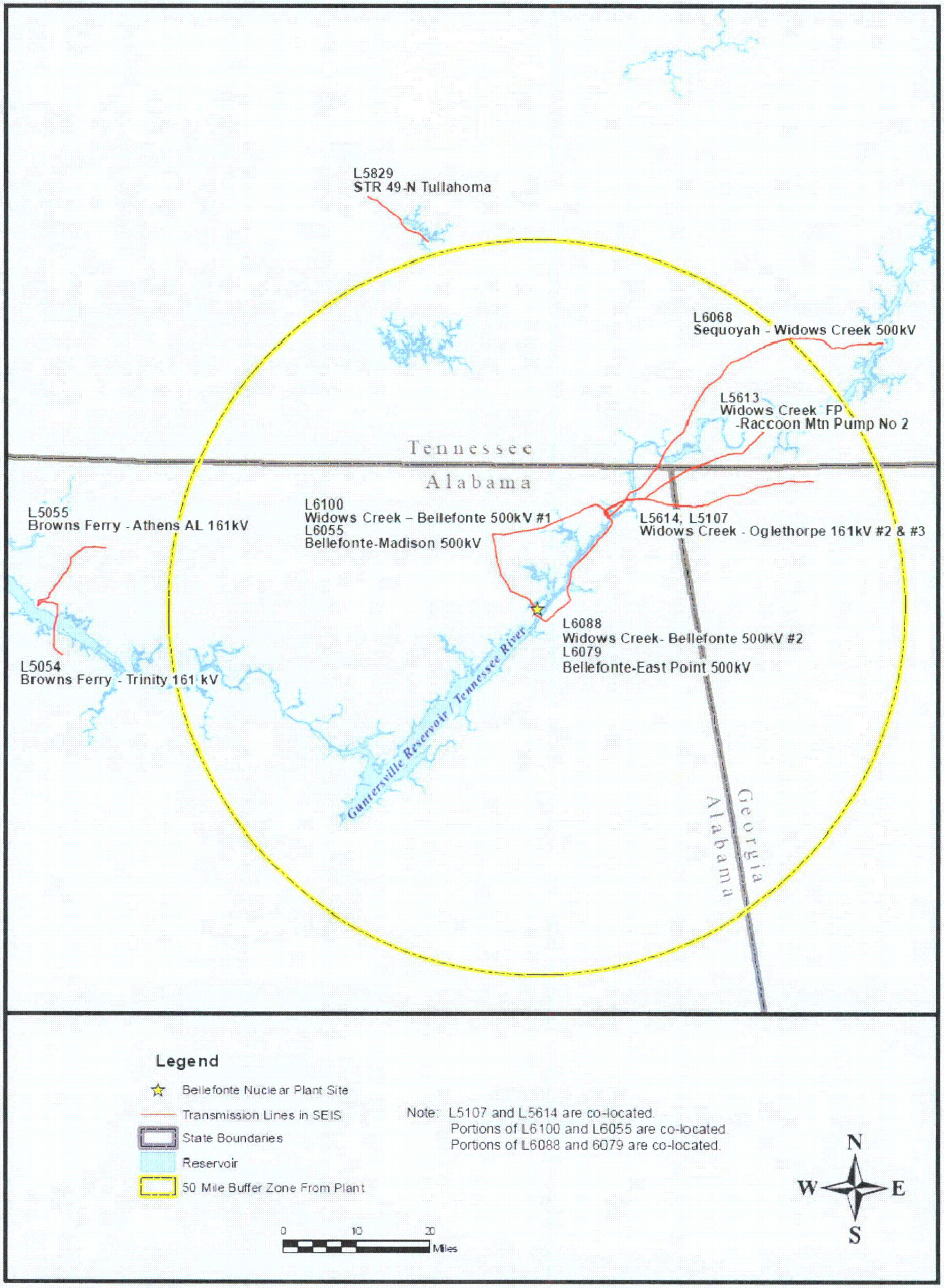

Figure 2-6. Transmission Line Right of Ways Affected by the Action Alternatives

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 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 onsite.

- *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.

- *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 a taller structure is needed, the existing structure is removed and new ones 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 are 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 will 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 500-kV #1 and #2 transmission line sections. 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 determine 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 eleven transmission lines or segments of these lines would require upgrades. A list of the 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	Miles of Line to be Upgraded
Number	Name		
L5829	STR 49-N. Tullahoma Tap 161 kV	Reconductor to 954 ACSS @ 180° C (446-518 MVA)	10.9
L6068	Sequoyah-Widows Creek 500 kV	Uprate to 100° C capability (2598 MVA)	49.5
L5613	Widows Creek-Raccoon Mountain 161 kV	Reconductor to 2x956 ACSS @ 180° C (957-1068 MVA)	25.3
L5614	Widows Creek-Oglethorpe 161 kV #2	Reconductor to 954 ACSS @ 180° C (446-518 MVA)	30.5
L5107	Widows Creek-Oglethorpe 161 kV #3	Reconductor to 954 ACSS @ 180° C (446-518 MVA)	30.6
L6100	Widows Creek-Bellefonte 500 kV #1[1]	Uprate to 100° C capability (2598 MVA)	29.8
L6055	Bellefonte-Madison 500 kV[1]	Energize	29.8
L6088	Widows Creek-Bellefonte 500 kV #2[2]	Uprate to 100° C capability (2598 MVA)	21.2
L6079	Bellefonte-East Point 500 kV[2]	Energize	21.2
L5054	Browns Ferry-Trinity 161 kV	Reconductor to 1590 ACSS @ 180° C (669-734 MVA)	10.0
L5055	Browns Ferry-Athens 161 kV	Reconductor to 1590 ACSS @ 180° C (669-734 MVA)	14.1

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

[2]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 Upgrades).

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 nuclear generation alternatives are summarized in Table 2-3 below. Potential environmental impacts of the two alternatives for transmission upgrades are summarized in Table 2-4 below. Mitigation measures designed to avoid or minimize impacts of the proposed action are listed in Section 2.8.

Table 2-2. Summary of Generation Alternative Characteristics

Characteristics		Generation Alternative		
		A – No Action	**Alternative B – B&W Unit**	**Alternative C – AP1000 Unit**
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		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.
	Steam generator system		Once-through	U-tube
	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	400 acres	585 acres
	Site clearing/grading	Negligible	Minor re-clearing and grading of previously disturbed ground	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	Off-site construction of modules delivered to BLN via barge and completed on site.
	Demolition	Little to none	No major buildings demolished	Several buildings demolished, including turbine building and administration complex
	Quantity of nonhazardous solid waste generated	Not applicable	392 cubic meters of concrete waste; 208 tons steel waste	---[7]
	Quantity of hazardous waste generated	Not applicable	6.3 tons solid; 56.7 tons liquid	7.25 tons
	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

[7] Estimate currently being developed

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	34,000 gpm	23,953 gpm
	Typical amount of water discharged to Guntersville Reservoir	approximately 400,000 gallons per quarter year	22,650 gpm	7,914 gpm
	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	200	849	650
	Quantity of nonhazardous solid waste generated	about 100 cubic yards/year (average)	---[7]	400 tons/year
	Quantity of hazardous waste	less than 100 kg/month	between 100 and 1000 kg/month	less than 100 kg/month
	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
	Number of containers needed for long-term storage of spent fuel	None	96	76
Cost	Construction	Not applicable	$3,120 – $3,360/kWe	$3,300 – $4,900/kWe
	Operation and maintenance	Not applicable	$.0132/kwh	$.0126/kwh

Table 2-3. Summary of the Environmental Impacts of the Three Nuclear Generation Alternatives

Resource	Attribute/Potential Effects	Alternative		
		A - No Action	B – 1 B&W Unit	C – 1 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 associated with construction. No long-term or cumulative impacts to water quality associated with cooling water discharge. No impacts are anticipated to water supply. Minor impacts from chemical discharges.	Minor effects similar to Alternative B, but less due to smaller amount of blowdown water withdrawal and discharge Temporary and minor impacts associated with construction. No long-term or cumulative impacts to water quality associated with cooling water discharge. No impacts to water supply. Minor impacts from chemical discharges.
Groundwater	Chemical impacts to groundwater quality; changes in use of groundwater	No impacts expected.	No impacts expected.	No impacts 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 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 Probable Maximum Flood (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 FRP elevations.
Wetlands	Destruction of wetlands or degradation of wetland functions	No impacts	No impacts	Loss of 12.2 acres of wetlands to be mitigated in-kind within watershed. No indirect or cumulative impacts.

Resource	Attribute/Potential Effects	Alternative		
		A - No Action	B – 1 B&W Unit	C – 1 AP1000 Unit
Aquatic Ecology	Destruction of aquatic organisms; degradation or destruction of aquatic habitat	No impacts	Minor impacts to benthos from dredging intake, 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 water volumes. No cumulative effects.
Terrestrial Ecology	Removal or degradation of terrestrial vegetation, wildlife habitat, and/or wildlife	No impacts	No impacts	Little to no direct impacts from removal of 50 acres of forest and native grass. No indirect or cumulative effects.
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 run-off. Adverse direct, indirect, and cumulative impacts to the pink mucket and sheepnose 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 run-off. 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 and sheepnose mussel 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
Natural Areas	Degradation of the values or qualities of natural areas	No impacts	No impacts	No impacts

Resource	Attribute/Potential Effects	Alternative		
		A - No Action	B – 1 B&W Unit	C – 1 AP1000 Unit
Recreation	Degradation or elimination of recreation facilities or opportunities	No impacts	Minor impacts from construction and operation noise and withdrawal of water.	Minor impacts from construction and operation noise and withdrawal of water.
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 hydro-demolition and other construction. Minor impacts during operation.	Small to moderate impacts from temporary noise during blasting and other construction. Minor impacts during operation.

Resource	Attribute/Potential Effects	Alternative		
		A - No Action	B – 1 B&W Unit	C – 1 AP1000 Unit
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 and services.	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.
	Public Services	No impact	Minor with the exception of significant increase in demand for schools during construction; moderate increase in demand for schools during operation.	Minor with the exception of significant increase in demand for schools during construction; moderate increase in demand for schools during operation.
	Changes in land use.	No impact	Minor indirect impact from increased residential use.	Minor indirect impact from increased residential use.
	Cumulative effects associated with Redstone Arsenal	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 offsite disposal in permitted facilities.	No direct or cumulative impacts; minor indirect impacts during construction and operation from offsite 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 of offsite disposal in permitted facilities.

Resource	Attribute/Potential Effects	Alternative		
		A - No Action	B – 1 B&W Unit	C – 1 AP1000 Unit
Seismology	Seismic adequacy	No change.	No adverse seismic effects anticipated.	No adverse seismic effects anticipated.
Air Quality	Emissions resulting in increases of air pollutants	No impacts expected	Minor impacts from emissions controlled to meet current applicable regulatory requirements. Minor impacts from vehicular emissions.	Minor impacts from emissions controlled to meet current applicable regulatory requirements. Minor impacts from vehicular emissions.
Radiological Effects	Effects to humans and non-human biota from normal radiological releases	No impacts expected	Annual doses to the public well within regulatory limits; no observable health impacts. Doses to non-human biota well below regulatory limits; no noticeable acute effects.	Annual doses to the public well within regulatory limits; no observable health impacts. Doses to non-human 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 adverse impacts
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 MOAs developed in consultation with the appropriate 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, 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

2.7.1 Nuclear Plant Construction

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 terminated/deferred status, does not address the need for power. Compared to the action alternatives, the 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.

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. Completion of the single B&W unit would require replacement of the steam generators.

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 this unit and associated structures are anticipated to disturb approximately 185 additional acres on the site. 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 unit.

Under both action alternatives, 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 B (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 2-7.

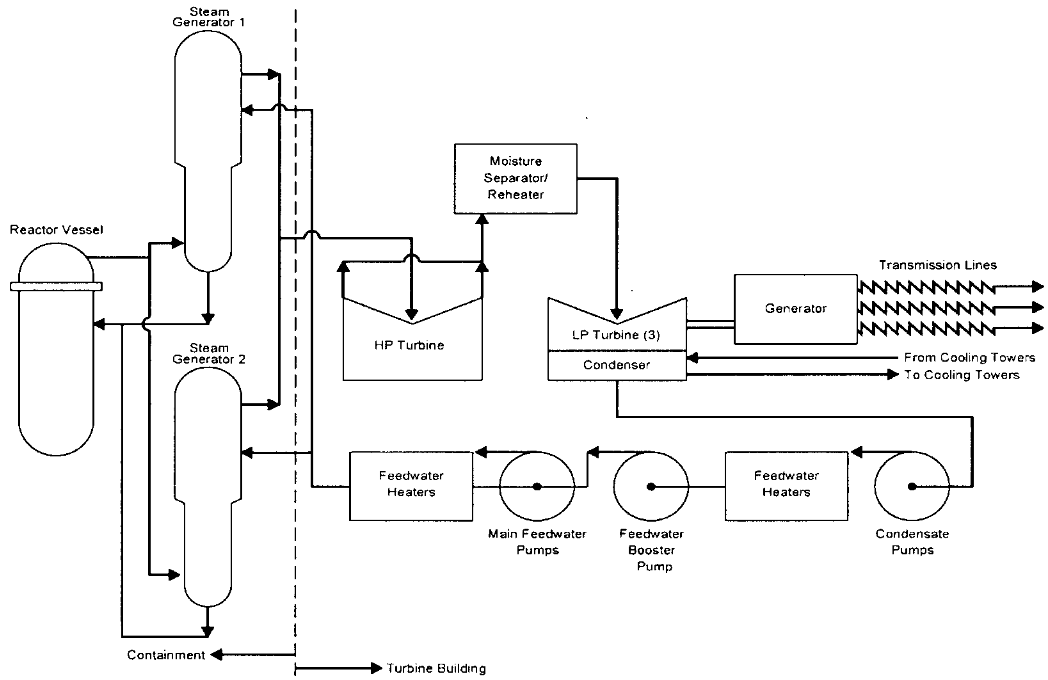

Figure 2-7. Typical Pressurized Light Water Reactor - Reactor Power Conversion System and Reactor Coolant System

Both plants would generate comparable quantities of radioactive waste and use similar chemicals and processes for water treatment. The most significant difference between these two systems is that the B&W plant utilizes once-through steam generators that produce about 50 degrees of superheat, whereas the AP1000 uses a U-tube steam generator system. The ability to create superheated steam makes the B&W unit thermally more efficient, such that even with a larger capacity of 3,600 MWt versus 3,400 MWt for the AP1000, the B&W unit discharges slightly less waste heat to the environment than does the AP1000.

Both the B&W and AP1000 would use closed-cycle cooling systems, discharging cooling tower blowdown via a diffuser in Guntersville Reservoir. The two plant designs differ in volumes of operating waterflows. For a single B&W unit, intake water would make up 11,350 gallons per minute (gpm) for evaporation plus about 22,650 gpm of cooling tower blowdown, resulting in a typical withdrawal from Guntersville Reservoir of 34,000 gpm (75 cubic feet per second [cfs], or less than 0.2 percent of the flow through Guntersville Reservoir). Typical discharge from the B&W to the reservoir through the diffusers would be about 22,650 gpm. For a single AP1000 unit, intake water would make up for 16,039 gpm for evaporation plus about 7,914 gpm cooling tower blowdown, resulting in a typical withdrawal from Guntersville Reservoir of 23,953 gpm (53 cfs, or about 0.1 percent of the flow through Guntersville Reservoir). Typical discharge from the AP1000 to the reservoir would be about 7,914 gpm. Both plants would meet the same specifications for temperature of discharged water.

Another significant difference between the B&W and the AP1000 designs is that the AP1000 works on the simple 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 indicated in Figure 2-8.

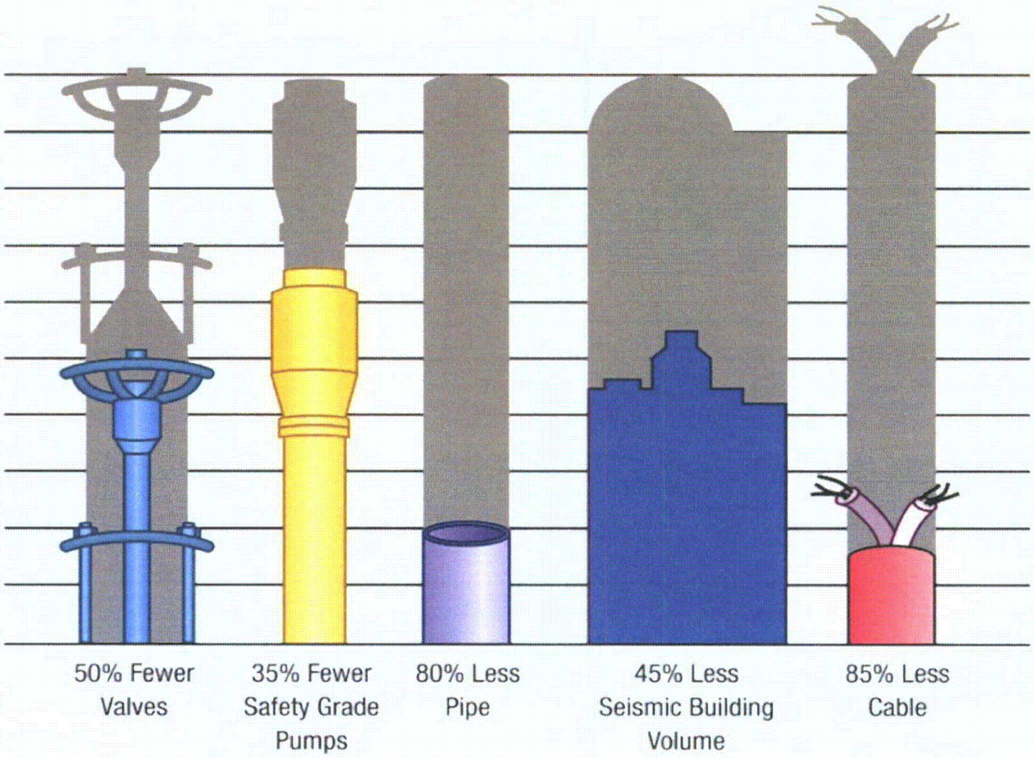

Figure 2-8. AP1000 Simplified Design - Fewer Components

The B&W design is similar to nuclear plants currently operating elsewhere in that it requires active safety systems to mitigate the consequences of an accident. Valves must open or close, pumps must start quickly and run at rated capacity, and diesel generators must start. Guntersville Reservoir is the ultimate heat sink, and the intake channel must provide a continuous source of cooling water through severe droughts, even in the rare instance of loss of the downstream dam.

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 lower than for the B&W unit, although partially offset by the B&W unit's higher thermal efficiency.

2.7.3 Transmission Upgrades

Should a BLN nuclear plant 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 or Construction and Operation of a Nuclear Unit

If Alternatives 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 1JA111would be subjected to further testing to determine the extent and nature of adverse effects.

If either action alternative is implemented, TVA would review the availability of housing during the construction phase to assess whether efforts to mitigate housing impacts in Jackson County is needed. Such efforts could include housing assistance for employees, transportation assistance for commuting employees, or remote parking areas with shuttles.

TVA is currently coordinating with the U.S. Fish and Wildlife Service (USFWS) under Section 7 of the Endangered Species Act to evaluate potential effects to federally listed aquatic animals, plants, and wildlife from completion/construction and operation of the BLN nuclear plant and associated transmission line upgrades. Under Alternatives B and C, TVA would implement any avoidance or mitigation measures that result from the USFWS Biological Opinion.

If Alternative C were selected and implemented, TVA would conduct a survey to 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 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 Upgrades

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 rights-of-way (ROW), and additional listed species are likely to be present. 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 determine if the rare species are still present and the full extent of the plants in the ROW. 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 determine 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 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. 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 MOAs that TVA is developing with each of the affected states (Alabama, Tennessee, and Georgia). TVA would use the phased identification and evaluation procedure set forth in those agreements, as well as other pertinent federal legislation. Site-specific activities proposed in the future would be approved or denied according to the significance of any archaeological resources within the affected ROWs. Archaeological sites in affected areas would be avoided whenever possible. If avoidance would not be possible, mitigation may be required. Such mitigation typically calls for additional archaeological investigation and may require data recovery of potentially impacted archaeological resources in the form of removal, cataloging, and archiving, as defined in the appropriate MOA. Although mitigation documents the site and preserves certain artifacts, under the revised NHPA regulations, excavation and removal of artifacts are considered adverse impact to an archaeological site.

2.9. Preferred Alternative

TVA will identify its preferred alternative in the Final SEIS after receiving input from the reviewing agencies and the public. The Draft SEIS will be made available for public and agency review. TVA will hold an open house meeting to receive comments and answers questions from the public during the 45-day comment period. The agency will identify its preferred alternative based on the project purpose and need as defined in Chapter 1, assessment in the Final SEIS, including input provided by reviewing agencies and the public, as well as information in the Detailed Scoping, Estimating, and Planning (DSEP) Project study for BLN 1&2 and the cost and engineering studies for the AP1000. TVA's preferred alternative will be identified in the Final SEIS, along with the environmentally preferred alternative. The Final SEIS will be distributed to the public 30 days prior to the TVA Board making its decision and the agency issuing a Record of Decision for the BLN Project.

CHAPTER 3

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

The Bellefonte site has been the subject of several environmental reviews. The environmental consequences of constructing and operating BLN 1&2 (B&W) were addressed comprehensively in TVA's 1974 FES and AEC's 1974 FES. Subsequent environmental reviews updated that analysis (see Section 1.7). By 1988, when TVA deferred construction activities, most of the construction effects had already occurred. The environmental consequences of constructing and operating BLN 3&4 (AP1000) were addressed in the COLA ER, Rev 1 (TVA 2008a). This chapter updates the information contained in those earlier reviews, identifies any new or additional effects that could result from the completion or construction and operation of 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 2-4, unless otherwise specified.

