CHAPTER 5

5.0 OTHER EFFECTS

5.1. Unavoidable Adverse Environmental Impacts

This section describes principal unavoidable adverse environmental impacts for which mitigation measures are either considered impractical, do not exist, or cannot entirely eliminate the impact. Specifically, this section considers unavoidable adverse impacts that would occur for either of the action alternatives, i.e., constructing and operating one Westinghouse AP1000 reactor, or completing and operating one partially-completed B&W reactor at the BLN in addition to maintaining and operating associated transmission facilities. These unavoidable construction and operational effects are identified in Table 5-1.

Table 5-1. Construction and Operational-Related Unavoidable Adverse Environmental Impacts

Issue - Construction	Unavoidable Adverse Impact
Land Use	The BLN site is approximately 1600 acres in total. Disturbance of approximately 185 additional acres of land within the 1600 acre BLN site would occur for an AP1000 unit and associated infrastructure. No additional area of land disturbance would occur for completion of either of the two partially completed B & W units. Original disturbance for the partially completed units was approximately 400 acres (200 acres each). There would be a long-term commitment of land for the existing transmission corridors. Potential for unanticipated disturbances to historic, cultural, or paleontological resources is mostly or entirely mitigated. Some land would be dedicated to long-term disposal of construction debris and not available for other uses.
Hydrologic & Water Use	A small amount of water is consumed during construction activities. Ground disturbing activities along river banks or stream banks (in the case of the transmission line maintenance) on a short-term basis, introduces minor amounts of sediments and potentially chemicals into water bodies.
Aquatic Ecology	Construction at river's edge may cause direct, short-term and minor loss of some organisms and temporary degradation of habitat. Existing transmission line crossing streams may continue to cause minor disruption of some organisms and degradation of habitat.
Terrestrial Ecology	Operation of the BLN and transmission corridor would continue minor alterations to habitat and the suite of species which inhabit them. Construction, clearing and grading of the BLN site could directly harm or displace a few animals. Construction noises may startle or scare animals. These minor impacts are intermittent and would continue throughout the construction phase.
Socioeconomics and Environmental Justice	Construction workers and local residents would be exposed to elevated levels of traffic through the course of the construction phase. The influx of construction workforce would cause short-term, minor effects on local housing, infrastructure, land use and community services such as fire or police protection. In the short-term, there may be school crowding. Increased tax revenue would mitigate much of this impact. Construction workers and local residents would be exposed to elevated levels of dust, exhaust emissions, and noise from construction and equipment. These constitute minor unavoidable impacts. No unavoidable adverse construction impacts to minority populations are anticipated.

Issue – Operational	Unavoidable Adverse Impact
Land Use	The commitment of land use described above would continue over the operational life of this project. Some of the land would be returned to its former state following the end of construction. The BLN and UFC increases radioactive and nonradioactive wastes that would require land to be dedicated for the long-term disposal of hazardous and nonhazardous materials in permitted disposal facilities or permitted landfills. This land would not be available for most other uses. The viewscape of the BLN site and transmission facilities would continue to be impacted over the operational period, but no more so than at the present.
Hydrologic & Water Use	Normal plant operations result in discharge of small amounts of chemicals and radioactive effluents to Guntersville Reservoir throughout the life of the BLN. Compliance with the NPDES permit , applicable water quality standards; stormwater pollution prevention (SWPPP) and Spill Prevention Countermeasures and Control (SPCC) Plans ; and discharge of radioactive effluents in compliance with applicable regulatory standards, would ensure that the result would be little or no unavoidable adverse impacts. Discharge of cooling water results in a thermal plume in Guntersville Reservoir throughout the operational life of the BLN. The differences between plume temperature and ambient water temperature are maintained within limits set in the NPDES permit. Cooling towers mitigate much of the heat that would otherwise be discharged to the reservoir. Use of closed cycle cooling would result in only minor adverse impacts. Water lost to evaporation represents consumption of water that would not be available for other uses. The maximum consumptive use of surface water, which would continue throughout the operational life of the plant, is less than 1 percent of 7Q10.
Aquatic Ecology	The effects of entrainment or impingement result in a loss of fish and other aquatic species. Because a closed-loop cooling system that substantively reduces the loss of fish and aquatic species is used, the impacts of entrainment or impingement on aquatic species would be minor and insignificant. Routine maintenance activities may result in rare episodic chemical or petroleum spills near water that could, in turn, affect aquatic life. Preparation and adherence to SPCC Plan would avoid/minimize contamination from any such spills. Although within NPDES permit limits, discharge of small amounts of chemicals to Guntersville Reservoir from outine plant operations could result in minor insignificant effects on aquatic life over the operational life of this project.
Terrestrial Ecology	Birds may periodically collide with the cooling towers or the existing transmission lines. Such occurrences are anticipated to be minor. Some minor clearing, maintenance and upgrading of transmission lines could result in short-term disruption of wildlife, but no long-term changes would be expected from existing habitat conditions. Periodic noise, such as maintenance at the site or along the existing transmission line, may cause temporary and minor impacts to nearby wildlife over the operational life of this project.
Socioeconomics and Environmental Justice	Minor unavoidable adverse impacts are expected over the life of operating a unit at BLN. The transmission lines are built in accordance with applicable regulations and codes to minimize the risk of electric shock. However, over the life of the plant, the transmission line has the potential to produce electric shock to people working near the line or from fallen lines. Operation and outages of the BLN would increase traffic on local roads during shift change. Although emissions would be maintained within limits established in permits, air emissions from diesel generators and equipment, and vehicles would have a small impact on workers and local residents over the operational life of this project. Unavoidable adverse operational impacts to minority populations are not expected to occur.

