CHAPTER 10

ENVIRONMENTAL CONSEQUENCES OF THE PROPOSED ACTION

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CHAPTER 10

ENVIRONMENTAL CONSEQUENCES OF THE PROPOSED ACTION

10.0 ENVIRONMENTAL CONSEQUENCES OF THE PROPOSED ACTION

Section 102(c) of the *National Environmental Policy Act (NEPA)* specifies three special NEPA requirements that an Environmental Impact Statement (EIS) must evaluate. This chapter evaluates these three requirements, as well as a benefit-cost balance (BCA), associated with constructing and operating the BLN. The three requirements, as well as the BCA, are evaluated in the following four sections:

1. Section 10.1: Unavoidable Adverse Environmental Impacts.
2. Section 10.2: Irreversible and Irretrievable Commitments of Resources.
3. Section 10.3: Relationship between Short-term Uses and Long-term Productivity of the Human Environment.
4. Section 10.4: Benefit-Cost Balance.

10.1 UNAVOIDABLE ADVERSE ENVIRONMENTAL IMPACTS

This section describes principle 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 described in Chapter 4 of constructing and Chapter 5 of operating two AP1000 reactors at the BLN, in addition to maintaining and operating the 500-kV and 161-kV transmission corridor that transverses the Tennessee River at three locations. Each reactor has an estimated thermal power level of approximately 3400 megawatts thermal (MWt) and a net electrical output of approximately 1100 megawatts electric (MWe).

Some mitigation measures for reducing construction-related impacts are also referred to as best management practices (BMPs). The BMPs are frequently implemented through permitting requirements, and plans and procedures developed for constructing or operating the BLN units.

10.1.1 ADVERSE ENVIRONMENTAL CONSTRUCTION IMPACTS

Construction effects are identified and evaluated in detail in Chapter 4. Construction impacts, and measures and controls that may be implemented to reduce or eliminate such impacts are briefly summarized in Table 4.6-1. This section describes unavoidable adverse impacts resulting from construction of the BLN and transmission corridor. Most impacts, other than socioeconomic, are relatively small and short-term; the non-socioeconomic impacts can either be partly mitigated or may dissipate after construction has ended. Anticipated impacts and potential mitigation measures that are available for reducing some of the construction impacts are summarized in Table 10.1-1. Because socioeconomic impacts deal with a markedly different set of issues, this discussion is divided into two sections; non-socioeconomic impacts and socioeconomic impacts.

Non-Socioeconomic Impacts

This section briefly identifies and describes the principal non-socioeconomic unavoidable adverse impacts associated with construction.

As described in Chapter 4, the principal unavoidable adverse impacts of construction of the BLN and maintaining and energizing the transmission line corridors involve:

- Impacts on land use of the site and vicinity from construction could be MODERATE if the disposition of dredge spoils and the use of borrow affect areas outside the proposed facility construction footprint, or if best management practices are not followed in the management of the resources.

- Any potential disturbance to historic, archaeological, or paleontological resources is considered to be SMALL.

- Impacts on water resources including a minor temporary increase in the sediment load due to storewater effluents, dredging and other related construction activities taking place near or along the Guntersville Reservoir (an impoundment of the Tennessee River) shoreline are considered to be SMALL.

- A SMALL impact on shoreline habitat as a result of construction activities near or along the Guntersville Reservoir shoreline.

- Common terrestrial biological effects resulting from construction at the BLN site include temporary and long-term disturbance or loss of vegetative cover, loss of habitat, and increased interaction between humans and wildlife, whose impact is considered to be SMALL. Altered areas not containing permanent structures are revegetated and routinely maintained following construction. Direct wildlife mortality could occur during the construction period; however, this is expected to only affect organisms that cannot readily flee the construction area. Direct mortality of wildlife in the limited areas of construction is not expected to be great enough to cause detectable generational population effects.

- Adverse impacts to wetlands on the BLN site are considered to be MODERATE and are expected to require mitigation.

- Workers constructing Unit 4 could be exposed to direct radiation, and to gaseous radioactive effluents emanating from the routine operation of Unit 3. Construction worker doses attributable to the operation of BLN Unit 3 for the proposed construction areas for Unit 4 are a small fraction of 10 CFR Part 20 and 10 CFR Part 50 Appendix I limits. This represents a SMALL impact upon worker health and safety.

Socioeconomic Impacts

This section briefly identifies and describes the unavoidable adverse socioeconomic impacts associated with construction of the BLN and maintaining and energizing the transmission corridors. Socioeconomic impacts can be at least partially offset through use of selected mitigation measures. The principal socioeconomic effects involve:

- Increased traffic congestion from construction workers and deliveries results in a SMALL to MODERATE impact in the vicinity of site during the peak period of construction.