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 msl. The width of the reservoir ranges from 900 feet to 2.5 miles. Average flow at Guntersville dam is 41,100 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 mean sea level (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 1-3). 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 Clean Water Act). 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 monitoring program on Guntersville Reservoir in alternate years since 1994. The Vital Signs 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), mid-reservoir (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 mid-reservoir and inflow locations were among the highest observed for all TVA reservoirs.

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
Mid-reservoir	Good	Good	Fair	Fair	Good
Inflow	*	*	Fair	Fair	*

* Not measured at inflow station

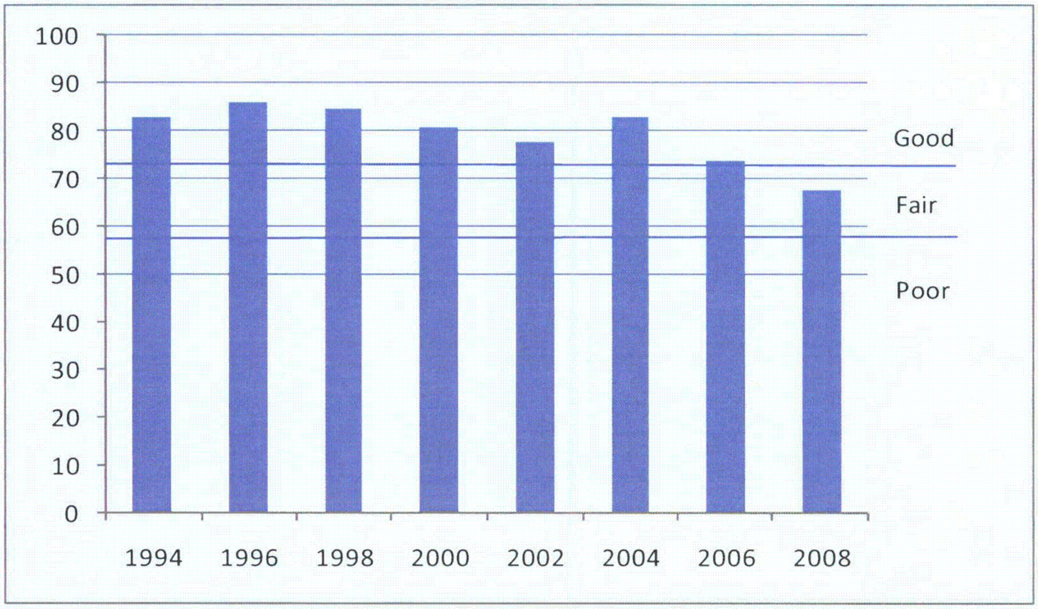

Figure 3-1. Guntersville Reservoir Ecological Health Ratings, 1994-2008

Dissolved Oxygen. Dissolved oxygen levels typically rate good at both monitoring locations, and the mid-reservoir continued to do so in 2008 (Table 3-1). However, the forebay received its first fair rating for dissolved oxygen, 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 mid-reservoir 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 mid-reservoir 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 mid-reservoir, 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 mid-reservoir 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 mid-reservoir monitoring location because no 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 mid-reservoir 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 the autumn of 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

While both the B&W and AP1000 involve substantial construction activities, the magnitude and extent of 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 which 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 to upstream properties. 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.

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 provides a ready source of raw water of sufficient quantity to meet foreseeable needs, including the operation of the 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 1522 million 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 1501 MGD, thus, the net consumptive use was approximately 21 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, TN	0.75	1.01
Monteagle Public Utility	Laurel Lake	Grundy, TN	0.43	0.55
Jasper Water Dept.	Sequatchie River	Marion, TN	0.47	0.59
South Pittsburg Water System	Guntersville Res.	Marion, TN	1.02	1.27
Taft Youth Center	Bee Creek	Bledsoe, TN	0.06	0.08
Tracy City Water System	Big Fiery Gizzard	Grundy, TN	0.47	0.60
Whitwell Water Dept.	Sequatchie River	Marion, TN	0.80	1.00
Albertville Municipal Utilities	Short Creek	Marshall, AL	11.64	14.46
Arab Water Works Board	Guntersville Res.	Marshall, AL	4.31	5.35
Bridgeport Utility Board	Guntersville Res.	Jackson, AL	2.36	3.12
North Marshall Utilities	Guntersville Res.	Marshall, AL	1.20	1.49
Northeast Alabama Water	Guntersville Res.	Marshall, AL	1.36	1.69
Scottsboro Water Board	Guntersville Res.	Marshall, AL	4.66	6.15
Section & Dutton Water	Guntersville Res.	Jackson, AL	3.06	4.03
Guntersville Water Works	Guntersville Res.	Marshall, AL	2.44	3.03
Fort Payne Water Works	Guntersville Res.	DeKalb, AL	0.47	0.60
Industrial				
Bellefonte Nuclear Plant	Guntersville Res.	Jackson, AL	0	48.00/36.00[2]
Widows Creek Fossil Plant	Guntersville Res.	Jackson, AL	1,476.30	1,476.30
Avondale Mills	Guntersville Res.	Jackson, AL	0.05	0.07
Shaw Industries	Guntersville Res.	Jackson, AL	0.20	0.28
Smurfit-Stone Container	Guntersville Res.	Jackson, AL	8.53	12.26
Irrigation			1.77	2.21
Total			**1,522.35**	**1,584.13/1,571.31**

[1] MGD - Million 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

Plant Water Use

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 Scottsboro Municipal Water System. Sanitary sewage would be pumped to the Scottsboro Wastewater Treatment Facility for treatment through existing sewer pipes.

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. A floating trash boom would be located at the reservoir shoreline to protect the intake channel from floating debris. The pumping station would be further protected by a trash rack and a traveling screen for 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 Figure 3-2 and Figure 3-3. The approximate alignments of the same conduits for the AP1000 unit are shown in Figure 3-4. All of the alternatives use the same intake pumping station and the same blowdown conduit and diffuser.

The process water needs for operating one B&W unit are given in Table 3-3, as identified in the environmental report prepared in conjunction with the operating license application in 1976 (TVA 1976). For operation of one B&W unit, the intake water flow would make up for the 11,350 gallons per minute (gpm) or 25 cubic feet per second (cfs) of evaporation, plus about 22,650 gpm (50 cfs) of cooling tower blowdown. Thus, the typical withdrawal from the reservoir would be about 34,000 gpm (75 cfs, or less than 0.2 percent of the flow through Guntersville Reservoir). The typical discharge to the reservoir through the diffusers would be about 22,650 gpm (50 cfs).

Table 3-3. Approximate Operating Water Flows – One B&W Unit

Description	Flow Rate	Units
Intake (One Unit Operation)	34,000 to 68,000	gpm
Raw Service Water	1000	gpm
Alternate Essential Raw Cooling Water[a]	104,000	gpm
Alternate Fire Protection	0 to 10,000	gpm
Condenser Circulating Water	420,000	gpm
Raw Cooling Water	15,000 to 20,000	gpm
Evaporation	11,350 to 13,500	gpm
Blowdown	22,650 to 33,662	gpm
Auxiliary Boiler Blowdown	5,000 to 11,000	gpd
Makeup Water Treatment Plant	175,000	gpd
Strainer Backwash	700,000	gpd
Screen Backwash	18,000	gpd
Makeup Demineralizer Spent Regenerants	12,000	gpd
Condensate Demineralizer Regenerants	6,000	gpd[b]
Sump Collection Ponds	350,000	gpd

(a) This discharge path and flow rate represents an extreme case which would occur with a loss of power or loss-of-coolant accident. This number is the design flow for two unit emergency flow, and is used here pending determination of appropriate emergency flow for one unit.

(b) Normal volume for two units was estimated based on one regeneration per day; for one unit, estimated volume was based on a regeneration every two days. Frequency of regeneration would be expected to be less.

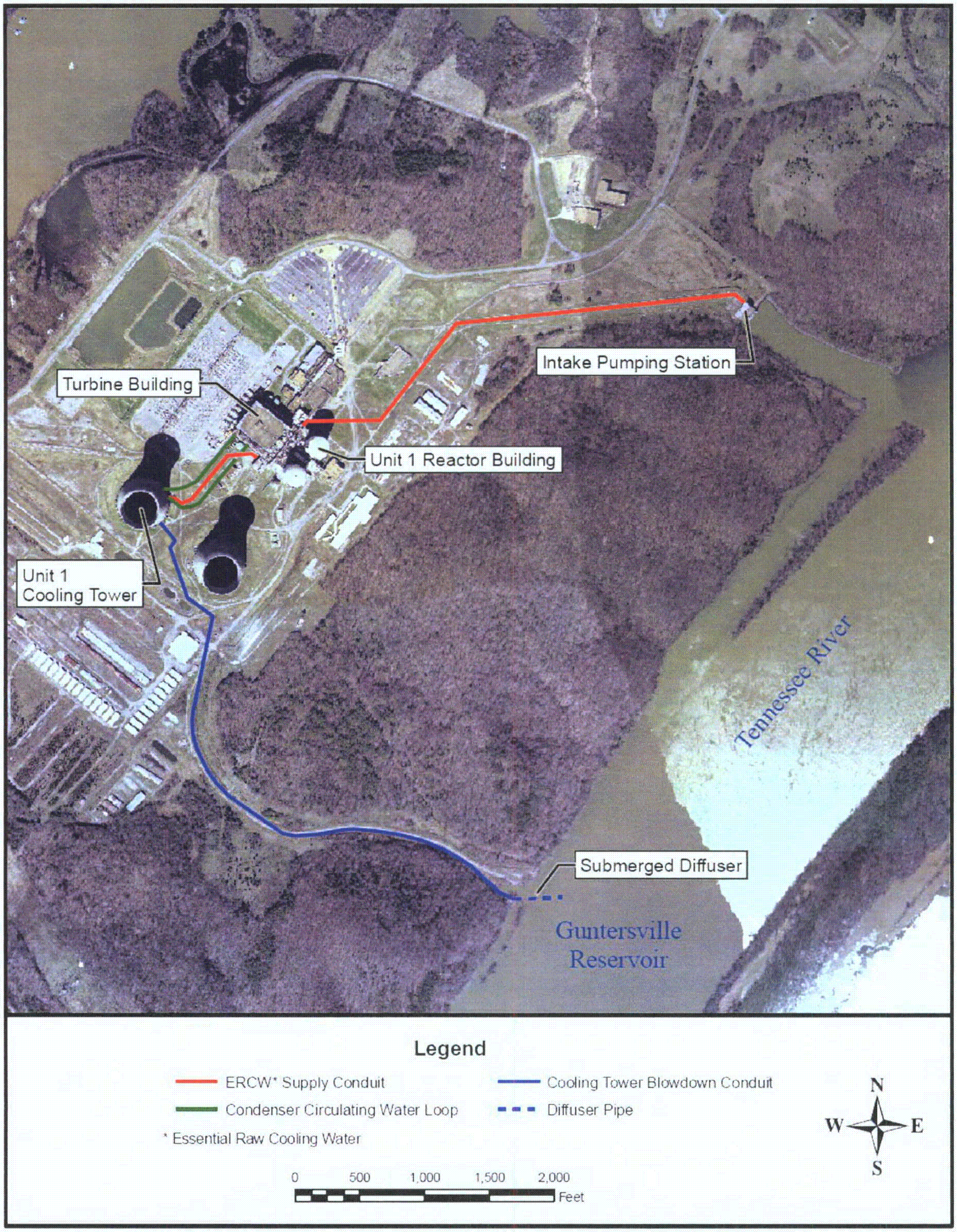

Figure 3-2. B&W Unit 1 Water Intake and Discharge Facilities

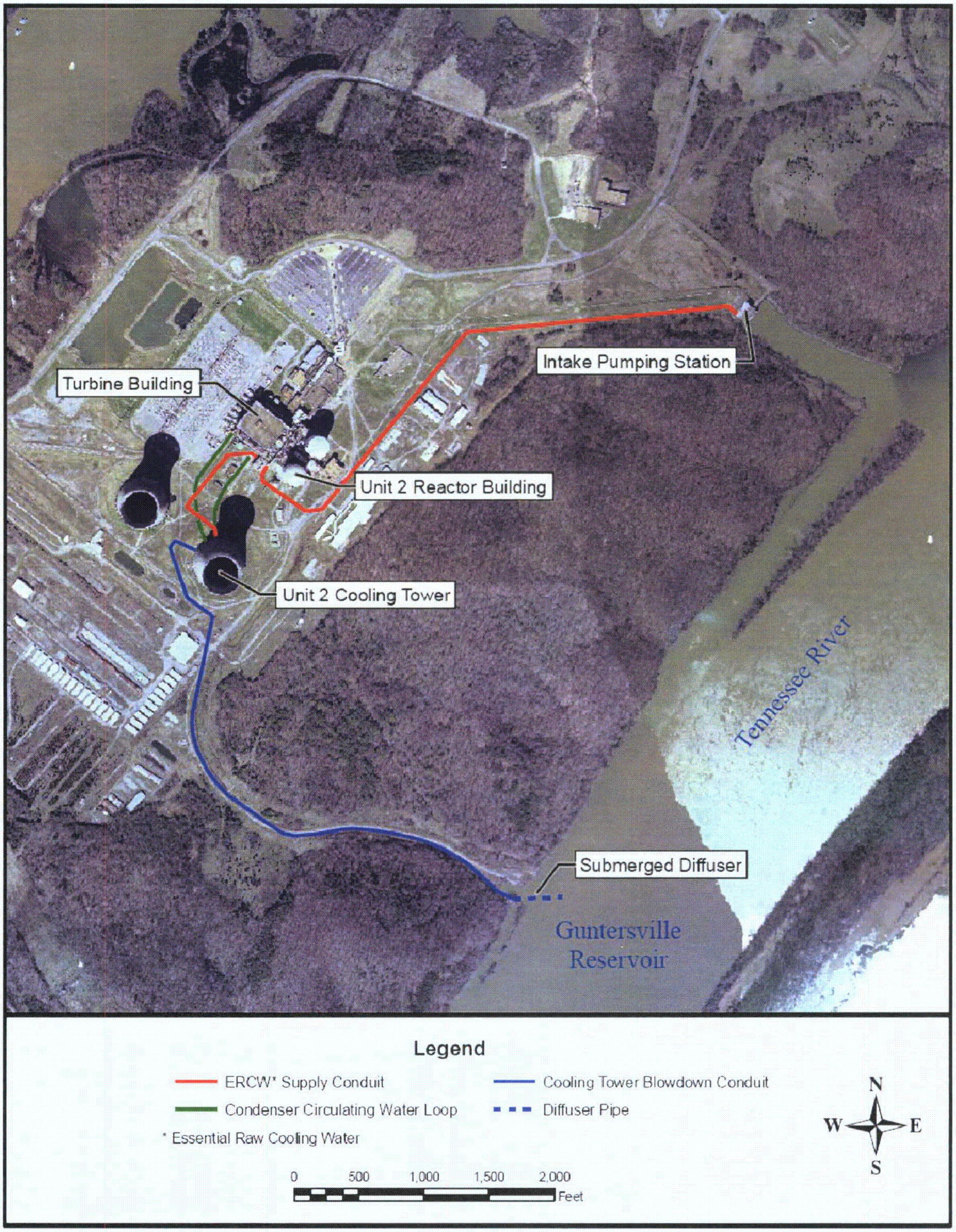

Figure 3-3. B&W Unit 2 Water Intake and Discharge Facilities

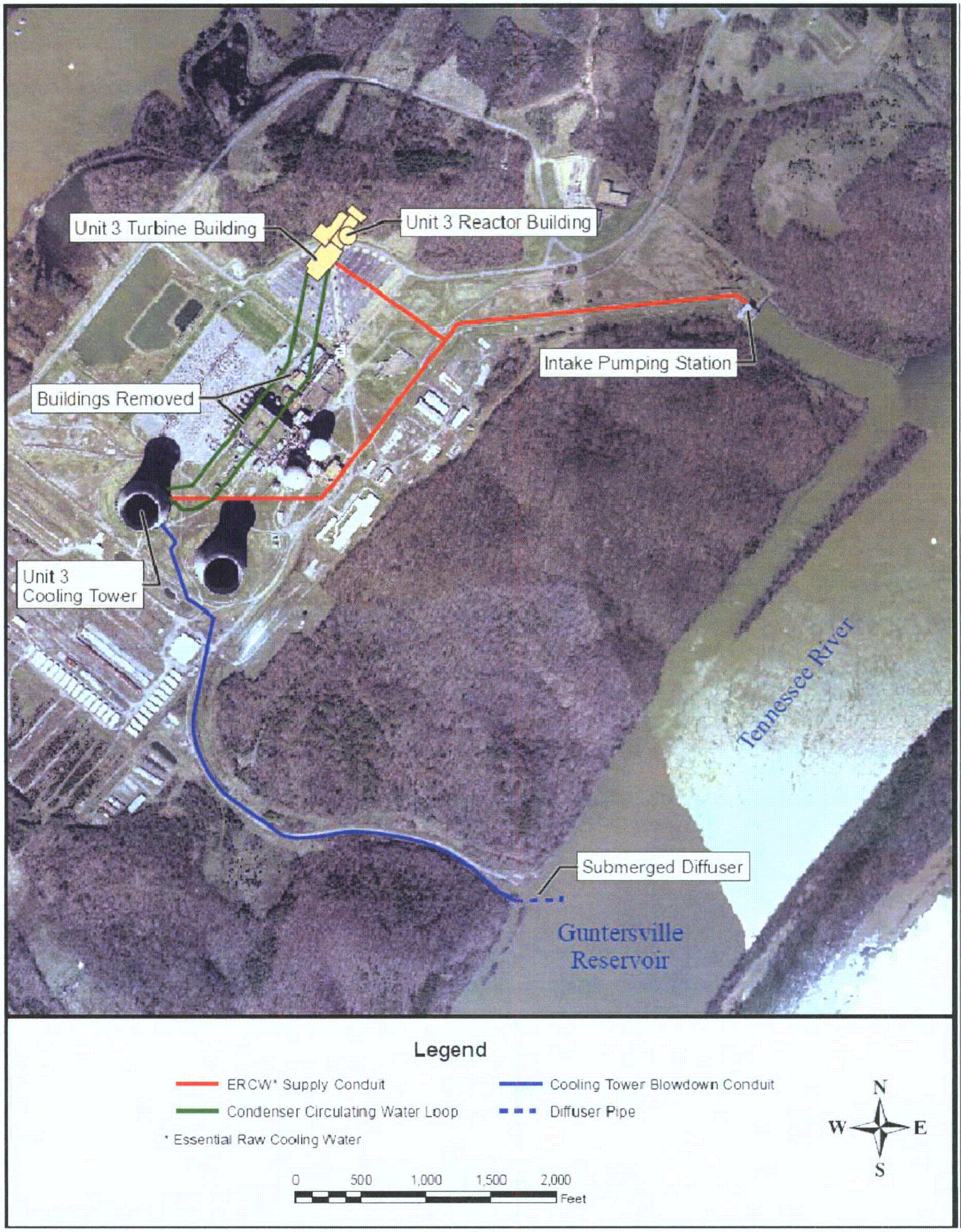

Figure 3-4. AP1000 Unit 3 Water Intake and Discharge Facilities

The process water needs for operation of one AP1000 unit are given in Table 3-4, as identified in the COLA ER. During typical one-unit AP1000 operations, intake water flow would make up for about 16,039 gpm (36 cfs) of evaporation, plus about 7,914 gpm (18 cfs) of cooling tower blowdown. Thus, the typical withdrawal from the reservoir would be about 23,953 gpm (53 cfs), or about 0.1 percent of the flow through Guntersville Reservoir). The typical discharge to the reservoir through the diffusers would be about 7,914 gpm (18 cfs).

Table 3-4. Approximate Operating Water Flows – One AP1000 Unit

Stream	Normal One Unit (gpm)	Maximum One Unit (gpm)
Circulating Water System		
Evaporation Rate	16,039	16,039[a]
Drift Rate	106	106[a]
Blowdown Rate	7,914	7,914[a]
CWS Makeup Flowrate	24,059	24,059[a]
Service Water System		
Evaporation Rate	183	624
Drift Rate	1	2
Blowdown Rate	61	205
SWS Makeup Flowrate	245	831
Demineralized Water Makeup Rate	175	540
Fire Water Makeup Rate	0.4	625
Potable Water	17	35

(a) Typically, the plant is at 100 percent power operation, which is at maximum makeup demand; therefore, the maximum is approximately the same as the normal need.

Under either alternative, plant water withdrawals are a small portion (less than 0.2 percent) of average river flow and of the reservoir volume. 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 Section 3.10.4.1.

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, a BLN nuclear plant 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. The cooling system for the B&W unit is described in the 1974 FES (TVA 1974) 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 re-use.

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 will 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 DSN003, shown in Figure 3-5.

The outfall includes an existing two-pipe multiport diffuser on the bottom of the river, as shown in Figure 3-6. As constructed, the two discharge pipes extend approximately 300 feet from the shoreline into the reservoir at an angle of about 115.5 degrees counterclockwise to the direction of river flow. Each pipe contains a diffuser section, one 36-inches in diameter and one 42-inches in diameter, with diffuser ports centered at a position of 22 degrees above horizontal and pointing downstream. The diffuser lengths are 75-feet and 45-feet, respectively, for the 42-inch and 36-inch discharge sections.

Current NPDES Permit

BLN was issued NPDES permit number AL0024635 in November 2004, and the permit is subject to renewal in November 2009. 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, the Alabama Department of Environmental Management (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, 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 (see Figure 3-5):

DSN002: Impoundment pond discharge consisting of main plant area stormwater 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 stormwater 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 stormwater runoff.