Issue – Operational (continued)	Unavoidable Adverse Impact
Radiological	Small radiological doses to workers and members of the public from releases to air and surface water would occur over the operational life of this project. Releases are well below regulatory limits. Effluents are treated according to applicable regulatory standards before being discharged into Guntersville Reservoir. While employees are potentially exposed over the long term, adherence to applicable regulatory standards, radiological safety procedures, work plans and safety measures reduce this exposure to a negligible impact. High-level radioactive spent fuel is stored and isolated from the biosphere for thousands of years. The impacts of high-level radioactive waste and spent fuel are reduced through specific plant design features in conjunction with a waste minimization program. Impacts are further reduced through employee safety training programs and work procedures, and by strict adherence to applicable regulations for storage, treatment, transportation, and ultimate disposal of this waste in a geological repository, or re-processing. The mitigation measures reduce the risk of radioactive impacts, but there is still some residual risk. Waste disposal constitutes a commitment of land that continues for thousands of years into the future. Low-level radioactive and nonradioactive waste would be stored, treated, and disposed. Disposal of these materials represents a commitment of land for hundreds or thousands of years. The impacts of low-level radioactive and nonradioactive hazardous waste are reduced through waste minimization programs, employee training programs, and strict adherence to work procedures and applicable regulations.
Atmospheric & Meteorological	Diesel generators and equipment would contribute to minor air emissions over the course of this project. Burning of any material associated with maintaining transmission line rights-of ways would contribute to short-term air pollution As described in Chapter 3, minor radioactive emissions would occur from the proposed unit during normal operations. Compliance with permit limits and regulations for installing and operating air emission sources and monitoring of those air emissions would result in little or no adverse impacts. Cooling towers would emit a plume of water vapor resulting in a limited obstructed view of the sky and causing a shadowing effect on the ground that has a small effect on vegetation. The plumes present little environmental effect on humans or biota.

5.2. Relationship Between Short-Term Uses and Long-Term Productivity of the Human Environment

One of NEPA's basic Environmental Impact Statement requirements is to describe "the relationship between local short-term uses of man's environment and the maintenance and enhancement of long-term productivity." Unavoidable adverse impacts of construction and operation are discussed in Section 5.1 and the irreversible and irretrievable commitments of resources are discussed in Section 5.3. This section focuses on and compares the significant short-term benefit (e.g., principally generation of electricity) and uses of environmental resources which have long-term consequences on environmental productivity. Table 5-2 summarizes the proposed action's short-term uses and benefits versus the long-term consequences on environmental productivity. For the purposes of this section, the term "short term" represents the period from start of construction to end of plant life, including prompt decommissioning. In contrast, the term "longterm" represents the period extending beyond the end of plant life, including the period up to and beyond that required for delayed plant decommissioning. This discussion applies to the general ramifications of implementing either action alternative.