- SMALL visual impact from the BLN facility and structures, and the existing transmission corridors.

- Intermittent noises may impact nearby workers and residents as a result of plant construction and maintenance activities on the transmission corridor. Increased traffic congestion leads to a SMALL increased noise level.

- Noise impacts from BLN plant construction activities are considered to present a SMALL impact to people in the surround community. Peak traffic noise during construction should have a SMALL to MODERATE impact at approximately 10 homes along the access road and off-peak traffic should have a SMALL impact to surrounding communities.

- Increased impact in fugitive dust and gaseous emissions would lead to SMALL socioeconomic impact.

- A total of approximately 3900 workers on site during peak construction period, of which about 50 percent migrate into the region. This worker impact is deemed to be SMALL.

The projected influx of workers and their families have a SMALL demographic impact upon the county.

- The temporary peak impact of construction upon the Jackson County economy is expected to represent a MODERATE to LARGE beneficial impact.
- The potential impact of taxes within the region is expected to be SMALL and beneficial. The potential impact within Jackson County, Alabama, is expected to be a MODERATE to LARGE beneficial impact.
- A SMALL short-term strain on fire protection, police, and other essential community services and infrastructure.
- Due to the availability of rentals and housing, the impact of the construction of the BLN on local housing is expected to be SMALL to MODERATE in Jackson County.
- The impacts of construction on the educational system of Jackson County, Alabama are expected to be MODERATE to LARGE but temporary.
- Impacts of construction on recreation would be SMALL.

No impacts that are disproportionately high and adverse on minority or low income populations were identified in association with construction of the BLN.

The influx of construction workers is not expected to have a substantial impact to housing, but may place a small short-term strain on the local school system.

Over the short-term, increased construction traffic adversely affects traffic patterns and levels of service in the vicinity of BLN. Mitigation measures for partially offsetting some impacts may include promoting carpooling, implementing staggered shifts, and using signage and turn lanes to alleviate traffic concerns.

Construction of the BLN may, over the short-term, place a SMALL strain on infrastructure (e.g., roads, water, utilities, and schools) capabilities and community services such as teachers, and fire and police protection; these effects may not constitute a significant impact upon infrastructure or social services. Conversely, increased property tax revenues generated through an influx of construction workers may fund additional services and the infrastructure.

Other measures that are beyond the direct control of TVA may include changing the tax structure to generate revenue to support additional services and infrastructure improvements, rezoning to encourage beneficial changes in growth patterns, and offering incentives for construction of rentals and new housing.

10.1.2 UNAVOIDABLE ADVERSE ENVIRONMENTAL OPERATIONAL IMPACTS

Operational effects are identified and evaluated in detail in Chapter 5. Table 5.10-1 summarizes operational impacts, and identifies measures and controls that may be implemented to reduce or eliminate such impacts. This section describes unavoidable adverse impacts resulting from operation of the BLN and the transmission corridor. Some of these impacts have greater environmental implications and are sustained over a longer timeframe than are construction impacts.

Anticipated impacts and mitigation measures available for reducing some of the operational impacts are summarized in Table 10.1-2. Because socioeconomic impacts involve a markedly different set of concerns, this discussion has been divided into two subsections; non-socioeconomic impacts and socioeconomic impacts.

Non-Socioeconomic Impacts

Many of the operational issues are considered to be long-term effects that range over or beyond the operational life of the BLN. As described in Chapter 5, the unavoidable non-socioeconomic adverse operational impacts from the BLN and the transmission corridor involve:

- A continued commitment of land use over the operational life of this facility. Maintenance and operational activities at the BLN site are expected to have SMALL impacts on land use within the site boundary. Land is also allocated for the transmission corridors. Impacts on land use associated with operation and maintenance of the transmission corridors and off-site areas are considered SMALL.

- Continued long-term unavailability of habitat, and disruption of some species. Some of this land is re-vegetated and allowed to enter secondary successional stages after construction is complete. This represents a SMALL impact to biota.

- Potential disturbance or impacts to historic, archaeological, or paleontological resources are considered to be SMALL.

- Hydrologic alteration impacts, including water withdrawn from the Guntersville Reservoir for cooling tower makeup and discharged back to the reservoir as blowdown, are considered to be SMALL.

- A thermal plume is generated from cooling water blowdown discharged to the Guntersville Reservoir. Summaries of the predicted thermal discharge plume analysis data are provided in Table 5.3-2. The thermal impact and its effect on water aquatic biota is considered to be SMALL.