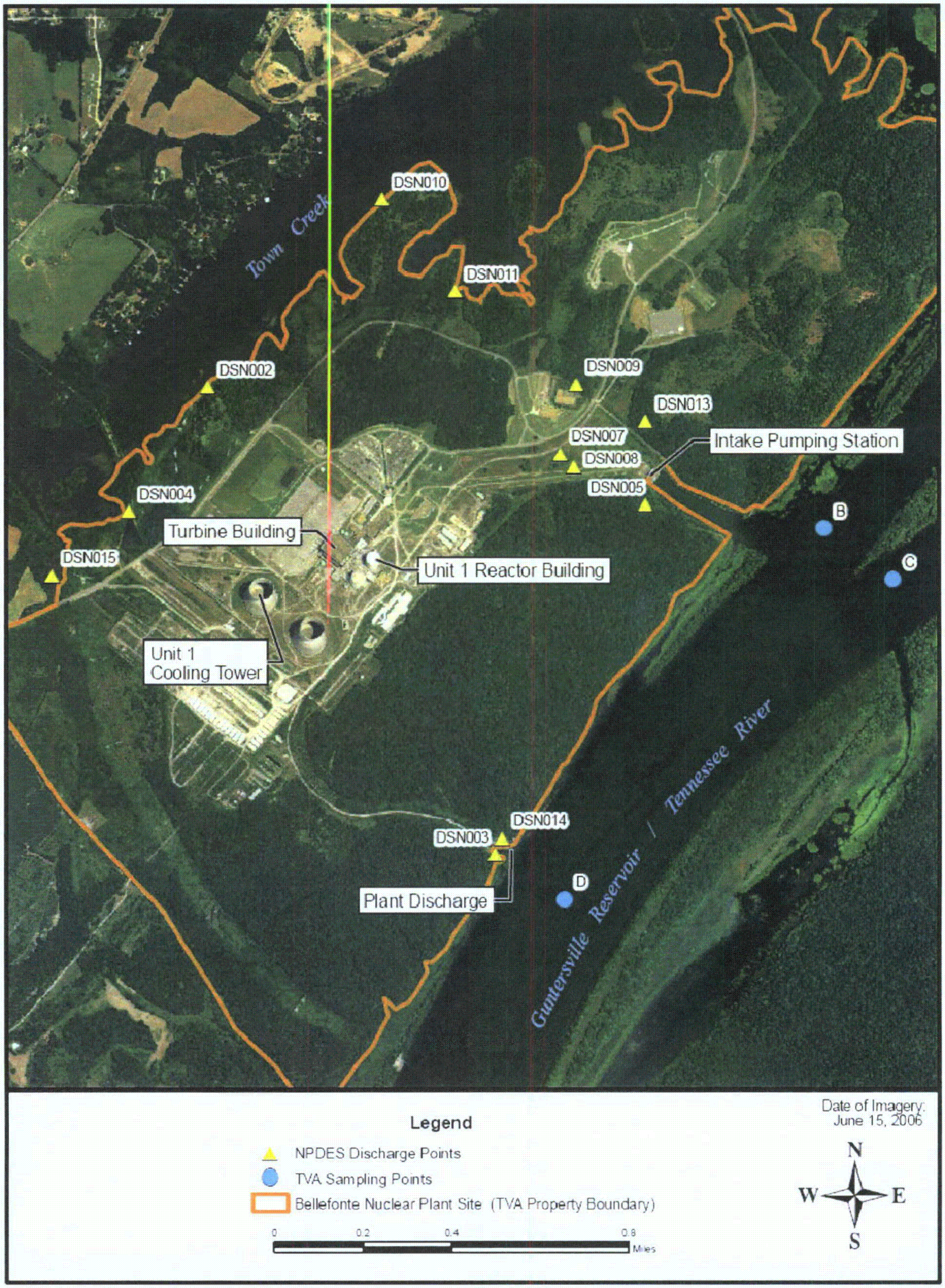

Figure 3-5. Outfalls for NPDES permit AL0024635 of November 2004

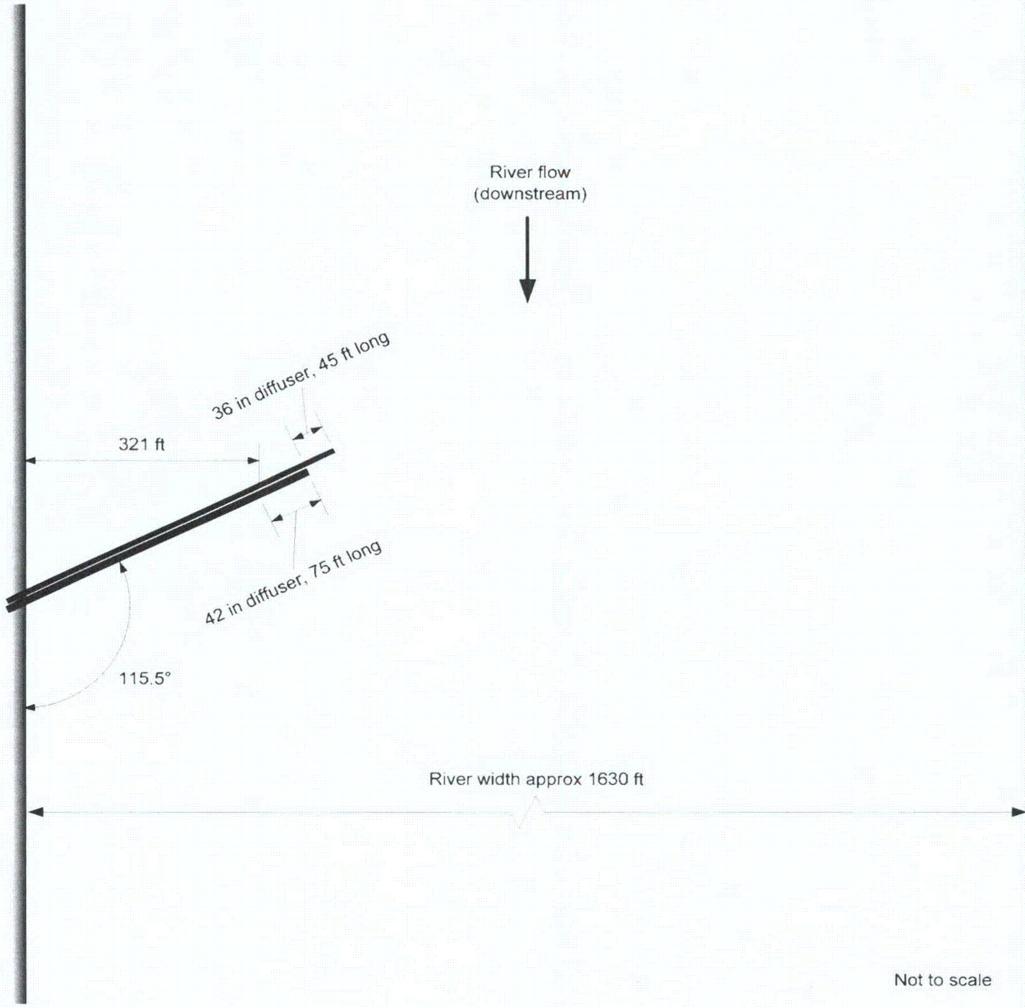

Figure 3-6. Diffuser for Blowdown Discharge, Outfall DSN003

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 3-5). 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 1977b). Consistent with Section 316(a) of the Clean Water Act, 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 to be 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 in-stream temperature rise above ambient water temperature to exceed 5°F (ADEM 2008).

Table 3-5. NPDES Discharge Limits for BLN Outfall DSN 003 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 hydrothermal effects associated with the blowdown discharge were examined using two models: (1) CORMIX to examine the thermal plume near the diffuser and (2) CE-QUAL-W2 to examine reservoir-wide effects. 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), dissolved oxygen, nutrients, algae, organic matter, and sediment.

CORMIX was used to evaluate performance of the cooling system and diffusers (discharge 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 3130 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 indicates 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 3760 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 9160 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 A, Table A-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 this 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 A-1 (Appendix A) 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 and 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 1600 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 A, Table A-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 1977a). 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. 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 non-thermal 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 water quality impacts to 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 Widows Creek Fossil Plant (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 A, Tables A-2 and A-3, provide an estimate of thermal effects on reservoir water temperatures (i.e., beyond the diffuser mixing zone), dissolved oxygen (DO) concentrations, and algae biomass. Results are shown for four reservoir segments:

1. Upstream of WCF intake (TRM 409.5-410.7).
2. Upstream of BLN intake (TRM 393.0-393.9).
3. Downstream of BLN discharge (TRM 389.0-390.0).
4. Guntersville Reservoir forebay (TRM 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 1999 or 2007 in the 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 mg/L 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.

It is emphasized that the analyses summarized herein do not include the potential impact of climate change. TVA has performed studies to examine 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 perhaps increase between 0.3°F and 0.5°F for every 1°F increase in air temperature. Thus, if the air temperature over Guntersville Reservoir were to increase by an amount of 1°F or more, a measurable increase in the average temperature of the ambient water would be expected. Such a temperature rise would impact the operation of a BLN generating unit, for example, the frequency of events wherein the blowdown discharge temperature exceeds the NPDES limit of 95°F, and consequently the number of unit derates, 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 model assessments of thermal discharges from the BLN outfall DSN003 diffusers. The CORMIX 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 model assessed potential cumulative effects on Guntersville Reservoir.

- The CORMIX 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 suggest 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). During such events, plant derates would be required 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 to be 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 only a fraction 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 such 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 non-thermal constituents of the blowdown occur in unacceptable amounts in the plant withdrawal zone.

- The CE-QUAL-W2 model assessment of potential impacts to reservoir water quality indicates essentially no effects on far-field reservoir temperatures, dissolved oxygen concentrations, or algae biomass. These analyses included cumulative effects from solar activity and WCF, the only other significant source of waste heat in Guntersville Reservoir. These analyses will need to be updated for the potential impact of climate change, once a consensus emerges on the recommended procedures for such.

Alternative C
Under this alternative, one AP1000 unit would be constructed and operated. Surface water and cumulative 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

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 1974). 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 is the Essential Raw Cooling Water (ERCW) system and for an AP1000 plant it would be the Scottsboro Municipal Water System. Treatment of the ERCW is described below under **Proposed Schemes for Cooling Water Treatment for B&W and AP1000 Units.** The water supplied by the municipal water system is treated offsite in accordance with applicable drinking water standards, and no further treatment would be performed onsite. The source of potable water for either a B&W plant or an AP1000 plant would be the Scottsboro Municipal Water System. The water supplied by this municipal water system is treated offsite in accordance with applicable drinking water standards, and no further treatment would be performed onsite. The water would be routed to the sanitary drainage system, which would be discharged offsite to the Scottsboro Wastewater Treatment Facility, where it would be treated (TVA 2008a).

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 which 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 PWR reactors. The discussion is followed by a description of the types of chemicals, which 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 MIC. 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 compound (i.e., a nitrogen atom with four attachments, some or all of which can be benzene-based, rather than hydrocarbon-based) 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 section.

Prior Environmental Reviews of Plant Cooling Water Chemical Treatments
Previous environmental reviews for proposed projects at the BLN site (TVA 1974; 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, an invasive species, the zebra mussel (*Dreissena polymorpha*), has also caused fouling problems at the TVA plants. TVA's 1974 FES (TVA 1974) recommended using the product *acrolein* to address macrofouling. However, the product is no longer used in the industry, because in the past decade, chemicals that are more effective than *acrolein* have been introduced to control both species. The chemical presently in use at TVA plants is generically known as a quaternary amine.

In its 1974 FES (TVA 1974), 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) 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 CLRW FEIS (DOE 1999) 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 CLRW 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 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 to be 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 Electric Power Research Institute (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 essential raw cooling water 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)

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 (TVA 2009a). Biocide and water treatment chemicals are injected to maintain a noncorrosive, nonscale-forming condition and limit the biological film formation, and 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 anitscalant 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 which 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 parts per million (ppm) of active product (3.0 ppm total product). Typically, the quaternary amine is applied to the systems 3 to 5 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) involves 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 onsite sewage treatment plant is planned for either a B&W unit or an AP1000 unit. BLN sanitary waste would be discharged to the Scottsboro 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 is 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.

Environmental Consequences

Based on average estimated daily streamflow of 38,850 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 the Alternative B or C, the 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 TVA's 1974 FES through the COLA ER (TVA 2008a) and COLA FSAR (TVA 2009a). A summary of that groundwater information is provided below:

3.2.1.1. 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; TVA 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 in the 1980s and 1990s, all show the direction of groundwater flow from the plant site towards 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; TVA 2009a). Subsurface testing at BLN using a network of test observation wells installed in 2006 was conducted in support of the COLA (TVA 2008a; TVA 2009a).

3.2.1.2. Groundwater Use and Trends

There are no groundwater supply wells onsite 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 (Mike 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 groundwater source within a 2-mile radius of BLN (TVA 2008a; TVA 2009a).

Private groundwater sources were identified early on (1961) within a 2-mile radius (see Figure 3-7 and Table 3-6) (TVA 1986) and more recently within a 1-mile radius (Figure 3-8) (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 non-potable purposes.

3.2.1.3. Groundwater Quality

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

The locations of the TVA monitoring wells installed onsite between 1973 and 1996 (Julian, 1999), and in 2006 (TVA 2008a) in support of the COLA are shown in Figure 3-9.

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

Monitoring through 1990 of the effects of trisodium phosphate waste/wastewater disposal onsite 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 onsite in the 1980s and early 1990s, indicated that, by 2004, the levels of critical contaminants had decreased to regulatory acceptable values (Nix 2006).

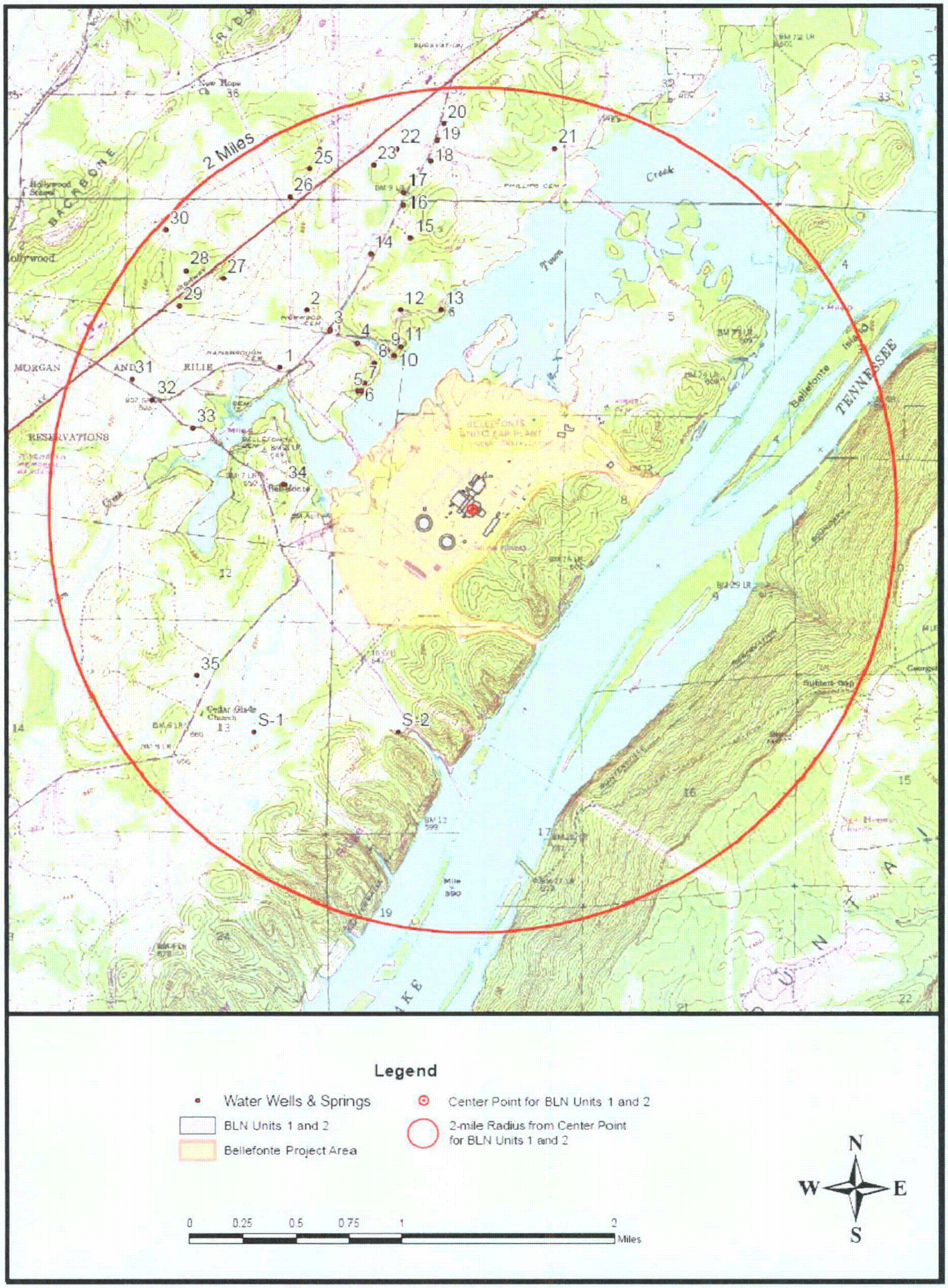

Figure 3-7. Water Wells and Springs Within 2 Miles of BLN

Table 3-6. Inventory of Private Wells and Springs Located Within the 2-Mile Radius of BLN -- 1961 Data[a]

Well Number[b]	Year Installed	Elevation[c] (ft. msl)	Well Depth (ft.)	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 3-7 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 3-8. Groundwater Wells in the Vicinity of the BLN Site - 1990

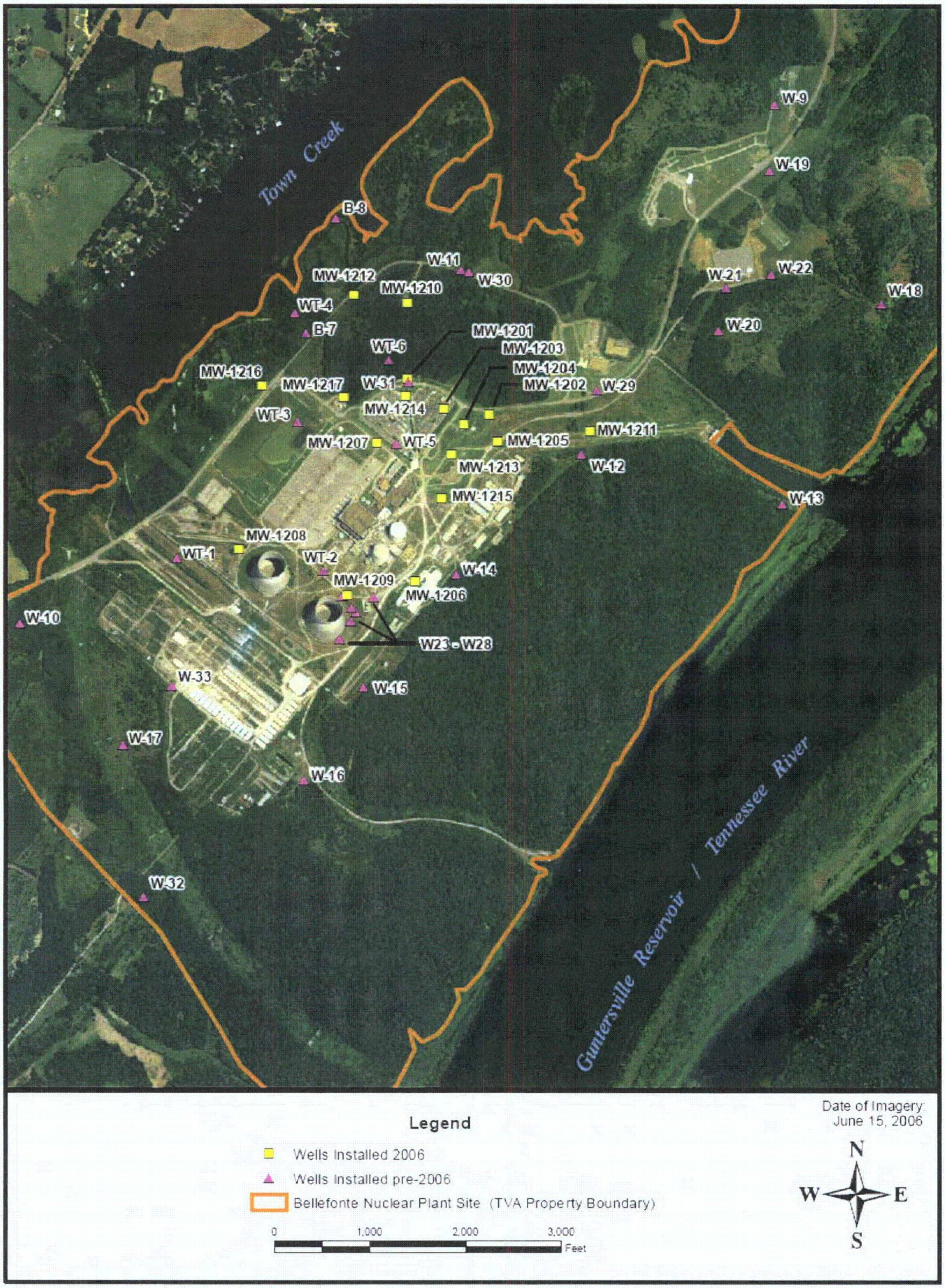

Figure 3-9. BLN B&W Groundwater Wells

3.2.2. Environmental Consequences

Alternative A – No Action

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 will reach groundwater. There is currently no groundwater use onsite. 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

The completion and operation of one B&W unit or the construction and operation of one AP1000 unit would have no impact on the groundwater hydrology or groundwater use, either onsite or locally. Potable water will be supplied by the Scottsboro Municipal Water System. Water for fire protection, concrete batching (if necessary), and other construction uses will be withdrawn from the Tennessee River/Guntersville Reservoir. TVA does not anticipate the use of groundwater either as a safety-related source of water for a BLN unit or as its source of water supply for any purpose during operation.