The short-term beneficial impacts of usage outweigh the adverse impacts on long-term environmental productivity. The principal short-term benefit from the BLN is the production of a relatively clean and stable form of electrical energy. With respect to long-term benefits, nuclear energy avoids carbon dioxide emissions that may have a significant long-term detrimental effect on global climate. Nuclear energy also reduces the depletion of fossil fuels. Chapter 3 describes effects associated with the uranium fuel cycle (UFC). These impacts include the effects of mining and in-situ leaching, conversion, enrichment of uranium, fabrication of nuclear fuel, use of fuel, and disposal of the used (spent) fuel.

There are two key long-term adverse impacts on productivity. Both of these environmental liabilities are governed by the half-lives of the respective radioisotopes. The first involves long-term radioactive contamination of the reactor vessel, equipment, and other material that are exposed to radioactive isotopes. The second involves irradiated fuel and high-level waste that must be safeguarded and isolated from the biosphere for thousands of years, or reprocessed for use as fuel.

5.2.1. Short-Term Uses and Benefits

There are a number of short-term benefits that are derived from construction and operation of a single nuclear generating unit at BLN. These benefits, as summarized below include:

- Electric generation
- Fuel Diversity
- Avoidance of Air Pollution and Greenhouse Gas Emissions
- Land Use
- Aquatic and Terrestrial Biota, and
- Socioeconomic Changes and Growth

As described in Chapter 1, the principal short-term benefit of BLN is the generation of electricity to meet the growing demand for electricity in TVA's power service area. Energy diversity is also an element fundamental to the objective of achieving a reliable and affordable electrical power supply system. Over-reliance on any one fuel source leaves consumers vulnerable to price spikes and supply disruptions. BLN furthers the goal of creating new nuclear baseload generating capacity. Operation of a reactor at BLN also advances the Congressional goal of obtaining a diversified mix of electrical generating sources. Upgrading of the existing transmission lines would increase the short-term and long-term capacity and reliability of the power supply in TVA's service area.

Natural gas, and in particular, coal-fired electrical generation plants produce substantive amounts of air pollutant emissions. Fossil fuel air emissions, particularly carbon dioxide, are believed by many in the scientific community to contribute to the greenhouse effect and, consequently, global climate change. Beyond steam and water vapor, modern nuclear reactors produce virtually no air emissions during operation, and only very minor levels of radioactive emissions. The generation of significant air emissions is avoided by foregoing construction of a comparably sized coal or gas fired alternative, and instead constructing or completing a single unit at BLN. Even with contributions from the Uranium Fuel Cycle (UFC), the net benefits of reduced emissions from nuclear over those of natural gas or coal-fired facilities are substantive.

Table 5-2. Summary of the Proposed Action's Principal Short-Term Benefits Versus the Long-Term Impacts on Productivity

Issue	Short-Term Uses and Benefits	Relationship to Maintenance and Enhancement of Long-Term Environmental Productivity
Land Use	Continued commitment of land use at the existing site. Some potential loss in agricultural productivity, or natural habitats and woodlands.	No long-term loss as the land could be released for other uses or returned to its natural state after the reactor is decommissioned.
Terrestrial and Aquatic Ecology	Disrupts or destroys some flora and fauna on and near the BLN, and along the transmission corridor. No significant effect to species or habitats is expected to occur. After construction, some flora and fauna may recover in areas that are no longer affected by construction or plant operations.	No significant long-term detrimental disturbance to biota or their habitats.
Socioeconomic Growth	Injection of tax revenues, plant expenditures, and employee spending contributes to the growth of the local economy. In the short-term, this growth may strain local infrastructure and services.	Tax revenues, plant expenditures, and employee spending leads to some long-term direct and secondary growth in the local economy, infrastructure, and services that may continue after the reactors are decommissioned.
Irradiated Spent Fuel	Provides a short-term supply of relatively clean energy.	Managed as a High-Level Radioactive Waste, and either reprocessed or isolated from the biosphere for thousands or tens of thousands of years. Long-term commitment of the local storage area and the underground geological repository.
Other Radioactive Waste	The radioactively contaminated reactor vessel and equipment are required for the short term production of nuclear energy	Contaminated waste must be managed and isolated from the biosphere for hundreds or thousands of years.
Potential for Accident	Potential security consequences of a reactor accident could range from small to large. However, the probability or likelihood of a severe accident is deemed to be very remote. Because the probability or likelihood of such an event is so small, the overall risk of a nuclear accident is likewise considered to be so small as not to constitute a potentially significant impact upon the human environment.	In the advent of an accident, the impacts could be long-term and substantial.