- Consumptive and evaporative water loss impacts affecting the Guntersville Reservoir are considered to be SMALL.

- Impacts on water quality of the Guntersville Reservoir are considered to be SMALL.

- Discharge of an atmospheric vapor plume from the two natural draft cooling towers (NDCT) can obstruct view of the sky and cause a shadowing effect on the ground which has a small effect on vegetation. Table 5.3-5 describes the expected cooling tower atmospheric plume lengths by season and direction for the two NDCTs. The potential impacts are considered to be SMALL.

- Relatively SMALL effects on fish and other aquatic organisms are a result of impingement and entrainment.
- Deposition of small amounts of salt on the surrounding vicinity created by cooling tower drift. These salt deposits represent a SMALL impact that is unlikely to have any measurable impact on plants and vegetation.
- Impacts from the discharge of relatively small quantities of hazardous and/or radioactive effluents into Guntersville Reservoir are considered to be SMALL.
- A SMALL potential for bird collisions with the cooling towers and transmission lines.
- Minor radioactive air emissions produced by the two nuclear units. These emissions represent a SMALL impact upon the environment.
- Generation of hazardous nonradioactive, mixed, and low-level radioactive waste that requires storage, treatment, and disposal and needs to be isolated from the biosphere for hundreds or thousands of years,
- Generation of high-level radioactive waste and spent fuel that needs to be either reprocessed or isolated from the biosphere for thousands or tens of thousands of years.
- Incidental external radioactive dose to plant operational workers, whose impact is considered to be SMALL.

Socioeconomic Impacts

The socioeconomic impacts can be at least partially offset through the use of selected mitigation measures. Because of the small number of workers involved in operation of the BLN, the socioeconomic impacts are generally smaller when compared to the construction phase, but take place over a longer period of time. The unavoidable socioeconomic adverse impacts resulting from the operation of the BLN and the transmission corridor involve:

- Increased traffic congestion entering and leaving the site results in a SMALL impact in the vicinity of site over the operational period of the two units.
- Visual impact from the BLN facility and structures, and the existing transmission corridors, are considered to be SMALL.
- Noise impacts from BLN plant operations and maintenance and operation of the transmission corridor are considered to present a SMALL impact to people in the surrounding community. Peak traffic noise during operation should have a SMALL to MODERATE impact at approximately 10 homes along the access road and off-peak traffic should have a SMALL impact to surrounding communities.
- Increased gaseous emissions would lead to SMALL socioeconomic impact.

- Operation of the two units requires approximately 1000 workers, of which about 50 percent migrate into the region. This worker impact is deemed to be SMALL. The projected influx of workers and their families would increase the population of Jackson County by approximately 3 percent which represents a SMALL demographic impact upon the county.

- The operational impact upon the Jackson County economy is expected to represent a MODERATE beneficial impact.

- The potential impact of taxes within the region is expected to be SMALL and beneficial. The potential impact within Jackson County, Alabama, is expected to be a MODERATE beneficial impact.

- The operational burden represents a SMALL impact on fire protection, police and other essential community services and infrastructure.

- Due to the availability of housing for sale or rent, operation of the two units is expected to place a SMALL impact on Jackson County housing.

No impacts that are disproportionately high or adverse on minority or low income populations were identified in association with either the construction or operational phases of the BLN.

10.1.3 SUMMARY OF UNAVOIDABLE ADVERSE CONSTRUCTION AND OPERATIONS IMPACTS

This section summarizes the unavoidable adverse construction and operational impacts, and describes methods for mitigating the impacts. Through the application of mitigation measures, some of the unavoidable adverse environmental impacts associated with the construction and operation of the BLN may be reduced to minimal effects or to the point where they have no measurable effect at all. The unavoidable impacts are summarized below by category beginning with socioeconomics, which is the only category that has greater than SMALL impacts.

Construction Impacts

Construction impacts and mitigation measures are summarized in Table 10.1-1. As outlined in Section 2.5.2, during the peak phase of construction, up to 3900 workers are on site. All of the impacts, other than socioeconomic, from the construction of BLN and initial re-clearing of existing transmission lines are SMALL and short-term. Most socioeconomic impacts can either be partly mitigated or are expected to dissipate after construction is complete.

Socioeconomic: Depending on the resource issues under examination, SMALL to LARGE socioeconomic impacts may result from the influx of construction workers. Many socioeconomic impacts are generally considered to be beneficial. Socioeconomic impacts can be at least partially offset through use of selected mitigation measures.

The cooling towers and transmission corridor present a small aesthetic impact but do not warrant any mitigation measures.

To the extent feasible, communications are performed using personal communication devices as opposed to loud speakers.