Adoption of either alternative would not have any substantial impact on groundwater quality. Under both alternatives, any chemicals used during construction would be managed using BMPs, which would limit the likelihood of chemical contamination of surface water as well as groundwater. Also, 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 presents a program required by regulators that reduces the likelihood that oil spills will occur and provides for measures to control and cleanup such spills if they do occur onsite. Implementation of the SPCC plan would help keep oils out of surface waters as well as groundwater.

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 TVA's 1974 FES, Section 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 FSAR (TVA 1986) contains information related to potential flooding of the BLN site from the Tennessee River and local probable maximum precipitation[8] (PMP) site drainage. Floodplain and flood risk information for the BLN site was updated in the COLA FSAR.

[8] 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

The Bellefonte Conversion FEIS (TVA 1997) described the floodplain and flood risk conditions at the BLN site. 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 mile 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.

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 non-functioning. The maximum PMP water surface elevation in the vicinity of safety-related structures would be 627.53 feet msl (TVA 2009a).

The controlling Probable Maximum Flood[9] (PMF) elevation at the BLN site would be 622.1 feet msl if all of the planned dam safety modifications were made to Watts Bar, Chickamauga and Nickajack dams. The dam safety modifications at Chickamauga Dam have not been completed. Without these modifications, the PMF elevation at the BLN site is 622.5 feet msl. The maximum wind wave activity is estimated to be 1.53 feet high. Therefore, the PMF and coincident wind wave activity results in a flood elevation of 624.03 feet msl.

TVA is currently re-evaluating existing PMF data for the Tennessee River at the BLN site in support of the COLA. Once this effort is completed, the flood information in this section will be updated if needed. The dam safety modifications at Chickamauga Dam will be addressed as part of the re-evaluation of the PMF data for the Tennessee River. TVA staff does not expect significant changes in flood data from those used in the previous BLN site evaluations that would affect conclusions in the following discussion.

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

---

Meteorological Society, 1959). In consideration of the limited knowledge of the complicated processes and interrelationships in storms, PMP values are identified as estimates.

[9] The Probable Maximum Flood is defined as the most severe flood that can reasonably be predicted to occur at a site as 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.

Executive Order (EO) 11988 (Floodplain Management) would be fulfilled. For non-repetitive actions, EO 11988 states that all proposed facilities must be located outside the limits of the 100-year floodplain unless alternatives are evaluated, which would either 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" 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 requires a flood risk evaluation of possible impacts from the Tennessee River PMF and PMP site drainage for all alternatives.

Because the activities evaluated in 1997 are different than 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 624.03 feet msl, and above the PMP site drainage elevation of 627.53 feet msl.

Alternative C
Based on the site plan (Figure 2-3), all of the proposed construction activities would occur outside of the 100-year floodplain, which would be consistent with EO 11988. The only activities planned below the FRP elevation would be the construction of site parking and the new PSO switchyard training facility. Every effort would be made to reduce the quantity of fill associated with these activities 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 624.03 feet msl, and above the PMP site drainage elevation of 627.53 feet msl. All safety-related structures will be either located above the resulting flood levels or flood-proofed below to the flood levels. The new Administration Building would be located well above the 100-year and FRP elevations.

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 Clean Water Act and addressed under Executive Order (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 U.S. Army Corps of Engineers (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 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 1974). Wetland habitat was specifically addressed during subsequent proposals for associated on-site operations (TVA 1997; DOE 1999; TVA 2008a). 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 2-1). 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 1996a), 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 B.

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 3-10). 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 comprising 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 wetland are anticipated from run off 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.

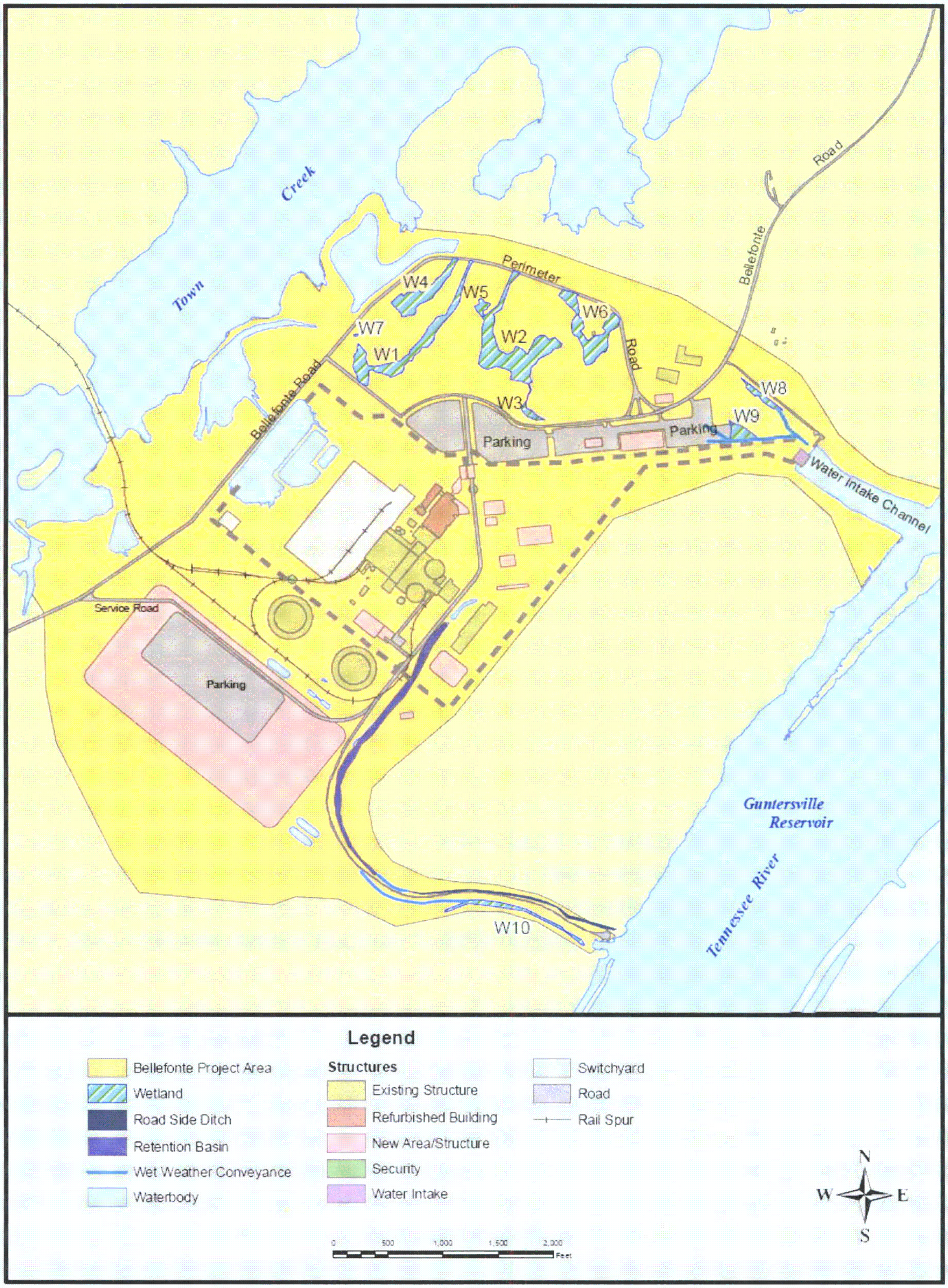

Figure 3-10. **Wetlands Shown in Relation to the B&W Site Plan (Alternative B)**

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 that area (Figure 3-11). In compliance with the Clean Water Act, 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 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 onsite 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 run off 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.

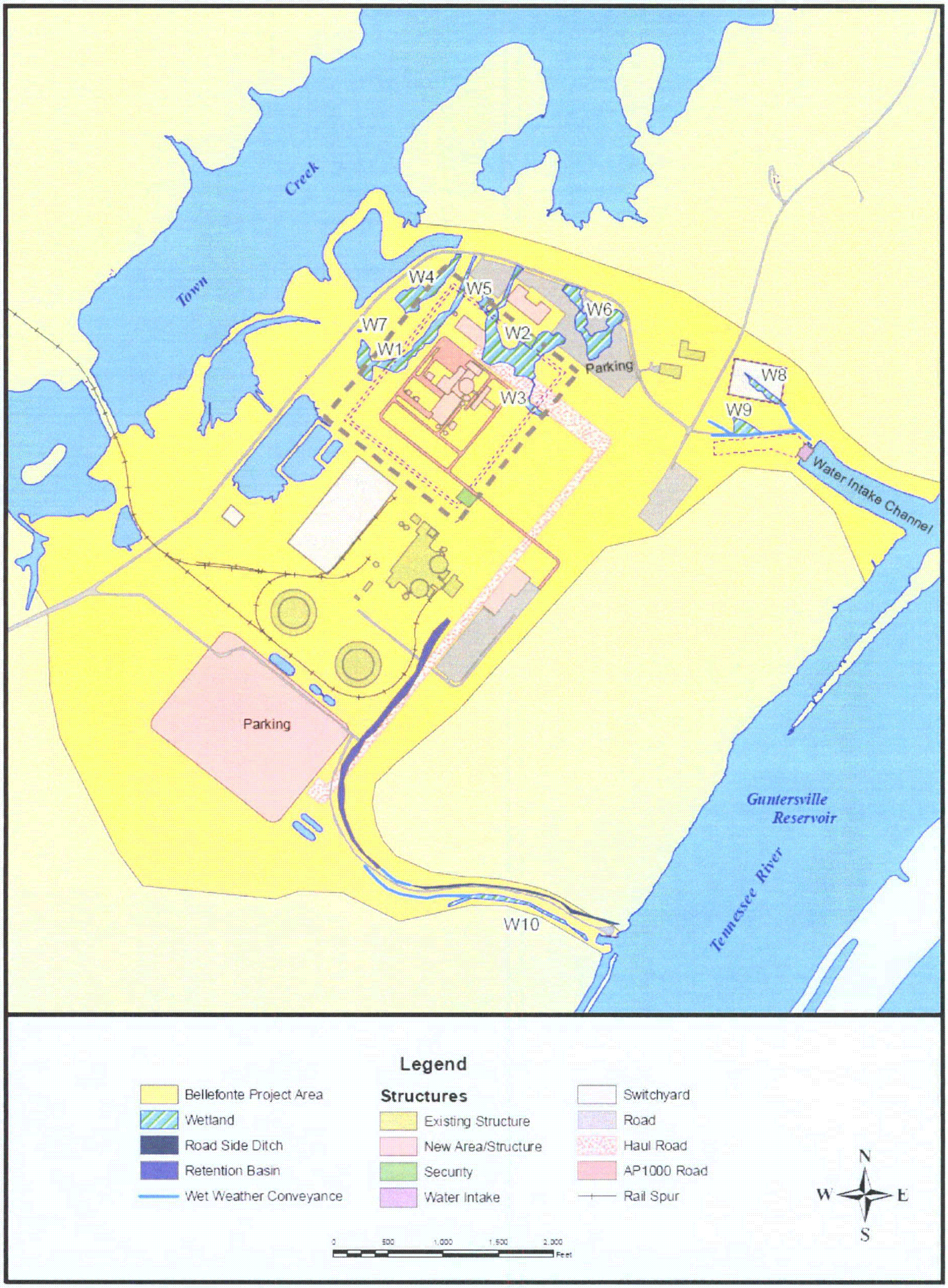

Figure 3-11. Wetlands Shown in Relation to the AP1000 Site Plan (Alternative C)

3.5. Aquatic Ecology

3.5.1. Affected Environment

To support the evaluation of the viability of licensing of additional nuclear reactors at the BLN site, TVA conducted one year of preoperational monitoring in Guntersville Reservoir in the vicinity of the BLN site during 2009 to characterize site-specific conditions. This preoperational monitoring serves to characterize the baseline condition of aquatic communities in Guntersville Reservoir. TVA uses its existing Vital Signs (VS) monitoring program, supplemented with additional fish and benthic macroinvertebrate community monitoring upstream and downstream of fossil and nuclear power plants, to evaluate effects of thermal discharges to aquatic communities in the receiving water body. This same methodology is being applied to sites upstream and downstream of BLN. VS monitoring results are summarized in Section 3.1.1.

The VS monitoring program began in 1990 in the Tennessee River System. This program was implemented to evaluate ecological health conditions in major reservoirs as part of TVA's stewardship role. One of the five indicators used in the VS program to evaluate reservoir health is the Reservoir Fish Assemblage Index (RFAI) methodology. 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 integrate conditions over time. Benthic macroinvertebrate populations are assessed using the Reservoir Benthic Index (RBI) methodology. Because benthic macroinvertebrates are relatively immobile, negative impacts to aquatic ecosystems can be detected earlier in benthic macroinvertebrate communities than in fish communities. These data are used to supplement RFAI results to provide a more thorough examination of differences in aquatic communities upstream and downstream of thermal discharges.

Fish Community

In spring 2009, fish community RFAI scores of 35 (Fair) and 34 (Fair) were observed at the downstream and upstream stations, respectively (Appendix C, Table 1; Simmons and Walton 2009). In summer 2009, fish community RFAI scores of 30 (Poor) and 35 (Fair) were observed at the downstream and upstream stations, respectively (Appendix C, Table 2). Although the scores reached only 58 percent and 56 percent of the highest attainable score during the spring, and 50 percent and 58 percent of the highest attainable score during the summer, they were within the 6 point range of acceptable variation, and therefore are considered similar.

Other VS monitoring sites on Guntersville Reservoir, upstream and in the vicinity of BLN, have averaged a RFAI score ranging from 33-38 (Fair), which is similar to what was observed at sites upstream and downstream of BLN during spring and summer 2009 (Appendix C, Table 3). The number of fish (by species) collected from 1993-2008 in RFAI samples are listed in Simmons and Walton (2009).

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 and RBI score of 25 (Good) (Appendix C, Table 4). Appendix C Table 5 provides estimated mean density per square meter by taxon at these sites. Results from samples taken upstream and downstream from BLN were very similar. Both sites received the same score for all but two metrics.

All VS sites on Guntersville Reservoir have averaged a "Good" to "Excellent" RBI score (Appendix C, Table 6). During 2008, scores for the three inflow sites upstream of BLN and for the transition site downstream of BLN ranged from 25 to 29, which is similar to what was observed during spring 2009 at sites upstream and downstream of BLN.

Ichthyoplankton
Data on fish communities; including density of fish eggs and larvae adjacent to the site 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 2009. Temporal and spatial distribution of ichthyoplankton during the 2009 study validated that the historical entrainment data collected several years earlier. Mandated minimum flows generated from Chickamauga and Nickajack dams provides 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 Vital Signs Program was initiated in 1993.

3.5.2. Environmental Consequences
This section addresses impacts to aquatic species (fish and benthic macroinvertebrates) from site construction and operation of the proposed nuclear plants.

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 stormwater runoff is limited under the construction stormwater 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 ADCNR and USACE permits.

Dredging 1960 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. Pre-dredge 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 BLN Unit would be in compliance with the NPDES discharge limits, as outlined in the 2004 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 (Sections 3.1.4 and 3.17.3, respectively).

Impingement and entrainment associated with operating plant intake structures has 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 Clean Water Act. 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 Watts Bar Nuclear Plant [WBN]) and preoperational monitoring results to estimate the magnitude of these effects.

The known impingement and entrainment at Widows Creek Fossil Plant (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. Since 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. Entrainment estimates from Watts Bar, a similar one unit nuclear plant with closed-cycle cooling, located upstream on Chickamauga Reservoir at Tennessee River Mile 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, will 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 of 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 would be similar to those described under Alternative B with two exceptions.

Under both alternatives, the intake channel will be dredged prior to initiating nuclear plant operations. However, under Alternative C, only 1,200 feet between the intake structure and the trash boom will be dredged, which reduces the volume dredged by approximately 1,850 cubic yards as compared to Alternative B.

Secondly, dredging at the barge unloading dock would occur only if TVA selects Alternative C. During dredging, loss of the benthic community adjacent to the barge terminal and temporary increases in turbidity are expected. Pre-dredge 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 one hundred miles from the Tennessee border to the southwest into Alabama. In the north, the open, rolling, valley floor, 600 feet in elevation, is nearly 1000 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 900 acres of the 1600-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 (AEC 1974, TVA 1974, TVA

1997, DOE 1999, TVA 2008a), no new quantitative field data were collected for the publication of this supplemental assessment.

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 1974), during the Bellefonte Conversion FEIS, and in support of the COLA ER. 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 1974) within the BLN site. An 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 3-12) (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 and are 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

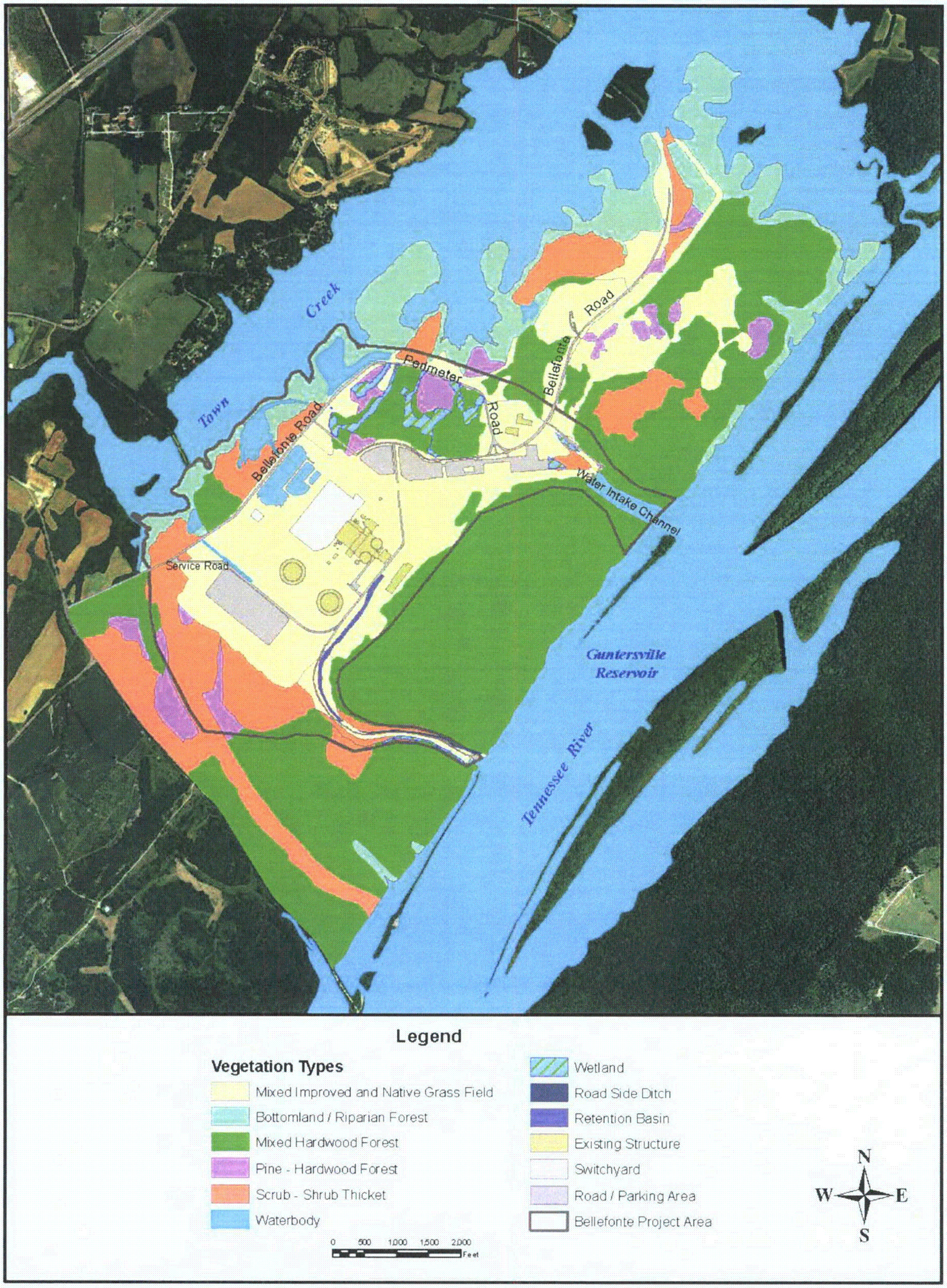

Figure 3-12. Vegetation Cover Types on the Bellefonte TVA Property

Most lands in and around the TVA power service area have been affected by introduced non-native plant species. Non-native plants occur across Southern Appalachian forests, accounting for 15 to 20 percent of the documented flora (USFS 2008). According to NatureServe (2009), invasive non-native species are the second leading threat to imperiled native species. Not all non-native species pose threats to our native ecosystems. Many species introduced by European settlers are naturalized additions to our flora and considered to be non-native non-invasive species. These "weeds" have very little negative impacts to native vegetation. Examples of these are Queen Anne's lace and dandelion. However, other non-native species are considered to be exotic invasive species and do pose threats to the natural environment. EO 13112 defines an invasive non-native 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).

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, cogon grass, Chinese privet, hydrilla, kudzu, multiflora rose, and tropical soda apple. Cogongrass, hydrilla, and tropical soda apple are also on 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 SPPC plan and BMPs designed to minimize impacts to the adjacent land (TVA 1992). Disturbed areas would be revegetated with native or non-native, non-invasive 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 1974, TVA 1997, DOE 1999, TVA 2008a). 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 residential organisms 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, bluewinged 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 (IAEA 1992; DOE 1999).