Issue	Short-Term Uses and Benefits	Relationship to Maintenance and Enhancement of Long-Term Environmental Productivity
Depletion of Uranium	As a reactor fuel, the uranium provides a short-term supply of relatively clean energy.	Construction and operation of the BLN contributes to the long-term cumulative depletion of the global uranium supply.
Offset Usage of Finite Fossil Fuel Supplies	During operation, BLN avoids the consumption of fossil fuels, albeit with some increase in the use of uranium. Consumption of fossil fuels in the UFC are substantively less than would occur for equivalently-sized fossil fuel based generation.	Reduces the cumulative long-term depletion of global fossil fuel supplies.
Materials, Energy and Water	In the short term, the energy used in constructing the reactors results in far more electrical power generation than was used in their construction. The use of materials in constructing the BLN is also critical to the goal of producing a clean and reliable supply of electrical power. A relatively modest quantity of cooling water is lost through evaporation and drift.	Construction and operation of the BLN contributes to the cumulative long-term irretrievable use of materials, energy, and water used in the construction and operation of the reactors. However, the reactor provides far more energy than is consumed in its construction.
Air Pollution	Operation of BLN avoids air pollutants that would likely be produced by fossil fuel plants if the reactor was not constructed.	Operation of the unit results in a long-term cumulative avoidance of greenhouse emissions that would likely be produced by fossil fuel plants if the unit were not constructed.
Social Changes	The project stimulates economic growth and productivity in the local area. In the short-term, however, this growth may strain local infrastructure and services, resulting in problems such as overcrowding of schools, and traffic congestion. However, revenue derived from this project may fund increased infrastructure and social services.	Payments made in lieu of taxes by TVA, and wages spent by the operational staff may inject significant revenues into the local economy that have long-lasting economic growth and development effects, that may continue after the BLN is decommissioned. Socioeconomic changes such as transformation in the nature and character of the community likely continue long after the BLN has been decommissioned.

The construction and operation of a single unit at the BLN would result in the continued commitment of land use at the existing site, as well as for the transmission corridor (i.e., there are not “new” long-term effects on land use within the existing rights-of-way). Land required for the corridor results in the continued loss of some agricultural or pastureland from transmission structures, or undeveloped habitats and woodlands. In the short term, the project results in some potential loss in agricultural productivity, or natural habitats and woodlands. However, this loss does not represent a long-term loss as the land may be released for other uses or returned to its natural state after the BLN has been decommissioned. Construction and operation of a single unit at BLN also disrupts or destroys some flora and fauna on and near the BLN, as does maintenance along the transmission corridor. However, no significant effect to species or habitats is expected to occur. After construction is completed, some flora and fauna may recover in areas that are no longer affected by construction or plant operations.

Construction of a BLN unit is expected to stimulate economic growth and productivity in the local area. Wages spent by workers are expected to provide an economic boost to the region. The construction and operation of the BLN may also spur indirect or secondary socioeconomic growth. In the short-term, however, this growth may strain some local infrastructure and services, resulting in problems such as overcrowding of schools and increased traffic. However, tax revenue derived from this project may fund increased infrastructure and social services. Property taxes paid by BLN and wages spent by the operational staff inject revenues into the local economy that may have long-lasting economic growth and developmental effects. In the long-term, some of this growth may continue even after the unit has been decommissioned. Socioeconomic changes brought about by the operation of the unit may also continue long after the plants have been decommissioned. This increased growth leads to long-term changes in the nature and character of the community that some may regard to be adverse.