A relatively small increase in noise level may result from construction activities. Impacts of noise are mitigated through employee training, work procedures, use of hearing and protective equipment, and use of modern equipment designed to reduce noise levels.

Area schools may be strained on a short-term basis as a result of accommodating the increased number of construction workers' children. The ability of the fire protection and other services or infrastructure to adequately meet the community's needs may also be strained on a short-term basis.

Local roads in the vicinity of the BLN are expected to experience increased traffic. Mitigation measures that may be implemented to partially offset traffic impacts include encouraging car pooling, staggering shifts, advertising and erecting signs alerting drivers of increased construction traffic, and constructing turn lanes onto the BLN site.

Increased tax revenue generated from the construction project may be used to fund schools, road improvements, and upgrades to the fire protection, and other services and infrastructure.

Land Use: As described in Chapter 4, the project results in a land use commitment of the approximately 1600 ac. existing BLN site and continued commitment of land for the transmission corridors. However, much of the site has been disturbed over the last 30 years and the project is consistent with current land use plans. The project also results in the loss of some agricultural or pastureland, and undeveloped woodland. Some of the land use impacts may be practically mitigated by allowing some of the land to be returned to its former state after construction is complete.

A Phase 1 survey of cultural resources has been completed. Based on this survey, it has been concluded that there is little or no risk of disturbing buried historic, archaeological, or paleontological resources. If cultural resources are discovered during ground disturbing activities, their significance is assessed; as appropriate, the State Historic Preservation Office is consulted.

Hydrological: Construction activities near or along the Guntersville Reservoir shoreline may temporarily increase the sediment load and adversely affect some shoreline habitat. These impacts can be reduced through applicable site-specific work procedures and BMPs.

Ecological: The project results include destruction of habitat, and disruption of some biota in the construction area. The project impacts include the permanent alteration of some habitat areas, potentially resulting in the loss or relocation of biota over the operational lifespan. Some of these impacts can be mitigated by re-vegetation and allowing the land to return to an unmanaged state after construction is complete.

Radiological: Construction workers on-site at Unit 4, located near the recently completed and operating Unit 3, receive a very low incidental external radioactive dose. Section 4.5 provides an assessment of the potential radiological exposure. Any such exposure is monitored and well within applicable regulatory limits. These impacts can be reduced through employee training and work procedures.

Atmospheric and Meteorological: Minor air emissions that do not require mitigation are produced by vehicles and equipment.

Environmental Justice: Some of the construction activities may affect the general population. However, there is no disproportionate impact on minority or low income populations. Thus, there are no unavoidable adverse environmental impacts.

Operational Impacts

Operational impacts are summarized in Table 10.1-2. Depending on the resource issue, operational impacts range from SMALL to MODERATE. Many operational impacts tend to be larger and to exist over a longer timeframe than do construction impacts. Some operational impacts are considered long-term effects that range over or beyond the operational life of the BLN.

Socioeconomic: As outlined in Section 2.5.2, the estimated number of operations workers to staff the two BLN units is approximately 1000 people, a small fraction of the total projected population of the region. Because of the smaller number of workers involved in operation of the BLN, the socioeconomic impacts are generally smaller but sustained over a longer period of time when compared to that of construction. An increased volume of traffic from operational workers may adversely affect traffic patterns and levels of service in the vicinity of BLN. Mitigation measures for partially offsetting some impacts may include promoting carpooling, implementing staggered shifts, and using signage and turn lanes to alleviate traffic concerns.

An influx of operational workers has the potential to place a short-term strain on the local school system. The increase in operational workers may also strain infrastructure (e.g., roads, water, utilities, and schools) and community services such as teachers, and fire and police protection.

Conversely, increased property tax revenues generated through an influx of workers can fund additional services and infrastructure enhancements. Additional measures outside the control of TVA may include changing the tax structure to generate revenue to support additional services and infrastructure improvements, and rezoning to encourage beneficial changes in growth patterns.

Infrequent loud noises from plant operations and maintenance activities on the corridor may result in a small impact on nearby workers and residents, which can be mitigated with noise protection equipment, and use of equipment that is designed to reduce noise impacts. Testing of emergency warning sirens is expected to be conducted periodically, with advance notification to the public.

Two cooling towers and the transmission corridors are visible from nearby locations and constitute a relatively small aesthetic impact.

Land Use: As described in Chapter 5, the commitment of land use, amounting to approximately 1600 ac. on the existing BLN site and continued commitment of land for the transmission corridors continues over the operational life of this project. However, much of the site has been disturbed over the last 30 years, and the project is consistent with current land use plans. Some of the land use is re-vegetated following the end of construction. Some of the land may be returned to its former state following completion of construction.