Potential for collisions between birds and structures, vehicles, and transmission lines exits. 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 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 indicates 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 Endangered Species Act (ESA) of 1973 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 has prepared a Biological Assessment (BA) pursuant to the requirements of Section 7 of the ESA (TVA 2009c). The BA examined potential impacts of completing and operating a single B&W unit as well as constructing and operating a single AP 1000 unit. Transmission line upgrades associated with operation of either technology were also evaluated in the BA. 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. In the BA, TVA documented the conclusion that proposed construction, operation, and transmission upgrades would have no effect, or are not likely to adversely affect any of the federally listed species except for two mussel species. Potential impacts to the pink mucket (*Lampsilis abrubta*) and sheepnose mussel (*Plethobasus cyphyus*), and measures to minimize those impacts, are described in Section 3.7.1 below. The analysis and conclusions of the BA also are referred to elsewhere in Chapters 3 and 4.

In accordance with Section 7 of the ESA, TVA is conducting formal consultation with the USFWS to determine reasonable and prudent measures designed to avoid or minimize take of the two mussel species. TVA anticipates receiving a Biological Opinion from the USFWS, the results of which will be incorporated into the final SEIS.

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 (*Lampsilis abrupta*), 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 which could support the federal candidate sheepnose mussel (*Plethobasus cyphyus*) 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.

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 (*Pleurobema cordatum*), butterfly (*Ellipsaria lineolata*), and monkeyface (*Quadrula metanevra*), were identified during the 2007 survey adjacent to the BLN site.

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*	E	(SP, SH)
Snails			
Anthony's river snail	*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.

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 stormwater 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 compliance 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. However, because the bottom of the intake channel is only marginally suitable for mussels, 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 BMP's such as silt curtains should limit the area affected by suspended sediments and sedimentation.

Mussels also may be indirectly affected from by tows delivering <50 total barges prior to operation of the BLN plant. Effects from tow propeller wash include brief periods of extreme turbulence, increased suspended sediments, scouring of substrate (and mussels) from the river bed, 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 Watts Bar Nuclear Plant shows mussles 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 directly harm mussels inhabiting the bottom of the river. 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 Section 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, proposed dredging and barge towing proposed under Alternative B would result in adverse direct, indirect, and cumulative effects to the pink mucket and sheepnose mussel. Operation of the proposed B&W unit may have minor indirect impacts on those species. TVA's currently ongoing consultation with the USFWS is expected to result in adoption of measures designed to minimize and/or mitigate for impacts to both species, which would become commitments described in the final SEIS.

Alternative C

Similar to Alternative B, proposed activities under Alternative C would use existing intake and discharge, and 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 on the federally listed or state-listed aquatic species in Guntersville Reservoir or its tributaries near BLN.

As described under Alternative B, dredging may affect federally listed mussels. 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 sheepnose mussel. Operation of the proposed AP1000 unit could have minor indirect impacts on those species. TVA's currently ongoing consultation with the USFWS is expected to result in adoption of measures designed to minimize and/or mitigate for impacts to both species, which would become commitments described in the final SEIS.

3.7.2. Plants

3.7.2.1. Affected Environment

A review of the TVA Natural Heritage Database indicates no federally listed plants and 25 state-listed plant species occur within five 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 five miles from BLN but within Jackson County, Alabama. These include: American hart's-tongue fern (*Asplenium scolopendrium* var. *americanum*), green pitcher plant (*Sarracenia oreophila*), Morefield's leather-flower (*Clematis morefieldii*), Price's potato bean (*Apios priceana*), and monkey-face orchid (*Platanthera integrilabia*). 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.

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

Common Name	Scientific Name	Federal Status	State Rank/Status
Woodland Tickseed	*Coreopsis pulchra*	--	S2/SLNS
Yellowwood	*Cladrastis kentukea*	--	S3/SLNS

* **Denotes** known from the county but not from within five miles of the project area
Federal status abbreviations: C = Candidate; LE = Listed endangered; LT = Listed threatened
State rank abbreviations: S1 = Critically imperiled often with 5 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
State status: Alabama does not give status to state-listed species; SLNS = No state status

3.7.2.2. Environmental Consequences

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.

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 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 of 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/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 will occur in non-forested areas, habitat potentially suitable for roosting Indiana bats will 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.

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 osprey 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 osprey are considered insignificant given the abundance of nesting habitat around BLN.

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 1974) 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 Regional 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 miles 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 miles east of BLN property boundaries, within the mid-channel 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 and 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 provides 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 B and C, 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 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 Nature 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 non-power 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 3-13 shows the location of these areas as well as three additional reservoir recreation areas situated within 10 miles of the BLN site.

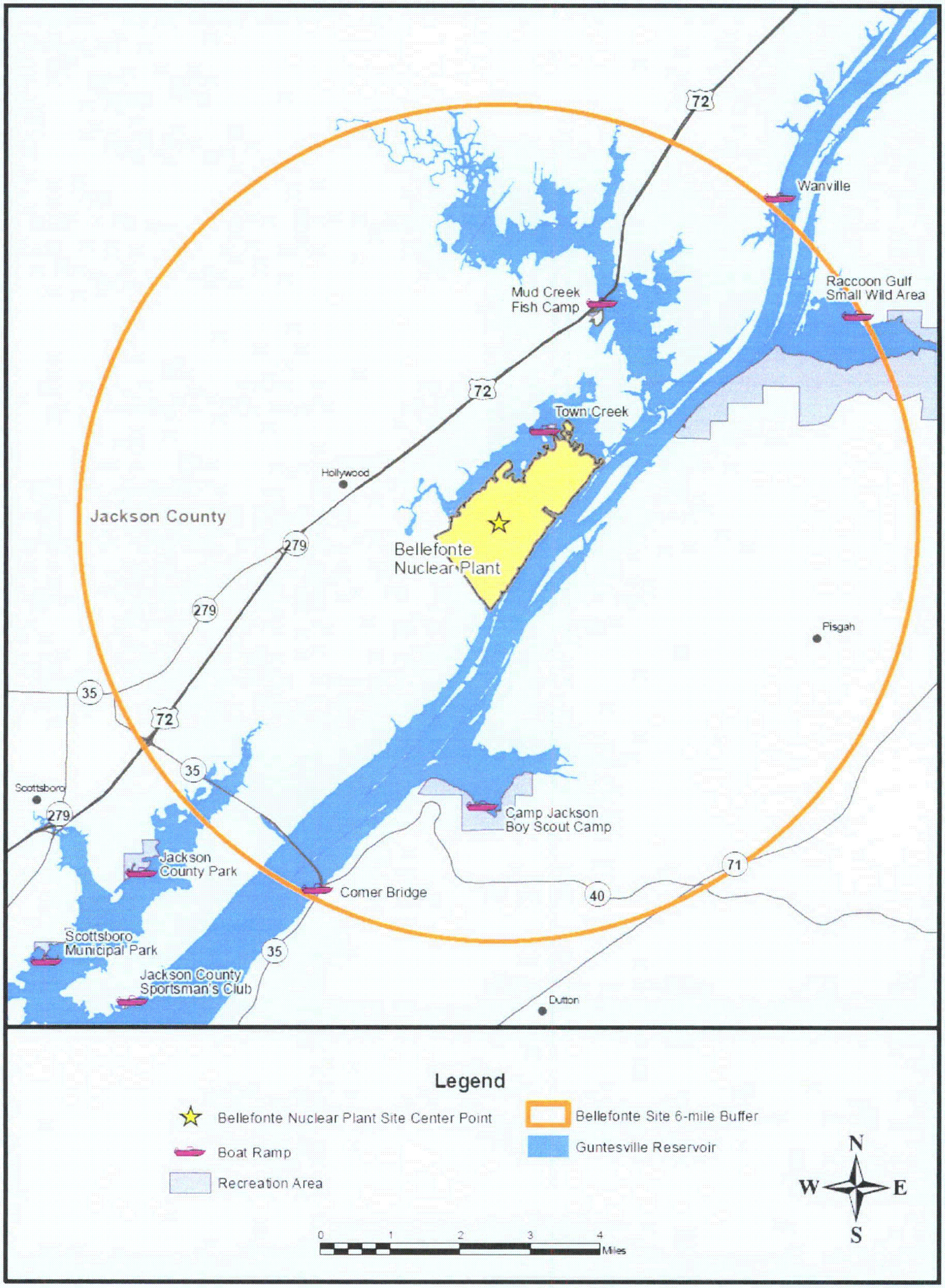

Figure 3-13. BLN Recreation Instream Use

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 1974; TVA 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.

Plant water use would represent a minimal amount relative to total water flow in the waterways around BLN (Section 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.

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. For investigations associated with the B&W unit (BLN 1&2), TVA has determined the area of potential effects (APE) 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 the similarity of areas needed for construction and operational purposes, this same APE was determined, with concurrence of the Alabama SHPO, for evaluations regarding the AP1000 unit (BLN 3&4). The archaeological APE is identified on both Figure 2-1 (B&W site plan) and 2-4 (AP1000 site plan) as "Bellefonte Project Area."

Previous archaeological surveys conducted within the archaeological APE identified 4 sites (1JA111, 1JA113, 1JA300, and 1JA301). Only 2 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-Wolfe 2007 and 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 one mile from the BLN cooling towers.

3.10.2. Environmental Consequences

The potential for direct, indirect, and cumulative effects to historic properties was evaluated. Proposed construction and other ground-disturbing activities have potential to affect archaeological sites and historic structures. None of the historic properties are located in areas proposed for new construction or associated activities. No direct, indirect, or cumulative effects to historic properties would occur from operation of BLN under any of the alternatives.

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 1JA11 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

State Historic Preservation Officer concurred with TVA's findings that proposed completion of the BLN site would have no effect on historic properties. 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 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 1JA11 and the vegetative buffers surrounding the cemeteries, TVA has determined that the implementation of Alternative C would have no direct or affect on historic properties. Because no effects are anticipated, there would be no cumulative effects to historic properties from AP1000 construction and operation.

3.11. Visual Resources

3.11.1. Affected Environment

The BLN site is buffered from the main river channel by a wooded ridgeline which 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 formally 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 over 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 3-14). 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 477-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 manmade visual features in the surrounding landscape.

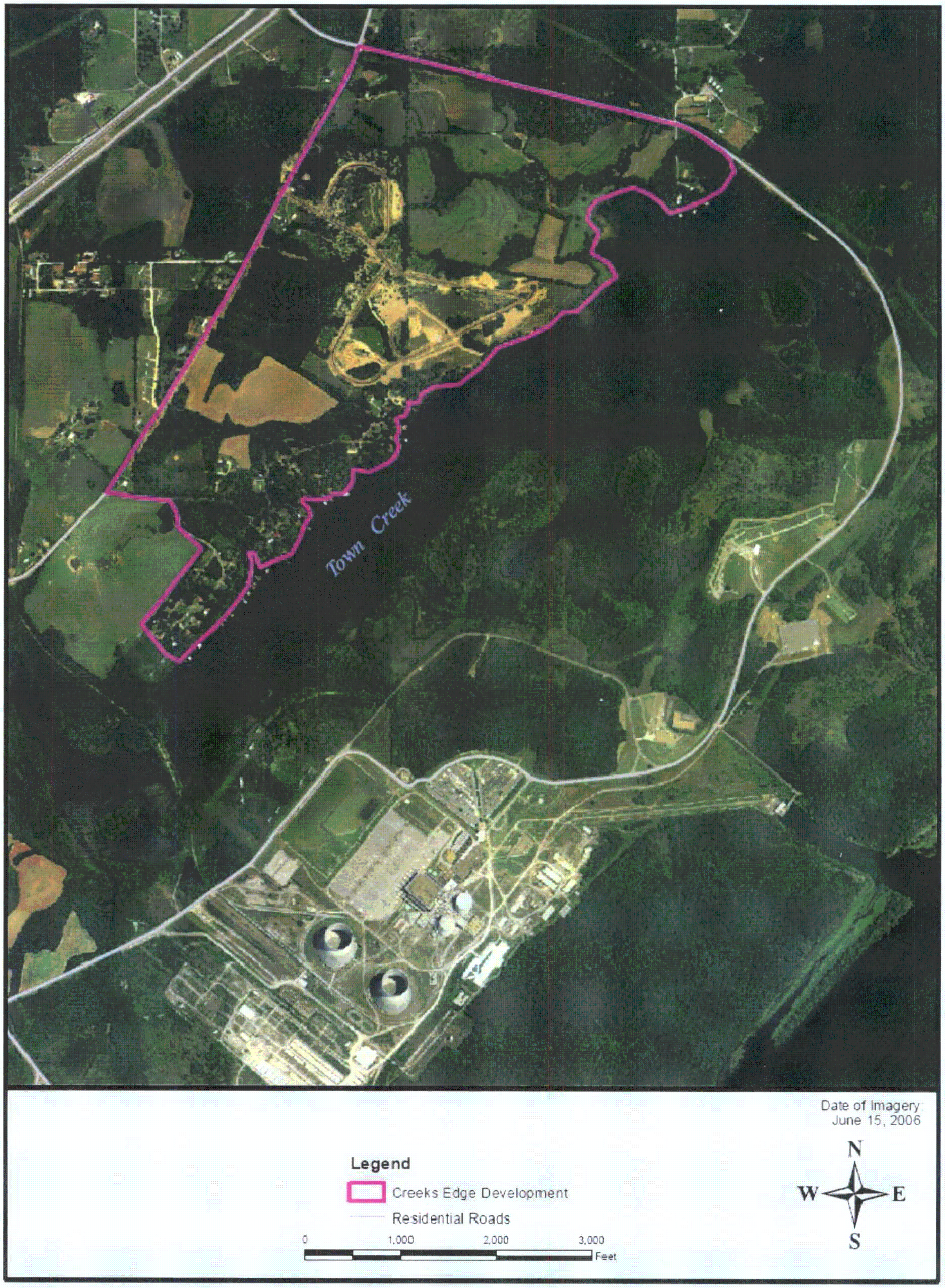

Figure 3-14. BLN Creeks Edge Development

Sand Mountain stretches in either direction from the plant site as it forms the eastern shoreline of Guntersville Lake. 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 mountain-side vantage points. Additional views can be seen by highway travelers traversing the mountain on State Roads 35 and 40 as well as by those crossing the lake on the Comber 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 contribute 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 site and its associated transmission lines currently present the most noticeable visual/aesthetic change in character to an area generally within a 5- to 7-mile radius.

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 the new Westinghouse 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 SR 72 to the west would likely not have views of construction activities at the plant site. Residents along County Road (CR) 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 477-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 would be visible up to five miles and beyond in all directions. Plumes would be less visible during the summer months when 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 Meade Paper Plant and Widows Fossil Plant 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. The new structure would add a new broadly horizontal element to the industrial landscape but would be visually similar to other structures seen on the plant site now. 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. Since 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-hr 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 (FICON 1992) recommends that a 3 dB increase indicates a possible impact requiring further analysis when the existing DNL 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.

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

3.12.2.1. Construction Effects

Alternative A
Because there would be no construction, implementation of the No Action Alternative would have no impact on noise levels near BLN.

Alternative B
The largest source of noise in the construction of a Babcock and Wilcox Pressurized Water Reactor is the hydro-demolition to access the steam generators. Hydro-demolition can be very loud, with noise levels often exceeding 110 dBA. However, all hydro-demolition work will be done inside the containment walls which will greatly decrease the potential for off-site impacts. Hydro-demolition will take place 24 hours a day, 7 days a week, for up to 12 days. While limiting most of the construction activities to daytime hours can reduce potential noise impacts, hydro-demolition cannot be limited to daylight hours. Any noise impacts of hydro-demolition 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, 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 exceed neither EPA's recommendation nor 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 Creek's Edge development (Figure 3-14).

Alternative C
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. No hydro-demolition work on the steam generator would be necessary under this alternative. However, site preparation for the construction of an AP1000 unit would 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.

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.

3.12.2.2. Operational Effects

Alternative A
Because no nuclear plant would be operated, adoption of the No Action Alternative would have no impact on noise levels around BLN.

Alternative B
The major noise source in the operation of a B&W is the cooling tower. Noise from the cooling tower is expected to be 85 dBA near the tower and approximately 55 dBA 1000 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. If the cooling tower operated 24-hr per day, 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 implementation of Alternative B are expected to be minor, for both the surrounding communities and for the nearest residents of Creek's Edge development.

Alternative C
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

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 the TVA's 1974 FES, Section 1.2; the 1999 Tritium FEIS, Section 4.2.3.8; and the 1997 BLN Fossil Conversion FEIS, Section 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). The most recent estimate by the U. S. Census Bureau shows a small decline to 53,134 in 2008. 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 Georgia, southeast of the site, all of the area within 10 miles 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 attractions near the site: Lake Guntersville Park; a campground which can host as many as about 650 campers daily; the Unclaimed Baggage Center in Scottsboro, with more than one 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. These are discussed in detail in the COLA ER, Section 2.5.1.3.

3.13.1.2. Environmental Consequences

Construction Effects
Under Alternative A, the No Action Alternative, no construction would occur and therefore there would be no impacts.

If Alternative B were selected, construction is expected to take about 7.5 years, with a peak on-site workforce of approximately 3,015. About 2,499 of these would be construction workforce and the remainder would be operations work force. If Alternative C were selected, construction is expected to take about 6.5 years, with a peak on-site workforce of approximately 2,933. About 2,319 of these would be construction workforce and the remainder would be operations work force. Impacts from a temporary increase in population due to construction are discussed in the TVA's 1974 FES, Section 2.8; the Tritium FEIS, Section 5.2.3.8; and the BLN Conversion FEIS, Section 4.2.12.1. Under either Alternative B or Alternative C, the impacts are expected to be small in the area and moderate in Jackson County, similar to those discussed in the COLA ER, Section 4.4.2.1.

Operation Effects
Under Alternative A, the No Action Alternative, there would no new plant, and therefore, no impacts of plant operation.

Under Alternative B, the BLN site is expected to employ approximately 849 operations workers at the new unit. Under Alternative C, operations employment is expected to be about 650. However, some of those would already be working at the site during construction. Therefore, not all operations workers would be additions after completion of construction. The impacts of plant operation would be similar to those discussed in the Tritium FEIS (Section 5.2.3.8), and probably somewhat greater than those anticipated in the Bellefonte Conversion FEIS (Section 4.2.12.2) or the BLN 1&2 FEIS (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, Section 5.8.2.1. Impacts under Alternative C would be slightly less than under Alternative B, since operations employment would be lower than estimated 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 the TVA's 1974 FES. They were discussed in the 1997 BLN Conversion FEIS, Section 3.1.12.2, and in the 1999 Tritium FEIS, Section 4.2.3.8. Employment and income have been increasing since these earlier studies were prepared. This growth has continued, with total employment in Jackson County in 2007 increasing to 25,950 and per capita personal income to $27,051 (Table 3-10). Manufacturing and farming account for a greater share of employment that either the state or national averages, while the private service sector accounts for a smaller share. Larger manufacturing establishments include textiles and textile products, paper products, machinery, and furniture and related products. Both employment and income are discussed in the COLA ER, Section 2.5.2.1.

Table 3-10. Employment and Income, 2007

Category	Percent by Region		
	Jackson County	Alabama	United States
Farm	5.9	1.9	1.6
Mining	0.3	0.4	0.5
Construction	5.9	7.2	6.4
Manufacturing	24.4	11.7	8.0
Wholesale Trade	3.3	3.5	3.7
Retail Trade	12.9	11.4	10.7
Finance, Insurance, and Real Estate	4.2	7.1	9.2
Government	17.1	15.7	13.4
Other	26.0	41.2	46.5
Total Employment	25,950	2,618,073	180,943,800
Per Capita Personal Income	$27,051	$32,419	$38,615

Source: BEA 2007

Per capita personal income in Jackson County, as of 2007, was 70 percent of the national average, and was well below the state average of $32,419, which was 84 percent of the national average.

The manufacturing sector accounts for about 33 percent of total earnings in the county, considerably more than in the state as a whole (17 percent) and the nation (12 percent). Farm earnings accounted for almost 3 percent of the total in the county, compared to less than one percent in the state and the nation.

3.13.2.2. Environmental Consequences

Construction

Under Alternative A, the No Action Alternative, no construction would occur and therefore there would be no impacts.

Employment and income impacts of the employment increases are discussed in the TVA's 1974 FES, Section 2.8; the Tritium Production FEIS, Section 5.2.3.8; and the Bellefonte Conversion FEIS, Section 4.2.12. Under either Alternative B or Alternative C, the increase in employment for completion of 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 in the COLA ER for the AP1000, Section 4.4.2.2. For both action alternatives, these beneficial impacts are considered to be moderate to significant in the county and minor regionally.

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

Under Alternative A, the No Action Alternative, there would be no new plant and therefore no impacts of plant operation.

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's 1974 FEIS, Section 2.8; however, the expected number of employees estimated for that document is well below the approximately 849 (for Alternative B) or 653 (for Alternative C) workers that are currently anticipated during operation. The impacts likely would be more similar to the operational impacts discussed in the Tritium EIS, Section 5.2.3.8, and similar to the upper end of the range discussed in the BLN Conversion EIS, Section 4.2.12.2. The impacts should also be less than those discussed in the COLA ER, Section 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. Adverse impacts would be minor, primarily a slight increase in traffic on the roads and increased demand for medical and governmental services. These impacts 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 of Population 8.8 percent of the total population (Census 2000b). This was 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.

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. 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.

The latest estimates for number of persons below poverty level indicate that in 2007, 13.0 percent of the population was below the poverty level in the nation, compared to 16.6 percent in the state of Alabama and 17.6 percent in Jackson County. These estimates are not available for smaller areas. However, the 2000 Census of Population showed a poverty level in Census Tract 9509, Block Group 1, of 3.4 percent. This is below the level of 5.1 percent in Census Tract 9509 and well below the 13.7 percent in Jackson County, the 16.1 percent in Alabama, and the 12.4 percent in the nation.