5.2.2. Maintenance and Enhancement of Long-Term Environmental Productivity

Potential long-term effects on the productivity of the human environment are described below and summarized in Table 5-2. The assessment of long-term productivity impacts does not include the short-term effects related to construction and operation of a BLN unit.

Some of the adverse environmental impacts may remain after practical measures to avoid or mitigate them have been taken. As described in Chapter 1, the BLN site was originally designated for construction of nuclear reactors, therefore siting and operation of a single nuclear unit at the BLN represents a continuation of the originally planned land use of the site. After the reactor is shutdown, and the BLN unit is decommissioned to NRC standards, this land would be available for other industrial or non-industrial uses. Therefore, land use impacts are not expected to constitute a long-term productivity issue. Similarly, impacts such as air emission, water effluents, and other impacts described in Chapter 3, but not specifically mentioned in this section are insignificant.

Exposure to Hazardous and Radioactive Materials and Waste

Workers may be exposed to low doses of radiation and trace amounts of hazardous materials and waste. Workerplace exposures are carefully monitored to ensure that radioactive exposure is within regulatory limits. Local nonworkers also receive a very small incremental dose of radiation. Radiological monitoring and impacts related to operation of BLN are described in Chapter 3. The persistence of radionuclides depends on the half life of the radionuclides. The doses are in compliance with applicable regulatory standards and permits and do not significantly affect humans, biota, or air or water resources.

Radiological emissions are not expected to contaminate BLN property or the surrounding land. Once the plant ceases to operate and is decommissioned, radiological releases also cease. No future issues associated with the radiological emissions from operation of a nuclear unit are expected to affect the long-term uses of the BLN site.

Potential for Nuclear Accident

The risk of a potential accident is the product of the potential consequences, and the probability or likelihood that an event occurs. The potential consequences of an accident could range between small to large. However, the probability or likelihood of a major accident is very remote. Because the probability or likelihood of such an event is so small, the overall risk of a nuclear accident is likewise so small as not to constitute a potentially significant impact upon the human environment. The results of TVA's analysis in section 3.19 indicate that the environmental risks due to postulated accidents are exceedingly minor.

Uranium Fuel Cycle and Depletion of Uranium

The principal use of uranium is as a fuel for nuclear power plants. With approximately 440 nuclear reactors operating worldwide, these plants currently produce approximately 16 percent of the world's electrical power generation. Global uranium fuel consumption is increasing as nuclear power generation continues to expand worldwide. The BLN contributes to a small incremental increase in the depletion of uranium. The World Nuclear Association studies uranium supply and demand issues and states that there is currently a 50-year supply of relatively low-cost uranium. Higher prices are expected to induce increased uranium exploration and production. A doubling in market price from the 2003 level might increase the supply of this resource tenfold. The introduction of fast breeder reactors and other technologies could further reduce the gap between supply and demand.

Offset Usage of Finite Fossil Fuel Supplies

Fossil fuels represent a finite geological deposit, the use of which constitutes a cumulative irreversible commitment of a natural energy resource. The construction and operation of the BLN helps offset the cumulative depletion of this limited resource.

Use of Materials, Energy, and Water

Construction and operation of the BLN results in the long-term irreversible use of materials and energy for the construction and operation of the reactors. However, in the short-term, the reactors provide far more energy than is consumed in their construction. A small amount of water is consumed in the construction of a BLN unit. A relatively modest quantity of cooling water is also consumed as loss to the atmosphere through evaporation and drift.

5.3. Irreversible and Irretrievable Commitments of Resources

This section describes anticipated Irreversible and Irretrievable (I&I) commitments of environmental resources that would occur in either the construction and operation of the AP1000 advanced reactor, or the completion and operation of the partially–completed B&W reactor at the BLN. The I & I commitments are summarized in Table 5-3 below.

For the purposes of this analysis, the term "irreversible" applies to the commitment of environmental resources (e.g., permanent use of land) that cannot by practical means be reversed to restore the environmental resources to their former state. In contrast, the term "irretrievable" applies to the commitment of material resources (e.g., irradiated steel, petroleum) that, once used, cannot by practical means be recycled or restored for other uses.