3.13.3.2. Environmental Consequences

Construction

Under Alternative A, the No Action Alternative, no construction would occur and therefore there would be no impacts.

Environmental justice impacts were not evaluated in the TVA's 1974 FES. However, they were evaluated in the BLN Conversion EIS, Section 4.9, and in the BLN Tritium FEIS, Section 5.2.3.10 and in Appendix G. The COLA ER evaluates these impacts in Section 4.4.3, concluding that any impacts would be minor and not disproportionate. More recent data are consistent with this conclusion for either Alternative B or Alternative C.

Operation
Under Alternative A, the No Action Alternative, there would no new plant and therefore no impacts of plant operation.

Environmental justice impacts were not evaluated in the TVA's 1974 FES. However, they were evaluated in the BLN Conversion EIS, Section 4.9, and in the BLN Tritium FEIS, Section 5.2.3.10 and in Appendix G. The COLA ER evaluates these impacts in Section 5.8.3, concluding that any impacts would be minor and not disproportionate. More recent data are consistent with this conclusion for either Alternative B or Alternative C.

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 Tritium FEIS, Section 4.2.3.8, and in the BLN Conversion FEIS, Section 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 1985). 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 of Population, 894 housing units were available, either for sale or for rent, in the county. Temporary housing is also available at local hotels/motels in the Scottsboro area. There are also temporary housing opportunities at the local campgrounds and RV parks. Housing is discussed in more detail in the COLA ER, Section 2.5.2.6.

3.13.4.2. Environmental Consequences

Construction
Under the No Action Alternative, no construction would occur and therefore there would be no impacts.

The majority of the BLN employees are expected to live in Jackson County. Workers who do not find acceptable facilities in Jackson County would be likely to 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 the TVA's 1974 FES, Section 2.8. They are also discussed in BLN Conversion FEIS, Section 4.2.12.1 and the Tritium FEIS, Section 5.2.3.8. The impacts are expected to be similar to those in the COLA ER, Section 4.4.2.4. This analysis concludes 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 is implemented, TVA would review the availability of housing during the construction phase to assess the necessity of mitigation, which could include housing assistance for employees, transportation assistance for commuting employees, or remote parking areas with shuttles. There are no known changes that would modify this conclusion under either Alternative B or Alternative C.

Operation
Under Alternative A, the No Action Alternative, there would no new plant and therefore no impacts of plant operation.

Housing impacts during operations are discussed in the TVA's 1974 FES, Section 2.8. They are also discussed in the BLN Conversion FEIS, Section 4.2.12.2, and in the Tritium FEIS, Section 5.2.3.8. The impacts of this proposal are expected to be similar to those discussed in the COLA ER, Section 5.8.2.3.2. This analysis concludes that the impact would be minor and insignificant in the 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 the TVA's 1974 FES Section 1.2. Water supply and quality were also discussed in the Tritium FEIS in Section 4.2.3.4. Water supply and usage, but not wastewater, was described in the BLN Conversion FEIS (Sections 3.1.6 and 3.1.8). Water supply and wastewater treatment are also described in the COLA ER, Section 2.5.2.7.1 and in Section 2.3.2. Section 3.1.2 of this DSEIS 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.

3.13.5.2. Environmental Consequences

Construction
Under the No Action Alternative, because no construction would occur, there would be no impacts to the supply of water or management of wastewater.

Water supply and wastewater impacts were not explicitly addressed in the TVA's 1974 FES, except for a commitment to properly handle onsite sewage (Section 2.7(1).4). They are addressed in the BLN Conversion FEIS (Section 4.2.6) and in the Tritium FEIS (Section 5.2.3.4). For completion of BLN Unit 1, these impacts are expected to be similar to those discussed in the COLA ER, Section 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.

Operation
Under Alternative A, the No Action Alternative, there would no new plant and therefore no impacts of plant operation.

As noted above, these services were not addressed in the earlier environmental analyses. They are briefly addressed in the BLN Conversion FEIS (Section 4.2.6.2). However, the COLA ER addresses operational impacts to these services in Section 5.8.2.3.1. No concerns were identified. As discussed in the 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

These services were not described in TVA's 1974 FES. However, they are discussed in the Tritium FEIS, Section 4.2.3.8, and in the Conversion FEIS, Section 3.1.12.3.

Jackson County, as of November 2006, had 95 sworn officers and 435 firefighters. In addition to the Jackson County Sheriff's Department, there are seven local police departments in the county, with jurisdiction within and around city limits. There are 25 fire departments in the county with a total of 35 paid firefighters and 400 volunteer firefighters (no less than 10 per station). Local police and fire protection are currently considered adequate, but future expansion and facility upgrades may be needed to accommodate future population growth.

The single hospital in Jackson County, Highlands Medical Center, is located in Scottsboro and provides 75 beds and 41 doctors. The Jackson County Health Department provides general medical services for approximately 6,100 individuals per year.

These services are discussed in more detail in the COLA ER, Section 2.5.2.7.2.

3.13.6.2. Environmental Consequences

Under the No Action Alternative, the in-migration of people associated with construction and plant operation would occur. Therefore, there would be no additional demand for public services under Alternative A.

Impacts to these services are not analyzed in the earlier studies, except for fire, which was discussed in the Conversion FEIS, Section 4.2.12. The COLA ER, Section 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 fire fighters. Likewise, the COLA ER, Section 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 BLN Unit 1 should be similar to those in the 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.

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 Highland Medical Center. Construction of BLN would have a minor effect on the already-existing physician shortage. Increased need for hospital services would impact Highlands Medical Center, which currently has adequate beds and staff. Overall, as discussed in the COLA ER, Sections 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, Section 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 EIS, Section 3.1.12.3 and in the Tritium EIS, Section 4.2.3.8. There are two school systems within Jackson County: Jackson County Schools and Scottsboro City Schools, both providing K-12 education. For the 2007-08 school year, these districts had 5,998 and 2,681 enrolled students, respectively. A discussion about local schools is included in the COLA ER, Section 2.5.2.8.2.

3.13.7.2. Environmental Consequences

Construction

Under the No Action Alternative, no construction would occur and there would be no additional demand for public schools.

In the 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, Section 4.2.12.1, concluded that the system would have adequate space for the projected increase. However, the Tritium FEIS, Section 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, Section 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.

Operation

Under the No Action Alternative, because the population increase associated with operation of a nuclear plant would not occur, there would be no additional demand for public schools.

The TVA 1974 FES did not evaluate operational impacts on schools. In the Tritium FEIS, Section 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, Section 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 BLN Unit 1 is expected to be similar to, but less than, the impact discussed in the COLA ER, Section 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 to be 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. The city has a well developed zoning plan and supporting zoning laws in place for land inside the city limits. Hollywood, 3 miles west of the site, is the closest town. It has an estimated 2008 population of 924.

Land use is discussed in detail in the TVA's 1974 FES, Section 1.2 and Appendix A, as well as in the Tritium FEIS, Section 4.2.3.1, and the BLN Conversion FEIS, Section 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 Highway 72 through most of Jackson County. The COLA ER, Sections 2.2 and 2.5.2.4, contain a recent description of land use.

3.13.8.2. Environmental Consequences

Construction

Under the No Action Alternative, no construction would occur and therefore there would be no impacts to land use.

Impacts of plant construction on land use were discussed in the TVA's 1974 FES, Section 2.9. They are also discussed in the Tritium FEIS, Section 5.2.3.1, and in the Conversion FEIS, Section 4.2.14.1. Under either Alternative B or Alternative C, the proposed construction would require no additional land acquisition and no road relocations. No new transmission lines or other uses of off-site land related to construction are proposed. 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.

Operation

Under the No Action Alternative, there would no new plant and therefore no impacts of plant operation.

Impacts of the plant on land use were discussed in the TVA's 1974 FES, Sections 2.9 and 3.0. They are also discussed in the Tritium FEIS, Section 5.2.3.1, and in the Conversion FEIS, Section 4.2.14.2. Under either Alternative B or Alternative C, adverse impacts to land use from operation of the BLN plant would be insignificant. A detailed discussion of these impacts is included in the COLA ER, Section 5.1.

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 Tritium FEIS in section 4.2.3.8. However, they are not discussed in The BLN Conversion FEIS. A more recent and extensive discussion is included in the COLA ER, Section 2.5.2.3.

3.13.9.2. Environmental Consequences

Construction
Under the No Action Alternative, no change in tax revenues would occur because the plant would not be constructed.

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 Tritium FEIS, Section 5.2.3.8.1. They are not discussed in the Bellefonte Conversion FEIS. These impacts would be similar to those described in the COLA ER, Section 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.

Operation
Under the No Action Alternative, no change in tax revenues would occur because no nuclear plant would be operated.

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 Tritium FEIS, Section 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, Section 5.8.2.2.1, considered to be moderately beneficial in Jackson County.

3.13.10. Cumulative Effects

TVA's 1974 FES did not address cumulative effects, other than radiological impact on the Tennessee River (see Appendix J). They were discussed in the Tritium FEIS, Section 5.3, and in the BLN Conversion FEIS, Section 4.4.2. In the COLA ER, the cumulative effects of forseeable projects within 50-miles of BLN. The realignment of Redstone Arsenal as part of the Base Realignment and Closure Act of 2005, was the one planned project within that area that could contribute to cumulative socioeconomic effects. 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 be likely to 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.

3.14. Solid and Hazardous Waste

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 control 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" onsite.

Normal non-radiological 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 residue 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.

Regarding solid waste from transmission line clearing, the marketable timber was to be sold, if practicable, and the remaining forest slash burned in accordance with the applicable environmental regulations, or piled in windrows along the ROW, where burning was unacceptable. Other waste, which should be in much smaller quantities, was comprised of wooden reels from cable dispensation, cardboard, steel retaining bands, etc. These waste materials were to be consolidated at the staging areas for disposal at an approved landfill, or smaller amounts burned locally.

This initial 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. Also, the manner/location of disposal varied, with offsite disposal retained as the favored option but disposal of various wastes onsite being maintained as an option. Actual and planned disposal was always in accordance with existing applicable environmental regulations.

In 1976, the Final Environmental Report (TVA 1976) restated the solid waste categories as demolition/construction waste, domestic (municipal type) waste, clearing and demolition/construction waste and added the category non-radiological hazardous waste or problem waste.

An exhaustive list was provided of likely items included in domestic waste: garbage, paper, plastic, packing materials (metal retaining bands, excelsior, cardboard), leather, rubber, glass, soft drink and food cans, expired 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 non-radiological solid waste. Domestic and demolition/construction wastes were to be disposed of in a local, state-approved sanitary landfill.

Notably, it was stated that broken concrete and bricks, waste concrete, asphalt, rocks, and dirt, along with the residue from burning clearing wastes, were used as unclassified fill material onsite. Also, 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.

Non-radiological 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 given of hazardous waste were empty containers from paints, solvents, pesticides, acids, oils, PCBs, chemical grouts, as well as the materials themselves. Problem wastes were represented as those wastes that are difficult to handle by conventional means. Examples given of problem wastes were sludges from water and wastewater treatment plants, tires, materials from intake screens, and materials used in the cleanup of chemical or oil spills.

It should be noted that the Resource Conservation and Recovery Act (RCRA) regulations (40 CFR Parts 260 – 273), the basis for current hazardous waste management, were not yet in force at the time of this report (TVA 1976).

In the TVA White Paper (TVA 1993a), which was developed to determine if the BLN FEIS needed to be supplemented for the proposed change from deferred status, asbestos materials were added to the list of BLN wastes. Notably, for the disposal of certain non-radiological nonhazardous waste, the intent was to be able to dispose of these wastes either offsite in State-approved sanitary landfills or in onsite approved landfills depending on the economics. Any hazardous wastes would be disposed of or treated offsite at State-approved treatment/disposal facilities. 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.

The BLN Conversion EIS (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 non fossil-based nonhazardous wastes were generated at BLN at that time as the existing plant was in regulatory deferred status. Beyond the large volume solid wastes associated with the fossil-based options, the typical hazardous and nonhazardous waste generation was discussed.

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 under the Affected Environment below.

Most recently, the COLA ER provided a description of the solid waste generation associated with the construction and operation of the BLN 3&4 AP1000 plant. Information as to the types of solid waste and the quantities were included. Further details are presented and discussed under Alternative C below.

3.14.1. Affected Environment

The changes in solid and hazardous waste generation at BLN from the earlier NEPA review conditions result from the further reduction of plant activities from those prevailing under the deferred status (TVA 2006). The effect of the resultant activities is reflected mostly in the quantitative distribution of wastes rather than changes in the types of wastes.

Recent activities at BLN have been primarily those necessary to clean the plant and maintain selected plant systems and the physical plant in a state of nondeterioration. No power is being generated onsite, some plant equipment has been sold or transferred to other TVA plants/facilities, remaining reservoirs/containers of various types of oil have been drained and the oils sent for recycling or disposal. Notably, the switchyards and the transformer yard onsite are being maintained in an active state, and facilities are being maintained to house personnel. Also, the Simulator Building and the Environmental Data Station continue to be used for training. The onsite staff is about 200 persons.

The solid waste generated is minimal, commensurate with the reduced level of activity at the plant. Typical sanitary solid waste is routinely put in dumpsters onsite and subsequently disposed of offsite in an approved sanitary landfill. Within the last three years (2007 to present), nonhazardous waste generated at BLN included 4 roll-offs (20 cubic yards each) of roofing materials (flashing, felt, etc.) and 11 roll-offs (20 cubic yards each) of asbestos waste generated from the repair and upkeep of plant buildings, and 1 roll-off (20 cubic yards) of oily debris (dirt and gravel). This material contained in 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 1392 kilograms (kg) of used oil (used oil, oily water, used grease, etc.) in large part from the decommissioning of plant operating equipment, 2489 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. BLN is a Conditionally Exempt Small Quantity Generator (CESQG). A CESQG generates hazardous waste at a rate of less than 100 kg (220 pounds [lbs)]) 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 Hazardous Waste Storage Facility (HWSF)	Interim storage prior to shipment for disposal	720 55-gallon 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 gallons storage in containers 176,598 gallons 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-gallon containers[a]
Chemical Waste Management Emelle, Alabama	Stabilization and landfilling	~ 800,000 tons/year for 10 to 20 years

a – Maximum to be held onsite at any one time.

3.14.2. Environmental Consequences

The types and amounts of solid and hazardous waste generated by the alternatives during and construction and operation are described below. For both action alternatives, 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. Also, 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 the disposal of the solid and hazardous wastes would always 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. This is true for construction and operation effects for both Alternative B and Alternative C.

The discussion to follow will describe only indirect effects. Because all of the solid and hazardous wastes would be disposed of offsite, there would be no direct effects. Also, 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.

Construction Effects

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.

Alternative B

The quantities and types of solid waste generated by this option would be determined primarily by the number 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 1for 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. Thus, 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.

Also, 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 CLRW 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 1for the duration of the construction period. (DOE 1999) These hazardous wastes would be sent to the TVA HWSF for disposal.

Alternative C

During the initial phase, 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 2-4), several buildings including the existing turbine building and the administration complex would need to be demolished.

Construction/demolition wastes are likely to include scrap metal, masonry, broken concrete, wall board, lumber, manufactured wood products, cardboard, plastics, broken glass, roofing materials, and such. The additional acreage is currently covered in overgrowth and some forestation (TVA 2008). 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. COLA ER estimated that 5,000 lbs (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 lbs (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 lbs (7.25 tons) of hazardous waste would be generated during construction of the AP1000.

Operational Effects

Alternative A
Under Alternative A 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
While exact calculations of the quantities of solid and hazardous waste that would be generated under Alternative B are yet to be determined by the DSEP, 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.

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 demineralizers 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 1000 kg of hazardous waste per calendar month. During outages, they may temporarily become EPA hazardous waste large quantity generators (greater than 1000 kg per calendar month) for the period of the outage. The operating TVA nuclear plants providing these generation rates are multi-unit plants, thus it is likely that the proposed single unit plant will have a lower generation rate. However, it is also likely that the single unit plant would be a SQG during normal operation.

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.

Alternative C
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 non-radioactive resins, filters and sludge (TVA 2008a). That study estimated the "the plant (Units 3&4) would generate approximately 800 tons of nonhazardous, non-radiological solid waste (i.e., trash) during each year of plant operation." Based on this estimate for two AP1000 units, the estimated quantity of solid waste generated annually during operation a single AP1000 would be approximately 400 tons. Based on the TVA experience, additional smaller amounts of nonhazardous waste such as oily debris, 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 estimates in the COLA ER for two unit operation (TVA 2008a), operation of a single AP1000 would generate about 2000 lbs (893 kg) 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.

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 2009).

Table 3-12. Earthquakes Within 200 miles of BLN (February 2005-December 2008)[1]

Date	Time	Latitude (Degrees North)	Longitude (Degrees West)	Depth (km)	Magnitude	Magnitude Type
03/18/2005	02:16.3	35.723	-84.164	9.1	3.2	Mc
03/22/2005	11:50.5	31.836	-88.06	5.0	3.3	ML
04/05/2005	37:42.6	36.147	-83.693	10.0	2.9	Mc
04/14/2005	38:15.7	35.468	-84.091	15.5	2.8	Mc
06/07/2005	33:36.7	33.531	-87.304	5.0	2.8	ML
10/12/2005	27:30.1	35.509	-84.544	8.1	3.8	Mc
10/25/2005	18:10.5	34.429	-85.315	9.1	2.6	Mc
10/28/2005	05:40.3	33.003	-83.094	14.4	2.7	Mc
10/29/2005	46:20.7	33.034	-83.156	17.1	2.5	Mc
03/11/2006	37:20.1	35.192	-87.996	0.0	2.9	Mc
03/11/2006	08:54.2	32.712	-88.159	30.7	2.6	Mc
04/11/2006	29:20.8	35.362	-84.48	19.5	3.3	Mc
05/10/2006	17:29.2	35.533	-84.396	24.7	3.2	Mc
05/16/2006	23:19.9	32.85	-88.087	20.5	2.5	Mc
06/16/2006	57:27.2	35.515	-83.229	4.7	3.1	ML
07/11/2006	45:40.7	33.606	-87.146	1.0	2.8	ML
08/07/2006	44:27.7	34.937	-85.461	14.2	2.9	Mc
09/05/2006	32:42.6	33.705	-82.992	10.2	2.5	Mc
10/02/2006	56:19.2	35.468	-84.984	8.7	2.5	Mc
12/18/2006	34:26.5	35.362	-84.349	17.2	3.3	ML
01/03/2007	05:45.0	35.92	-83.95	15.3	2.7	ML
02/07/2007	34:54.0	34.61	-85.31	10.7	2.6	ML
03/23/2007	15:33.3	33.652	-87.067	5.0	2.6	ML
05/04/2007	16:28.2	33.797	-87.299	5.0	3	ML
06/19/2007	16:27.0	35.79	-85.36	1.2	3.5	ML
07/27/2007	16:39.8	33.834	-87.329	1.0	2.6	ML
10/23/2007	16:12.0	35.59	-84.1	21.3	2.8	ML
11/17/2007	22:55.7	37.393	-83.087	1.0	2.5	ML
01/01/2008	59:53.0	37.04	-88.89	3.9	2.5	ML
01/04/2008	55:28.5	33.106	-86.161	5.0	2.5	ML
01/23/2008	22:13.8	33.739	-87.18	1.0	2.8	ML

Date	Time	Latitude (Degrees North)	Longitude (Degrees West)	Depth (km)	Magnitude	Magnitude Type
02/23/2008	03:18.5	33.864	-87.165	1.0	2.6	ML
04/08/2008	43:44.4	33.649	-87.502	1.0	2.6	ML
05/07/2008	44:35.1	33.691	-87.211	1.0	2.7	ML
05/16/2008	39:14.9	31.773	-88.203	5.0	3.1	ML
06/23/2008	30:20.0	34.92	-84.84	8.8	3.1	ML
06/28/2008	40:36.5	33.276	-87.396	5.0	3.1	ML
10/31/2008	37:34.0	35.77	-84	7.6	2.9	Mc
12/18/2008	05:06.8	36.043	-83.662	5.0	2.9	ML

Mc = Coda magnitude
ML = Local magnitude
[1] Source: Advanced National Seismic System Earthquake Catalog (2009)

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 9-m (29-foot)-wide sinkhole 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 kilometers (km) (5.0 to 9.3 miles) (Earthquake Center 2009 and USGS 2009). Based on the U.S. Geological Survey's Community Internet Intensity Map, the observed Modified Mercalli Intensity 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 the TVA's 1974 FES and 1986 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 that 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

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.

Regulatory Seismic Requirements

TVA is currently performing feasibility studies relative to a comparison of the original seismic design basis spectra (NRC Regulatory Guide 1.60 Rev 1) to 10 CFR Part 50, Appendix S (Regulatory Guide 1.208 and Interim Staff Guidance). The present regulatory requirements apply to new generation plant sites; however, TVA felt it prudent to perform analyses to understand how 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 Category 1 structures compare favorably with the latest requirements (AREVA 2008). At such time that an agreed Regulatory Framework is established for the completion of BLN 1&2, design basis analyses will be performed to demonstrate compliance with regulatory requirements.

As a standard plant, the seismic adequacy of the AP1000 design is addressed through the NRC's review and approval of the vendor-supplied Design Control Document.

3.16. Meteorology, Climatology and Air Quality

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 the TVA's 1974 FES, onsite data from 1979-1982, more recent climatological records, and onsite data for 2006-2007. This report also uses data collected for 15 additional months, into 2008.

3.16.1. Affected Environment -- Climatology and Meteorology

3.16.1.1. 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.