Table 5-3. Summary of Irreversible and Irretrievable Commitment of Environmental Resources

Environmental and Material Resource Issues	Irreversible	Irretrievable
Socioeconomic Changes	The project results in both short-term and long-term changes in the population and nature and character of the local community, and the local socioeconomic structure. Some impacts on infrastructure and services are temporary, while other changes represent a permanent and irreversible change in socioeconomic infrastructure.	None
Disposal of Hazardous and Radioactivity Contaminated Waste	The generation of radioactive, hazardous, and nonhazardous waste that needs to be disposed. Land committed to the disposal of radioactive and nonradioactive wastes is an irreversible impact because it is committed to that use, and is largely unavailable for other purposes.	None
Commitment of Underground Geological Resources for Disposal of Radioactive Spent Fuel	High-level waste and spent nuclear fuel is isolated from the biosphere for thousands or tens of thousands of years in a deep underground geological repository. This long-term commitment makes the surrounding geological resources unusable for thousands or tens of thousands of years.	None
Destruction of Geological Resources During Uranium Mining and Fuel Cycle	None	Uranium mining can result in contamination and destruction of geological resources, and pollution of lakes, streams, underground aquifers, and the soil.
Contaminated and Irradiated Materials	None	Some of the materials used in the construction of the BLN are contaminated or irradiated over the life of the BLN. Much of this material is not reused or recycled, and must be isolated from the biosphere for hundreds or thousands of years.
Land Use	None	The range of available land uses for the BLN site and existing transmission line ROW are now restricted for the life of the project and transmission lines resulting in irretrievable lost production or use of renewable resources such as timber, agricultural land, or wildlife habitat during the period the land is used.

Environmental and Material Resource Issues	Irreversible	Irretrievable
Water Consumption	None	Relatively small amounts of potable water are used during construction and operation of BLN. A small fraction of the cooling water taken from Guntersville Reservoir is lost through evaporation. The impact to surface water resources is relatively small, but represents a natural resource that is no longer readily available for use.
Consumption of Energy	None	Nonrenewable energy in the form of fuels (gas, oil, and diesel) and electricity is consumed in construction and to a lesser extent, operation of the BLN.
Consumption of Uranium Fuel	None	The BLN reactors contribute a relatively small increase in the depletion of uranium that is used to fuel the reactors.

5.3.1. Irreversible Environmental Commitments

Irreversible environmental commitments resulting from the BLN project would relate primarily to those of the UFC, i.e., 1) land disposal of equipment and materials contaminated by hazardous and low-level radioactive waste; and 2) UFC effects that include commitment of underground geological resources for disposal of high-level radioactive waste and spent fuel and destruction of geological resources during uranium mining. Implementation of either action alternative would also result in both short-term and long-term minor changes in the population, the nature and character of the local community, and the local socioeconomic infrastructure. Once the unit ceases operations, and the BLN is decontaminated and decommissioned in accordance with U.S. Nuclear Regulatory Commission (NRC) requirements, the land that supports the facility may be returned to other industrial or nonindustrial uses. However, the land may continue to be committed to use for other future electrical projects or other purposes.

Uranium Fuel Cycle

The UFC is defined as the total of those options and processes associated with the provision, utilization, and ultimate disposition of fuel for nuclear power reactors. Environmental effects are contributed from uranium mining and milling, the production of uranium hexafluoride, isotopic enrichment, fuel fabrication, use of the fuel, possible future reprocessing of irradiated fuel, transportation of radioactive materials, disposal of used (spent) fuel and management of low-level and high-level wastes.

The BLN unit would generate radioactive, hazardous, and nonhazardous wastes that require disposal. This waste is disposed of in permitted hazardous, mixed, or radioactive landfills or disposal facilities. Land committed to the disposal of radioactive and hazardous wastes represents an irreversible impact because it is committed to that use, and can be used for few other purposes.

Table 5.7-2 of the Environmental Report (ER) submitted to NRC as part of the TVA COL Application for siting two AP1000 units at BLN presents environmental data on the UFC. Those UFC effects noted in Table 5.7-2 as permanent or comprising emissions for fuel production or storage of spent fuel would be considered irreversible. That ER analysis, which is herein incorporated by reference, described the UFC environmental effects from both a single 1000 MW nuclear power reactor and those of two 1150 MWe units operating at the BLN. As described in the ER, the approach taken by NRC in estimating effects was intended to ensure that the actual environmental effects were less than the quantities shown for the 1000 MWe reference plant and to envelope the widest range of operating conditions for light water reactors. That analysis concluded all resource impacts were small (i.e., not detectable or are so minor that they neither destabilize nor noticeably alter any important attribute of the resource). The effects from either of the current action alternatives for constructing and operating a single 1100 MWe unit at BLN are bounded by that analysis. As such, impacts would be even less than the two unit analysis which concluded only small effects.

5.3.2. Irretrievable Environmental Commitments

Irretrievable environmental commitments resulting from the BLN include:

• Construction and irradiated materials.
• Water consumption.
• Consumption of energy.
• Consumption of uranium fuel.

Construction and Irradiated Materials

Common irretrievable commitments of materials used in either new reactor (AP1000) construction or for completion of the partially completed B&W reactors (BLN Unit 1 or Unit 2) include concrete, rebar, structural steel, power cable, small bore piping and large bore piping. A portion of these materials used in the construction of either type of reactor become contaminated or irradiated over the life of BLN operations. Much of this material cannot be reused or recycled, and must be isolated from the biosphere for hundreds or thousands of years. However, because some of this material may be reused (if uncontaminated) or decontaminated for future use, the recycled portion does not constitute an irretrievable commitment of resources. The estimated quantities of materials needed to construct an AP1000 reactor at BLN are concrete (77, 200 cu. yds.), rebar (10,000 T.), structural steel (6,400 T.), power cable(810,000 linear ft.), small bore piping (230,000 linear ft.) and large bore piping (68,000 linear ft.). As these reactors are partially complete, proportionally smaller amounts of materials would be needed to complete them than the Ap1000 alternative. Additionally, smaller amounts of materials would be required to complete Unit 1 than Unit 2.

While the amount of construction materials is large, use of such quantities in large-scale construction projects such as nuclear reactors, hydroelectric and coal-fired plants, and many large industrial facilities (e.g., refineries and manufacturing plants) represents a relatively small incremental increase in the overall use of such materials. Even if this material is eventually disposed of, use of construction materials in such quantities has a small impact with respect to the national or global consumption of these materials. An additional irretrievable commitment of resources includes materials used during normal plant operations, some of which are recovered or recycled.

Irreversible commitments of resources generally occur through the use of nonrenewable resources that have few or no alternative uses at the termination of the proposed action. Transmission line reconductoring and upgrades also would require the irretrievable commitment of fossil fuels (diesel and gasoline), oils, lubricants, and other consumables used by construction equipment and by workers commuting to the site. Other materials used for construction of the proposed facilities would be committed for the life of the facilities. Some of these materials, such as ceramic insulators and concrete foundations, may be irretrievably committed, while the metals used in conductors, supporting structures, and other equipment could be and would likely be recycled. The useful life of the transmission structures is expected to be at least 60 years.

Water Consumption
Relatively small amounts of potable water are used during construction and operation of the BLN. Some of the cooling water taken from Guntersville Reservoir is lost through the cooling towers by way of drift and evaporation. The impact to surface water resources is relatively small, but represents a natural resource that may no longer be available for use. However, as part of the natural hydrologic cycle, this water is eventually re-cycled through the ecosystem.

Consumption of Energy Used in Constructing the Reactors
Nonrenewable energy in the form of fuels (gas, oil, and diesel) and electricity are consumed in construction and, to a much smaller extent, in the operation of the BLN. Beyond ancillary (e.g., vehicles, equipment) usage, nuclear reactors do not consume fossil fuels such as petroleum or coal.

The total amount of energy consumed during construction or operation of the BLN is very small in comparison to the total amount consumed within the United States. On net balance, the reactor produces far more energy (as measured in British Thermal Units) than is consumed in its construction and operation. For this reason, one of the key considerations related to the I & I requirement is that operation of the BLN helps conserve or helps avoid the consumption of finite fossil fuels supplies.