3.16.1.2. Local Meteorology

The meteorological data collected from the BLN meteorological facility has expanded by an additional 15 months beyond the 2006-2007 period in the COLA ER. 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), since only that information was relevant to the AP1000 units. However, because of the potential for elevated releases from the B&W reactor, 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 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 mi/h) decreased from 0.753 percent in 1979-1982 to 0.397 percent in 2006-2008.

55-10 meter atmospheric stability--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

* 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] is relatively similar." Since 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 mi/h) decreased from 0.085 percent in 1979-1982 to 0.005 percent in 2006-2008.

3.16.1.3. Severe Weather

Section 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 section 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 3516 years (i.e., recurrence interval of 3516 years). For data based on Jackson County and five surrounding counties, this probability is 6.44E-4 with a recurrence interval of 1552 years.

When the tornado database extends to 2008, the probability calculation changes to 4.1E-4 with a recurrence interval of 2460 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 1482 years.

3.16.2. Environmental Consequences- Climatology and Meteorology

3.16.2.1. Dispersion

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 were estimated for all units and all release types using meteorological data collected at BLN during 2006-2008. In all cases, the atmospheric dispersion characteristics of the BLN site result in offsite doses within the regulatory limits of 10 CFR Part 100 for accident effluent releases and 10 CFR Part 20 for normal effluent releases. Low atmospheric dispersion (χ/Q) values are indicative of better transport and dilution of released effluents.

Routine Releases

The B&W unit uses two main release locations, the station vent and the turbine building vent. In accordance with the guidance from NRC Regulatory Guide 1.111, the station vent was modeled as a mixed-mode release since 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).

The AP1000 unit uses the plant vent release location, 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.

Table 3-14 B&W Unit Station Vent χ/Q Values Used For Calculating Maximally Exposed Individual (MEI) Doses at BLN

Receptor locations with maximum D/Q or χ/Q values for each receptor type for the station vent mixed-mode release

Receptor Type Analyzed	Direction	Maximum Receptor Type Values	Distance (miles)	X/Q (sec/m^3) No Decay Undepleted	X/Q (sec/m^3) 2.26 Day Decay Undepleted	X/Q (sec/m^3) 8.00 Day Decay Depleted	D/Q (m^{-2})
EAB[10]	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

[10] EAB – Exclusion Area Boundary

Table 3-15. BLN B&W Unit Turbine Building Vent χ/Q Values Used For Calculating MEI Doses

Receptor locations with maximum D/Q or χ/Q values for each receptor type for the turbine building ground-level release

Type of Location	Sector	Distance (miles)	X/Q (sec/m^3) No Decay Undepleted	X/Q (sec/m^3) 2.26 Day Decay Undepleted	X/Q (sec/m^3) 8.00 Day Decay Depleted	Max D/Q (m^{-2})
EAB	WSW	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

Table 3-16. BLN AP1000 Unit χ/Q Values Used For Calculating MEI Doses

Receptor locations with maximum D/Q or χ/Q values for each receptor type for the station vent mixed-mode release

Receptor Type Analyzed	Direction	Maximum Receptor Type Values	Distance (miles)	X/Q (sec/m^3) No Decay Undepleted	X/Q (sec/m^3) 2.26 Day Decay Undepleted	X/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	0.85	1.1E-06	1.1E-06	1.0E-06	4.8E-09
COW	SW	GARDEN	0.85	1.1E-06	1.1E-06	1.0E-06	4.8E-09
GOAT	SW	GARDEN	0.85	1.1E-06	1.1E-06	1.0E-06	4.8E-09
HOUSE	SW	GARDEN	0.85	1.1E-06	1.1E-06	1.0E-06	4.8E-09

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. The doses presented in Section 3.17.3.1 are well below the As Low as is Reasonable Achievable (ALARA) dose limits in Appendix I. This ensures that there are no cost-beneficial radwaste system augmentations of reasonably demonstrated technology that can reduce the dose to the population within 50 miles of the reactor. Also, 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.

Accident Releases

The accident χ/Q values were determined for time periods of 2 hours, 8 hours, 16 hours, 4 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. 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 ER COLA 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 was used.

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 Exclusion Area Boundary and Low Population Zone which 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 Section 3.19.1 show that the highest Exclusion Area Boundary (EAB) dose is 1.2 rem 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.

3.16.3. Affected Environment - Air Quality

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. The COLA ER Regional Air Quality section updated and discussed recent air quality criteria and attainment status of the area. It references an 8-hr ozone standard of 0.08ppm which is the 1997 standard. The newly-revised 2008 8-hr ozone standard is 0.075 ppm. The PM2.5 24-hr standard has also been lowered from 65 ug/m3 to 35 ug/m3, 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, De Kalb, 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 3-15.

The COLA ER identified Jefferson and Shelby Counties in Alabama as being designated non-attainment for 8-hour ozone. Since the COLA ER, some of the non-attainment designations have changed for ozone. The implementation schedule for the new National Ambient Air Quality Standards (NAAQS) required states to send their recommended designations to EPA in March 2009 with EPA finalizing designations in March 2010. As shown in Table 3-19, the nearest non-attainment recommendations to the Bellefonte site are located in North Alabama, North Georgia and Southeast Tennessee.

Table 3-19. Ozone Non-attainment State Recommendations near BLN as of August 2009 Based on 2008 NAAQS

County	State Recommendations	City/State
Jefferson Co. Alabama	Ozone - Whole County	Birmingham, AL
Shelby Co. Alabama	Ozone - Whole County	Birmingham, AL
Madison Co. Alabama	Ozone - Whole County	Huntsville, AL
Murray Co. Georgia	Ozone - Partial County	Georgia
Hamilton Co. Tennessee	Ozone - Whole County	Chattanooga, TN
Meigs Co. Tennessee	Ozone - Whole County	Chattanooga, TN

Source: EPA 2008b

The COLA ER identified the Birmingham area counties Jefferson, Shelby and part of Walker as being designated non-attainment for 24-hour PM2.5. In addition, part of Jackson County was designated non-attainment due to Chattanooga exceeding the annual PM2.5 NAAQS. Some of the non-attainment designations have changed for PM2.5 as well. As shown in Table 3-20, when EPA finalized new designations for PM2.5 in December 2008, only Jefferson, Shelby and a portion of Walker counties were designated non-attainment.

Table 3-20. PM2.5 Non-attainment Designations near BLN as of August 2009 Based on 2006 NAAQS

County	Designation	City/State
Jefferson Co. AL	PM2.5 - Whole County	Birmingham, AL
Shelby Co. AL	PM2.5 - Whole County	Birmingham, AL
Walker Co. AL	PM2.5 - Partial County	Birmingham, AL

Source: EPA 2006

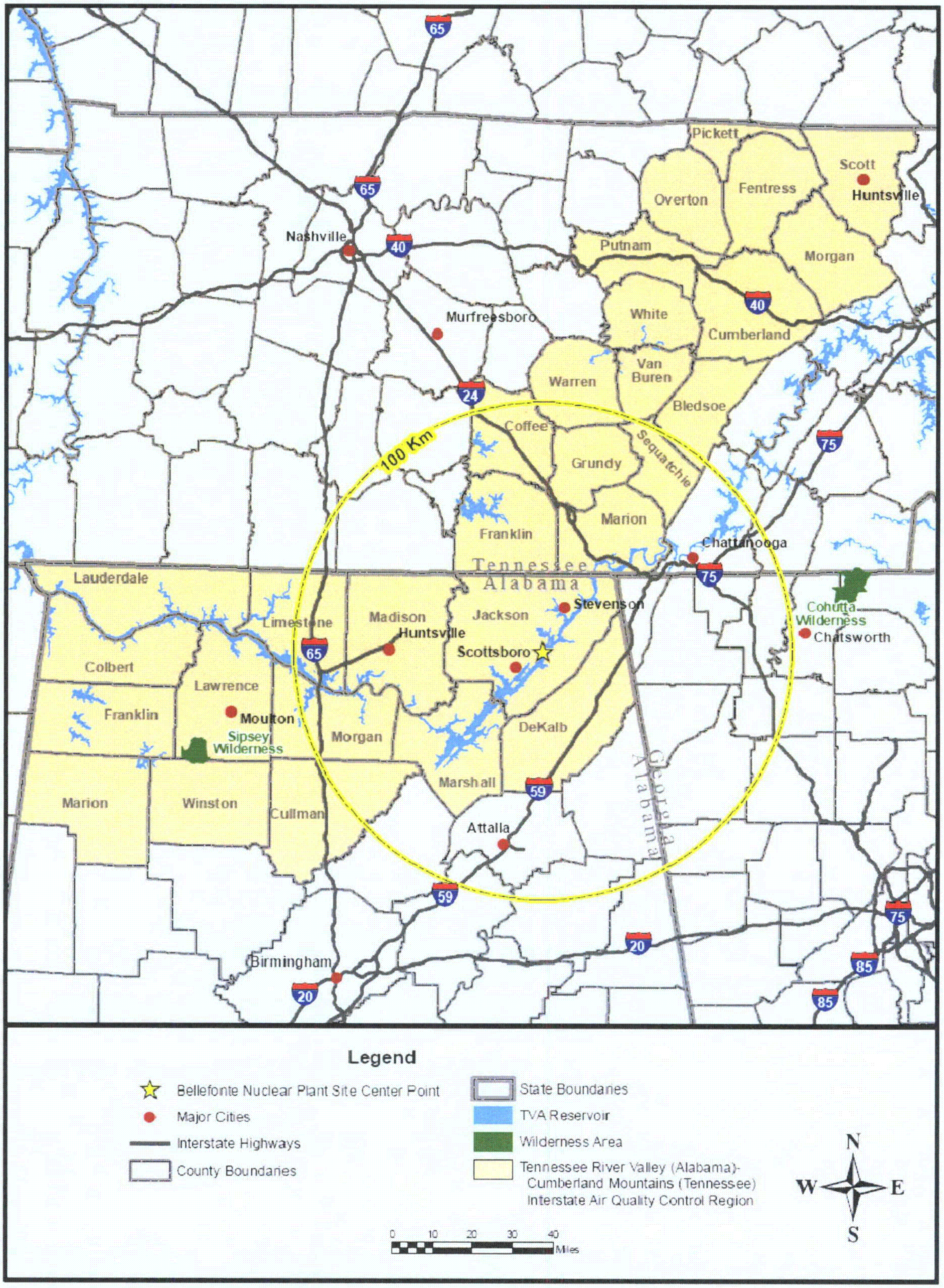

Figure 3-15. BLN 100-Kilometer Wilderness Area

3.16.3.1. Environmental Consequences – Air Quality

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 operation of the auxiliary boilers and diesel generators would emit small amounts of air pollutants as addressed in the 1974 TVA FES. Adoption of Alternative C would likely involve more construction activities than Alternative B, while activities related to operations would be roughly equivalent to those under Alternative B. The emissions related to either alternative would be controlled to meet current 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 850 personnel would be on-site once the plant is operational. Based on these projections and Alabama Department of Transportation 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 2,925 personnel would be on-site during construction and approximately 653 personnel would be on-site once the plant is operational. Based on these projections and Alabama Department of Transportation 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 the intermittent nature of the emissions and fuel regulations, resulting impacts are minor.

3.17. Radiological Effects of Normal Operations

This chapter discusses the potential radiological dose exposure of the public during normal operations of the BLN B&W unit or the 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 demonstrates full compliance. Recent calculations have confirmed 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 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 50 Appendix I.

3.17.1. 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 3-16. 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.

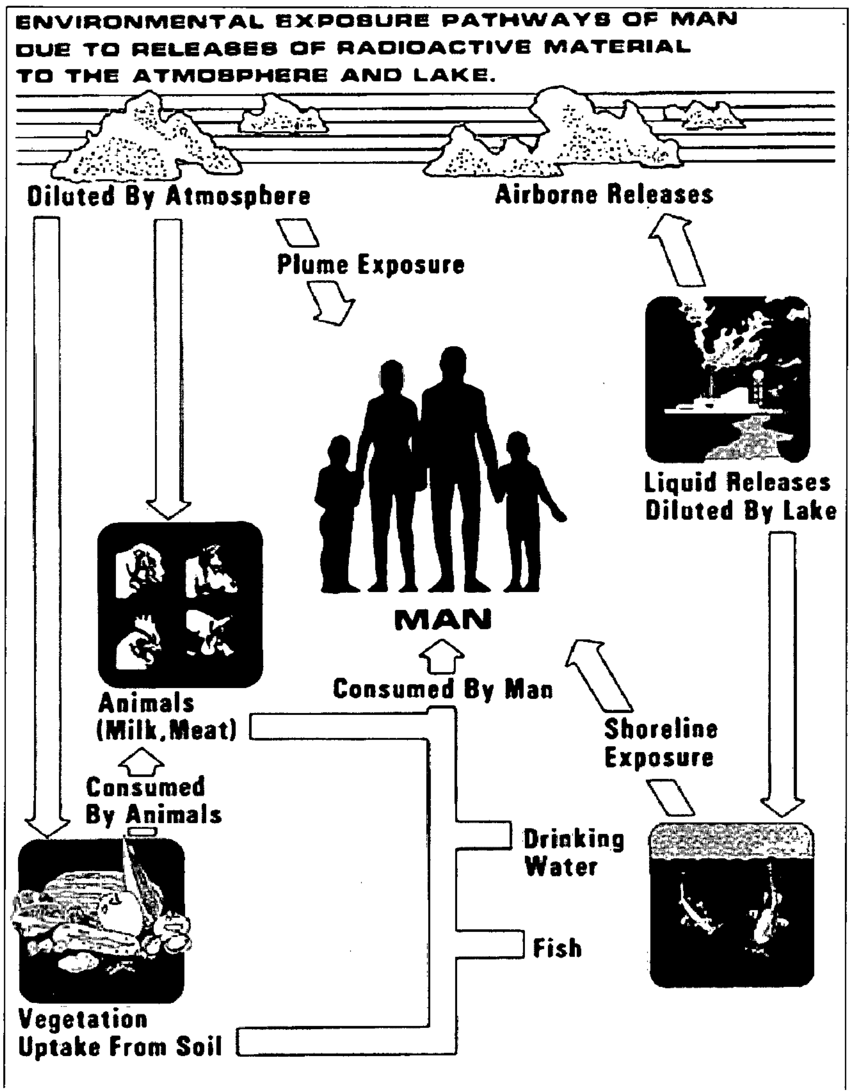

Figure 3-16. Possible Pathways to Man Due to Releases of Radioactive Material

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.

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:

- 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 area around BLN site.

3.17.2. Exclusionary Boundary

As defined in 10 CFR Part 100, the exclusionary boundary or exclusion area boundary (EAB) is 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 is as shown in Figure 2-3. 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 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 the 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.

3.17.3. Radiation doses to Members of the Public

This section provides an estimate of doses to the maximally exposed individual (MEI) and the general population during routine operations for both the liquid effluent and gaseous effluent pathways.

3.17.3.1. 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 of Radiological Protection Publication 2 (ICRP 1959). Changes in the model and inputs since the 1974 FES include:

- The calculation of doses to additional organs (kidney and lung).
- 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 & 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/yr
Shoreline Use (Guntersville Reservoir)	391.5 - 349	22,814,630 person-hr/yr
Swimming (Guntersville Reservoir)	391.5 - 349	22,814,630 person-hr/yr
Boating (Guntersville Reservoir)	391.5 - 349	22,814,630 person-hr/yr

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 the B&W unit. The liquid radioactive effluent releases for the AP1000 unit given in Table 3-24 were obtained from Table 11.2-7 of the AP1000 Design Control Document (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
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

Nuclide	Total Releases (Ci/y)	Nuclide	Total Releases (Ci/y)
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 the BLN B&W unit are given in Table 3-25, and for the 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 as low as practicable during normal conditions. The average annual radiation exposure from natural sources to an individual in the United States is about 300 mrem. So, 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 the 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)	Maximum Thyroid Dose	TEDE Dose	Dose Limit[a]
Maximum Individual Dose (mrem/yr)	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)	Maximum Thyroid Dose	TEDE Dose	Dose Limit[a]
Maximum Individual Dose (mrem/yr)	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 the B&W unit or the 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 Table 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 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.

3.17.3.2. 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 the B&W or AP1000 units. Gaseous effluents are normally released through the plant vent or the turbine building vent. The plant vent provides the release path for containment venting releases, auxiliary building ventilation releases, annex building releases, radwaste building releases, and gaseous radwaste system discharge. 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 the staff of the U.S. Nuclear Regulatory Commission to perform environmental dose analyses for releases of radioactive effluents from nuclear power plants into the atmosphere.

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, "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" (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.

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 the AP1000 unit. For this SEIS, identical methodologies, in compliance with NRC Regulatory Guide 1.109, were used for both the B&W unit and the AP1000 unit. The calculated doses provide information for determining compliance with Appendix I of 10 CFR Part 50 (NRC 2007) 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 the B&W unit and the AP1000 unit. Meeting the limits presented in 10 CFR Part 50 Appendix I also meets the "As Low As Reasonably Achievable" criterion for radioactive material in gaseous effluents. A tabulation of the resulting calculated gaseous doses to individuals for the 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 the AP1000 unit and the dose limits presented in 10 CFR Part 50, Appendix I, is given in Table 3-28. Based on these results, normal operation of a single unit at BLN under either Alternate B or Alternate 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 (mrad)	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[2] (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 miles west-southwest of the plant for the ground-level turbine building vent release.
2. 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 total effective dose equivalent (TEDE) to individual members of the public from the licensed operation does not exceed 100 mrem in a year. The maximum individual dose from the B&W unit due to routine gaseous effluents was calculated to be 1.25 mrem TEDE. The maximum individual dose from the 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 and it is therefore concluded that the 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 the B&W unit along with the 40 CFR Part 190 limits and Table 3-30 summarizes the doses to the maximally exposed individual for the total body, thyroid, and bone for the AP1000 unit along with the 40 CFR Part 190 limits. Based on comparison to the 40 CFR Part 190 limits, it is concluded that 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 dose due to normal liquid and gaseous effluent releases from a plant at the BLN site was found to be insignificant. The doses were 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 considered to be minor.

3.17.3.3. Population Dose

Population dose calculations determine the cumulative dose to the population within 50 miles of the site for ALARA (As Low As Reasonably Achievable) considerations. The estimated radiological impact from the normal gaseous releases from the 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
GI-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 expected to be minor.

3.17.3.4. 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 since 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 non-radioactive 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 since breathing rate and body size are more similar to biota. The total body inhalation dose (rather than organ specific doses) is used since 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 exclusion area boundary 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 the B&W unit and AP1000 unit respectively for comparison with the limits set forth in 40 CFR Part 190 as indicated by NUREG-1555, Section 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 to be minor.

3.17.4. 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".

3.17.4.1. 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 Action Alternative B or C would include the following:

1. Direct Radiation Monitoring

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 sixteen 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 8 other special interest locations including at least two control stations.

2. Airborne Pathway Monitoring
Sampling for air particulates and radioiodine will be performed at four locations, in different sectors, near the site boundary, at 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.

3. Waterborne Pathway Monitoring
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.

Ground water sampling will be conducted at one location on site down gradient from the plant and at a control location up gradient from plant. If site ground water hydrology data indicates that leaks or spills at the site might impact off site ground water, 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.

4. Ingestion Pathway
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.

3.17.4.2. Land Use Survey

A land use survey will be conducted annually. The purpose of the survey is to identify changes in land use within 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 sixteen meteorological sectors. The results of the annual land use survey will be documented in the Annual Radiological Environmental Operating Report (AREOR).

3.17.4.3. Interlaboratory Comparison Program

The laboratory performing the analyses of the BLN REMP samples will participate in a Interlaboratory Comparison Program providing radiological environmental cross checks 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

Radioactive waste (radwaste) sources, treatment systems and potential for effects of operating a B&W plant were described in the TVA's 1974 FES and updated in the commercial light water reactor (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. Section 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 Sequoyah and Watts Bar Nuclear Plants.

The management and effects of radwaste from operation of two B&W units is discussed in Chapter 11 of the BLN Units 1&2 FSAR. The management and effects of radwaste from operation of two AP1000 units is discussed in Sections 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 the no action Alternative A. Additionally, for the action alternatives, no radwaste would be generated during construction activities.

3.18.1.1. Liquid Radioactive Waste Treatment Systems

For the BLN 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 as low as is reasonably achievable (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 3-17 and 3-18 from the TVA 1974 FES show proposed sketches of the Liquid Waste Disposal System for tritiated and nontritiated liquid.