Uranium Fuel Cycle and Depletion of Uranium
The principal use of uranium is as a fuel for nuclear power plants. With approximately 440 nuclear reactors operating worldwide, these plants currently produce approximately 16 percent of the world's electrical power generation. Global uranium fuel consumption is increasing, as nuclear power generation continues to expand worldwide. The BLN reactors contribute a relatively small increase in the depletion of uranium. Sources of uranium include primary mine production as well as secondary sources. Nuclear reactor uranium consumption now exceeds the supplies produced through mining. The resulting shortfall has been covered by several secondary sources including excess inventories held by producers, utilities, other fuel cycle participants, reprocessed reactor fuel, and uranium derived from dismantling Russian nuclear weapons.

The limited availability of uranium fuel may affect the future expansion of nuclear power. U.S. Department of Energy uranium estimates indicate that sufficient resources exist in the United States to fuel all operating reactors and reactors being planned for the next ten years at a U_3O_8 cost (1996 dollars) of $30.00/lb or less. The resource categories designated as reserves and estimated additional resources can supply these quantities of uranium.

The World Nuclear Association studies supply and demand for uranium and states that the world's present measured resources of uranium, in the cost category somewhat above present spot prices and used only in conventional reactors, at current rates of consumption, are sufficient to last for some 70 years. Very little uranium exploration occurred between 1985 and 2005, so the significant increase in exploration that is currently being witnessed might double the known economic reserves. On the basis of analogies with other metal minerals, a doubling in price from present levels could be expected to create about a tenfold increase in measured resources over time. The introduction of fast breeder reactors and other technologies may also reduce the supply-demand gap. The addition of BLN increases consumption of uranium in the United States by approximately 2 percent and increases worldwide consumption of uranium by about 0.5 percent. Thus, the addition of BLN by itself does not create a significant impact on uranium resources.

5.4. Energy Resources and Conservation Potential

The total amount of energy consumed during construction or operation of the BLN is very small in comparison to the total amount consumed within the United States. On net balance, the reactor would produce far more energy (as measured in British Thermal Units) than would be consumed in its construction and operation. For this reason, one of the key considerations related to the I & I requirement is that operation of the BLN helps conserve or helps avoid the consumption of finite fossil fuels supplies.

Nonrenewable energy in the form of fuels (gas, oil, and diesel) and electricity would be, however, consumed in construction and, to a much smaller extent, in the operation of any of the action alternatives for BLN. An AP1000 reactor would require more off-site fabrication of components, transport of components, and on-site construction, and therefore more energy to build, than completing either the partially-built BLN Unit 1 or Unit 2. Because the existing Unit 1 is more complete than Unit 2, of the two units, Unit 1 would require less energy to build.

Beyond ancillary (e.g., vehicles, equipment) usage and that required to support the UFC, nuclear reactors do not consume fossil fuels such as petroleum or coal during operation. Processing of nuclear fuel is, however, an energy-intensive activity. Existing uranium enrichment facilities are large and each facility services several nuclear generating plants. For comparative purposes, the energy required to process or enrich uranium using gaseous diffusion sufficient to fuel a single 1000 MW pressurized boiling water reactor nuclear plant (slightly smaller than the action alternatives for a single BLN unit) would be approximately that of the output from a 50 MW fossil-fueled (coal-fired) facility operating at 75% capacity factor. Newer technologies (e.g., centrifuge or atomic vapor laser isotope separation) currently, or becoming, commercially available for enrichment, utilize only 4-15% as much power as this gaseous diffusion example. As it is anticipated that these new, less energy intensive technologies will eventually become the norm for production of nuclear fuel, the processing portion of the UFC would likely use even less energy and become even more "carbon-friendly" in the future. The DOE has also released the Draft Programmatic EIS for the Global Nuclear Energy Partnership (GNEP) (DOE 2008) with the identified preferred alternative of implementing a "closed" cycle for nuclear fuel management in the United States (i.e., select among nuclear fuel reprocessing alternatives). If selected and implemented by DOE, this approach for GNEP could both expand the availability of nuclear fuel and potentially stabilize or reduce the worldwide GHG releases associated with mining and milling of uranium as a fuel source.