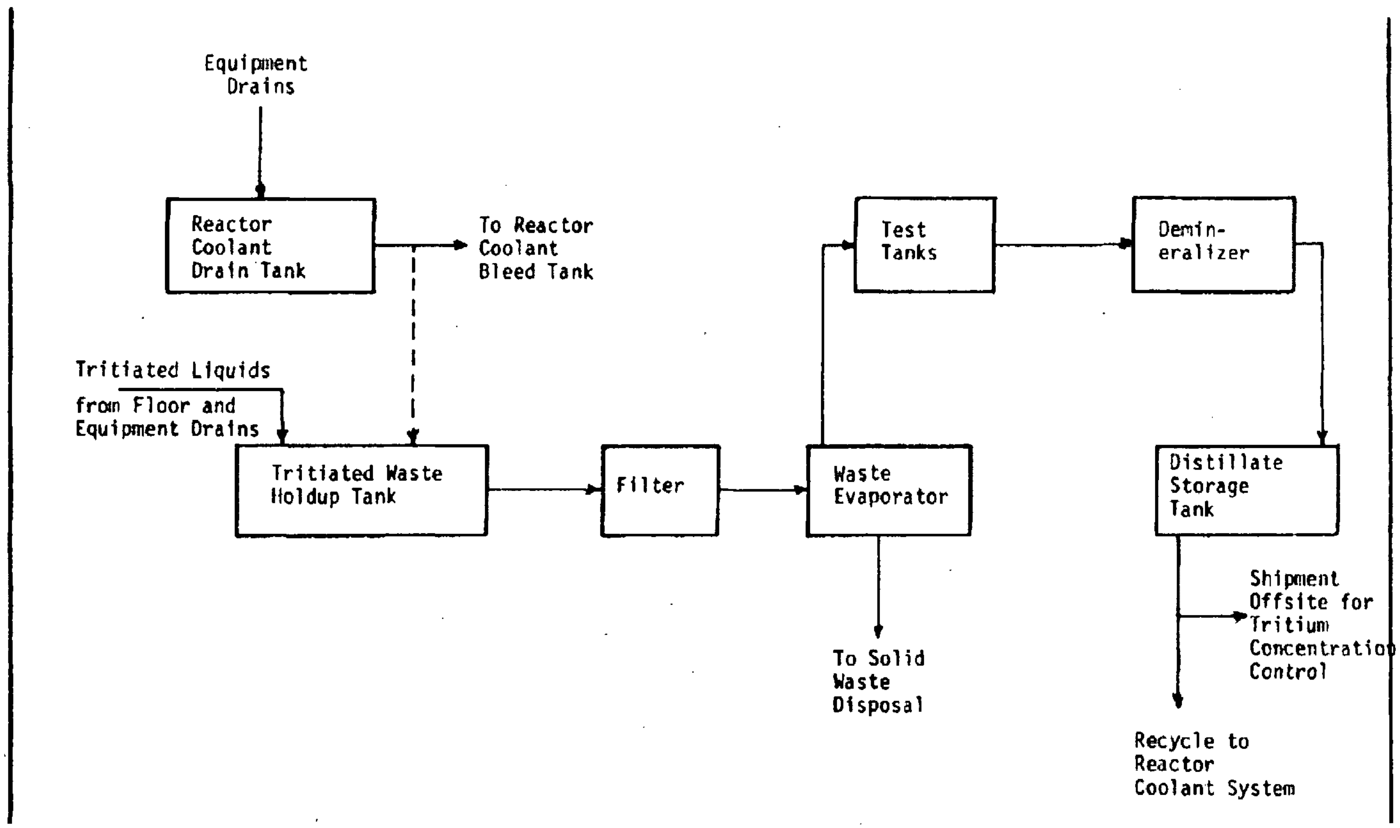

Figure 3-17. Tritiated Liquid Waste Treatment System

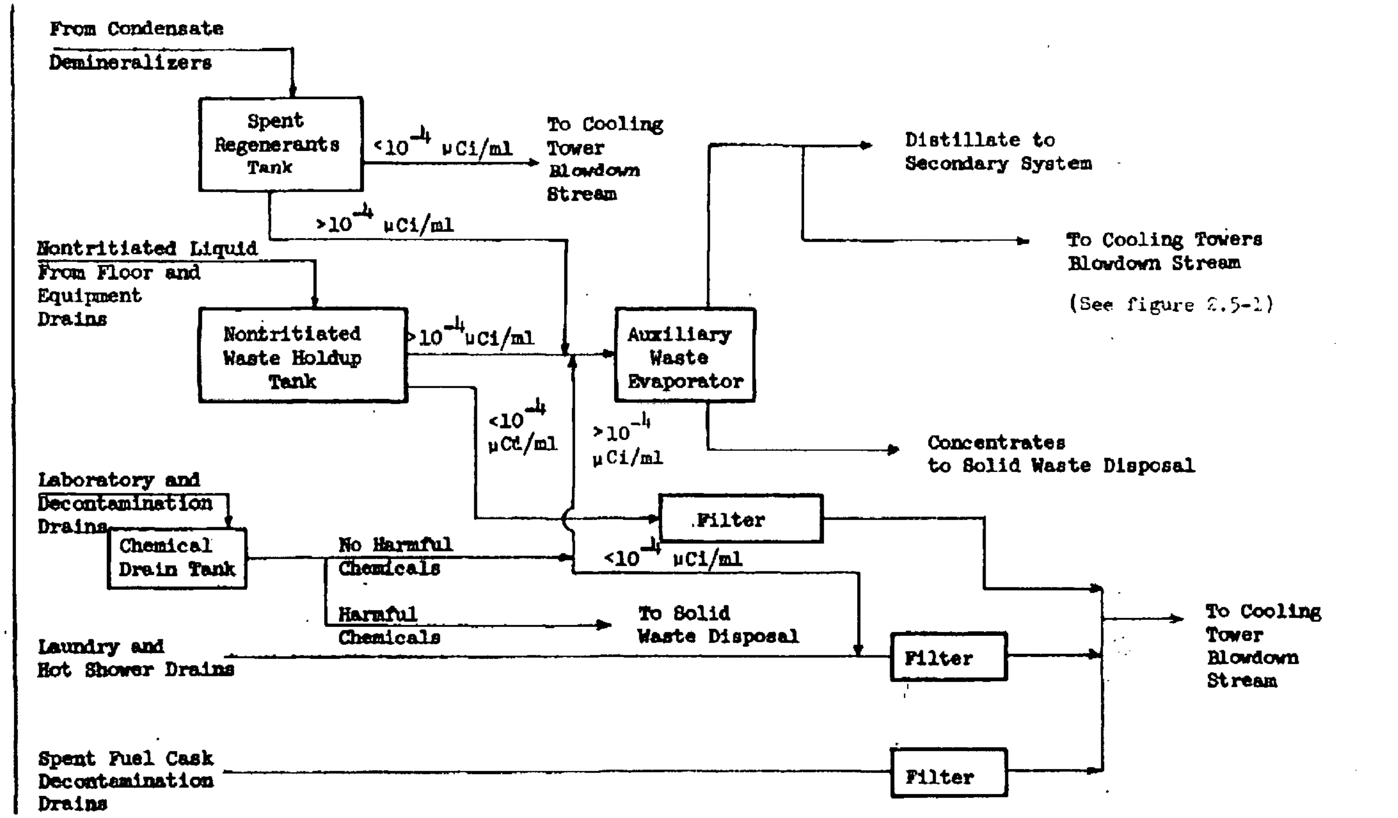

Figure 3-18. Nontritiated Liquid Waste Disposal System

The system would be designed and operated to demonstrate continued compliance with requirements to maintain environmental releases of radioactive materials in liquid effluents as low as is reasonably achievable 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 the BLN 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 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. 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 3-19 (TVA 2009a) shows a proposed drawing of the 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 as low as is reasonably achievable 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.

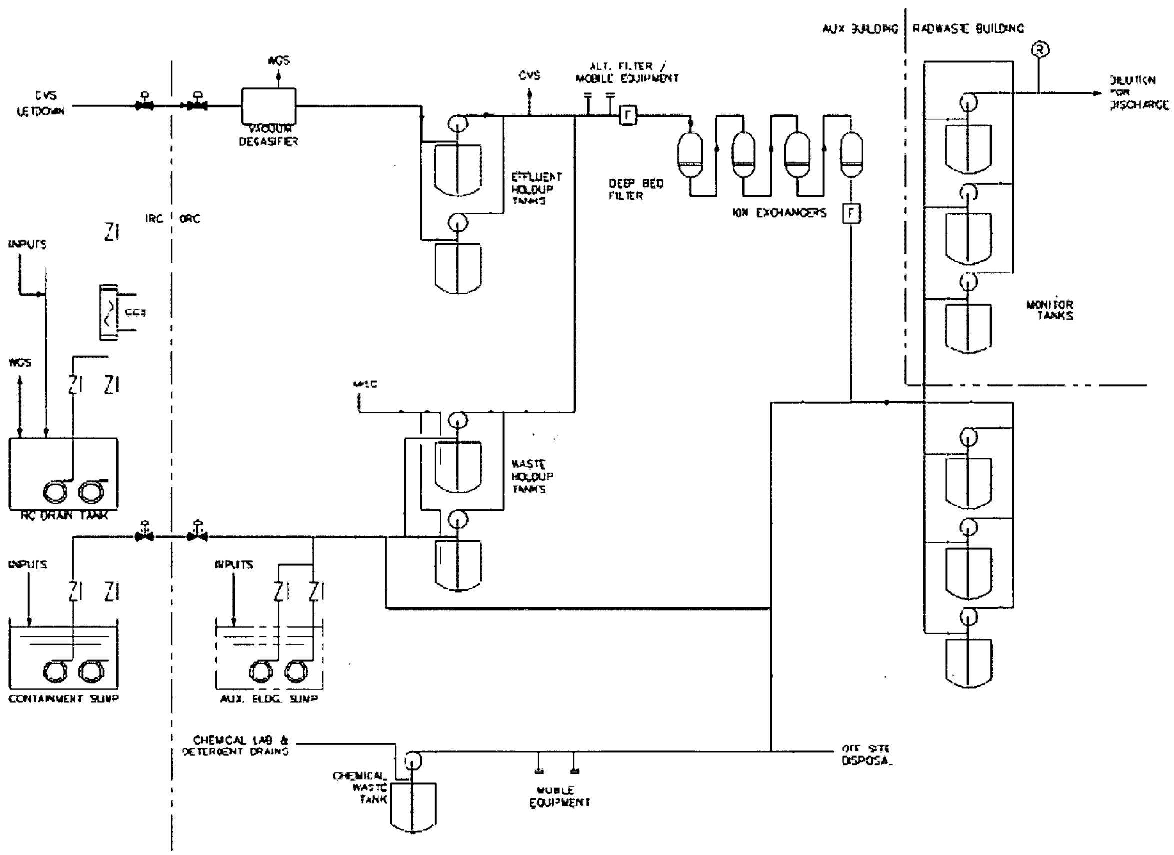

Figure 3-19. Liquid Radwaste System

3.18.1.2. 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 because of 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 the BLN 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 the BLN B&W unit would be designed and operated to demonstrate continued compliance with requirements to maintain environmental releases of radioactive materials in gaseous effluents as low as is reasonably achievable 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 the BLN 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 the BLN AP1000 unit would be designed and operated to demonstrate continued compliance with requirements to maintain environmental releases of radioactive materials in gaseous effluents as low as is reasonably achievable 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.

3.18.1.3. Solid Radioactive Wastes

Two additional types of radwaste which could be generated at BLN under both Alternative 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 onsite 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 non-compactable material. Compactable material includes paper, rags, plastic, mop heads, discarded clothing, and rubber boots. Non-compactable wastes include tools, pumps, motors, valves, piping, and other large radioactive components. DAW would be collected onsite 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 offsite processor, or compacted into 55-gallon drums by a radwaste compactor.

The wet active wastes (WAW) consist 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 de-watered prior to shipment for offsite 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 de-watered. Sludge would be processed into a form suitable for disposal by offsite 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 offsite 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 offsite 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:

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 Units 1&2 FSAR. The amount of radwaste generated for one B&W unit shown below is approximately half of that reported in the Unit 1&2 FSAR.

Table 3-33. Estimated Volumes of Solid Radwaste For a Single BLN B&W Unit

Source	Volume (before solidificatior ft^3/year
Spent resin (1.0 ft^3 water/ft^3 resin)	425
Waste evaporator bottoms	480
Miscellaneous solids - filter cartridges, paper, glassware, rage, equipment (compacted)	175
Spent 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 Units 1&2 FSAR (date?)

For the AP1000 unit, the proposed about of radwaste generated is taken from Table 11.4-1 of the AP1000 DCD (WEC 2008), and is presented in Table 3-34.

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
Non-Compactable 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

Notes:
1. Radioactive secondary resins and membranes result from primary to secondary systems leakage (e.g., SG tube leak).
2. Estimated activity basis is ANSI 18.1 source terms in reactor coolant.
3. Estimated activity basis is breakdown and transfer of 10% of resin from upstream ion exchangers.
4. Reactor coolant source terms corresponding to 0.25% 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. This facility was not built and as of September 29, 2009, the LLRW disposal facility in Barnwell, South Carolina, is no longer accepting Class B and C waste from sources in states that are outside of the Atlantic Compact, which includes Alabama. 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 the Sequoyah and Watts Bar nuclear plants is currently stored/shipped at/to Sequoyah. 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.
- Currently, Waste Control Specialists of Texas has a proposed location to permanently store Class A, B, and C waste. In September 2009, the Texas Commission on Environmental Quality issued a license for Waste Control Specialists to dispose of such low-level waste. Once approved construction is complete and conditions of the license are met, disposal may commence. TVA could use this facility as an alternative to onsite storage for 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. Sequoyah or Browns Ferry). For this option, BLN would have to be licensed by NRC to receive and store low-level radwaste.

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

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. Section 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 Babcock & Wilcox pressurized water reactor (B&W) or one Westinghouse Advanced Passive pressurized water reactor (AP1000) 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. 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 generic 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.

TVA plans to have at least 10 years' of spent fuel pool capacity for either Alternative B (B&W unit) or Alternative C (AP1000 unit). The spent fuel pool capacity for the B&W unit is 1058 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 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 x 11 = 198 /12 = 16.5), plus the core. Under the current schedule, assuming that one BLN unit would begin operation in 2017, the ISFSI would be needed by 2036.

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. Table 3-35 below updates Table 5-48 in the CLWR FEIS for one B&W unit and adds information for one AP1000 unit to provide an estimated total number of dry storage casks that would be needed for 40 years of operation if one BLN unit were completed. (Although SQN has received licensing approval to use casks that can contain 32 spent fuel assemblies, this evaluation uses the more conservative 24-fuel assembly cask design capacity.)

Table 3-35. Number of ISFSI Casks Determination for BLN Single Unit Operation

Data Parameter	BLN B&W	BLN AP1000
Operating cycle length	18 months	18 months
Number of assemblies in the core	205 [1]	157 [2]
Number of fresh fuel assemblies per refueling cycle	80 [3]	64 [4]
Number of refueling cycles in 40 years [5]	26	26
Number of fuel assemblies for 40-year operation [6]	2285	1821
Number of ISFSI dry casks needed for long-term storage of spent fuel [7]	96	76

1 (TVA 1978).
2 (TVA 2008a).
3 (TA 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.
7 Number is based on 24-fuel assembly cask designs.

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 spent fuel storage construction and operation.

3.18.2.2. Environmental Consequences

Construction Impacts

The CLWR FEIS 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 acres) 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 acres) 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 acres would be required for an AP1000 unit. The construction and environmental parameters for an ISFSI that would serve one B&W or one AP1000 unit at the BLN site are provided in Table 3-36. Construction and installation 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. There is ample room at the BLN site to locate a spent nuclear fuel storage facility.

Table 3-36. ISFSI Construction for One 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 and 21 feet tall.[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 and 21 feet tall.[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: 1500 person-hrs per cask/storage module[2] Total dose during construction: 72 person-rem	Dose rate: 0.5 mrem per hour[2] Construction hours: 1500 person-hrs per cask/storage module[2] Total dose during construction: 57 person-rem
Size of disturbed area	ISFSI footprint: 0.70 acres Total disturbed: 1.20 acres	ISFSI footprint: 0.55 acres Total disturbed: 0.94 acres
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

Operational Impacts

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 kilowatts (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 8 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 6 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 9 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 2700 kW (i.e., 96 casks × 28 kW = 2688 kW or 2.69 MW), as compared to 2000 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 2700 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 3840 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 is 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 One 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 1521 cubic feet	Transfer cask decontamination water consumption of less than 1204 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 received by a member of the public living in the vicinity of the ISFSI would be well below the regulatory requirements.	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 received by a member of the public living in the vicinity of the ISFSI would be well below the regulatory requirements.
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.
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

This section provides an updated discussion regarding the transportation of radioactive materials associated with the B&W unit. 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 Section 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.

The NRC evaluated the environmental effects of transportation of fuel and waste for light water reactors (LWRs) 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 sections describe the characteristics of the AP1000 unit and B&W 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 section. Information for the B&W unit's fuel design is taken from the BLN Unit 1&2 FSAR. Information for the AP1000 unit's fuel design is taken from the BLN COLA FSAR.

3.18.3.1. 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 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 the 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.

3.18.3.2. Transportation of Irradiated Fuel

For the 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 including a full core reserve. Each refueling offload would average 80 fuel assemblies. Therefore, the spent fuel storage pool has the capacity for 10 refueling offloads, which represents approximately 15 years of operation, with a full core reserve. The spent fuel would remain on-site for a minimum of 5 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 shown in the Nuclear Waste Policy Act of 1982, Section 302 and DOE makes the decision on transport mode.

For the 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 offload would entail 64 fuel assemblies. Therefore, the spent fuel storage pool has the capacity for 11 refueling offloads, which represents approximately 16 years, plus a full core reserve. The spent fuel would remain on-site for a minimum of 5 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 subsections 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 3800 megawatts (MW).

Both the B&W unit has a thermal power rating of 3,600 MWt and would meet this condition. The 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 (UO2) pellets. The B&W unit and AP1000 unit would use a sintered UO2 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 exceeding 4 percent by weight.

The B&W unit's reactor fuel would meet the 4 percent U-235 requirement.

For the 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 5 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. The U.S. 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 5-year cooling time. In addition, NRC specifies 5 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. The B&W unit and 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.

The B&W unit's reactor fuel would be encapsulated in Zircaloy fuel rods. Therefore, the B&W unit would meet this requirement

The AP1000 unit's reactor fuel would be encapsulated in ZIRLO™ cladding. License amendments approving the use of ZIRLO™ rather than Zircaloy have not involved 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 AP1000 unit use of ZIRLO™ cladding 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 the B&W unit and the 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 offsite 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.

3.18.3.3. Summary

The 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). The 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 the B&W unit or the 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 sub-sections that address design basis accidents, severe accidents, and plant security.

- Design Basis Accidents (Section 3.19.1).
- Severe Accidents (Section 3.19.2).
- Plant Security (Section 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. The set of DBAs considered covers that range from events with 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 which 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 Units 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 Design Basis Accidents. 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. Realistically 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 (SRP) 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. Design basis accidents 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 SRP 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 Final Environmental Statement demonstrates that the calculated DBA doses for the B&W unit are within the limits of 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 activity is released at the accident location inside a building, and this activity is eventually released to the environment. Chapter 15 of the BLN Units 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 Units 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 Units 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 50^{th} percentile (average) site-specific atmospheric dispersion (χ/Q) values reflecting more realistic meteorological conditions consistent with the guidance provided in NUREG-1555 (NRC 1999). The χ/Q values are calculated using the guidance in NRC Regulatory Guide 1.145 (NRC 1982) with site-specific meteorological data. The dose from the B&W unit for a given time interval is calculated by multiplying the BLN Units 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 NUREG-1555, Standard Review Plan 7.1.

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 Units 1&2 FSAR for the B&W unit and in Chapter 15 of the BLN COLA FSAR for the AP1000 unit. The BLN Nuclear Plant atmospheric dispersion factors (χ/Q values) used to calculate conservative design basis Exclusion Area Boundary (EAB) and Low Population Zone (LPZ) doses for the various postulated accidents for the B&W unit are obtained from Chapter 15 of the BLN Units 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 in Table 3-39 for the AP1000 unit.

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/m^3)

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. Radiological Consequences

The BLN site-specific radiological consequences of design basis accidents 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 NUREG-1555. 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 Total Effective Dose Equivalent (TEDE).

Table 3-40. Summary of Design Basis Accident Atmospheric Doses for the B&W Unit

Accident Description	Accident Dose					
	Thyroid (rem)			Whole-Body (rem)		
	EAB	LPZ	Limit (Note 4)	EAB	LPZ	Limit (Note 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
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 Section 15.2.8.5 of the BLN Units 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 Section 15.3.3.5 of the BLN Units 1&2 FSAR.
3. Radiological consequences of a Reactor Coolant Pump Shaft Break are bounded by Reactor Coolant Pump Shaft Seizure, as indicated in Section 15.3.4 of the BLN Units 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 the BLN AP1000 Unit

Accident Description	Accident Dose (rem TEDE)		
	EAB	LPZ	Limit (Note 3)
Steam System Piping Failure			
Pre-Existing 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			
Pre-Existing 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 design basis accidents. 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.

The results presented in Tables 3-40 and 3-41 provides realistically estimated radiological consequences of the postulated accidents for the B&W unit and 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. It is concluded from the results of this realistic analysis that the environmental risks due to postulated radiological accidents are exceedingly minor. This conclusion is in agreement with the conclusion presented in the BLN Final Environmental Statement dated June 1974.

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. Design basis accidents 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 considers both the risk of a severe accident and the onsite and offsite consequences.

The risk of a severe accident associated with a B&W PWR would be determined by a plant-specific probabilistic safety assessment, which would 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 PRA (probabilistic risk assessment) 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 probabilistic safety assessment 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 considered the B&W PWR design, representative of either Units 1 or 2, was prepared to support this SEIS and 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 offsite releases are presented here. Accident scenarios that do not lead to significant offsite releases are not presented because the public and environmental consequences would be significantly less.

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 severe accident analysis (NUREG-1150) (NRC 1990) 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

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 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 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 the B&W or the AP1000 unit, the risk to the general population and individual members of the public is insignificant when compared to other societal risks. Overall, the risk results presented above for both the B&W and the AP1000 unit are minor.

3.19.3. Plant Security

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 Nuclear Energy Institute (NEI) commissioned the Electric Power Research Institute (EPRI) to conduct an impact analysis of a large jet airline 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. 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 results of this analysis are summarized in an NEI paper titled "Aircraft Crash Impact Analyses Demonstrate Nuclear Power Plant's Structural Strength" (NEI 2002).

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 2007).*

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.

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 this section.

3.20. Decommissioning

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 1999 CLWR FEIS (DOE 1999, Section 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 EIS (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 internals 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 cost of decommissioning was $25 million. NRC currently estimates that decommissioning a PWR would cost a minimum of $400 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 August 31, 2009, totaled $798 million. This balance is less than the present value of the estimated future nuclear decommissioning costs for TVA's operating nuclear units and is primarily due to the recent downturn in market performance which has impacted TVA's investments. 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.

Potential Impacts to the Environment
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