Operation of the BLN increases the volume of radioactive and nonradioactive wastes that are required to be disposed in permitted disposal facilities or permitted landfills.

Hydrological: The calculated 7Q10 flow is the lowest average flow over a period of 7 consecutive days that occurs once every 10 years, on average. It is estimated that consumptive water loss from Guntersville Reservoir is less than 1 percent of the 7Q10 low flow conditions (see Table 2.3-32), an amount that could potentially lower the water level of the reservoir near the BLN by less than 1-in. This is small, in comparison with the weekly 1-ft. water level fluctuations for summer mosquito control. During high flow periods, the water level of the reservoir may be above the normal operating elevation range to regulate flood flows

Summaries of the predicted river plume analysis data are provided in Table 5.3-2. Based on the data presented in this table, high and low temperature plumes are predicted to dissipate in the near-field mixing zone region, and the thermal effects of plant operation are unlikely to have a discernible effect on water quality or the aquatic biota.

Radiological: The release of small amounts of radioactive liquid effluents is permitted, as long as releases comply with the requirements specified in 10 CFR Part 20. Effluents are treated according to applicable regulatory standards before being discharged into Guntersville Reservoir. The impacts of radioactive or hazardous effluents discharged into Guntersville Reservoir are reduced through a waste minimization program.

The maximum exposed individual annual doses from the discharge of radioactive materials in liquid effluents from the new units meets the guidelines of Appendix I of 10 CFR Part 50. Because the guidelines for the maximum individual exposure via hydrospheric pathways are much more restrictive (at least by a factor of 160) than the standards of 10 CFR Part 20, the radioactive releases in liquid effluents meet the standards for concentrations of released radioactive materials in water (accessible to a maximum exposed individual of the general public), as specified in Column 2 of Table 2 of 10 CFR Part 20.

Ecological: Operation of the BLN and the transmission corridor may continue to impact habitat and species. However, re-vegetating and returning some of the land to a native state results in a reduction of ecological impacts over time. A small impact on birds occurs as a result of collisions with the cooling towers and transmission lines.

Infrequent episodic loud noises related to plant operations for maintenance on the transmission corridor results in a small short-term disruption to wildlife.

Operation of two cooling towers results in small amounts of salt deposition near the reactors. However, the amount of salt deposition is expected to be below a level that harms leaves or other biota.

Because the nuclear units use a closed-loop cooling system to mitigate cooling water impacts, the effects of entrainment and impingement upon fish and aquatic organisms are relatively innocuous.

The transmission line has a remote potential to produce electric shock to people working on the line or to passersby who come in contact with a line that has fallen during a storm. There is an associated minor potential for electrocution of large birds such as eagles; some of this impact is reduced with modern mitigation technology such as spacing conductors. Potential impacts are further minimized because the transmission line would conform to (1) National Electric Safety Code requirements and (2) design guidelines to minimize potential for electrocuting large birds.

Radiological and Waste: Incidental external radioactive dose to plant operational workers is reduced through careful monitoring, employee safety training programs, and strict adherence to work procedures and applicable regulations.

The impacts from generation of high-level radioactive spent fuel is 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.

The BLN units also generate hazardous and nonhazardous waste that needs to be disposed of. The impacts from generation of radioactive, hazardous, and nonradioactive waste is reduced through waste minimization programs, employee training programs, and strict adherence to work procedures and applicable regulations. The waste is disposed of in landfills permitted to handle radioactive waste, and with the capacity. Alternatively, high-level waste may be reprocessed in the future to reduce the amount of waste sent to a geological repository.

Radiological and Non-Radioactive Air Releases: Air emissions from occasional operation of diesel generators and equipment, and vehicles creates a small impact on workers and local residents. The operation of equipment and employee vehicles releases a relatively small quantity of nonradioactive pollutants to the atmosphere. Potential doses are well within regulatory limits.

The two NDCT units emit a plume of water vapor that results in a limited obstructed view of the sky, causes a shadowing effect on the ground, and has a SMALL effect on vegetation. Table 5.3-5 describes the expected atmospheric plume lengths by season and direction for the two NDCT units. The longest average plume lengths occur during the winter months, and the shortest occur during the summer months. The model predicts a combined average length of less than or approximately equal to three miles in winter. This emission is unlikely to have any discernible effect on biota.

The routine release of small amounts of gaseous radioactive emissions is also permitted if the releases comply with the requirements specified in 10 CFR Part 20. Releases are well below regulatory limits.

The annual dose to the maximum exposed individual due to release of radioactive gaseous emissions meets the guidelines of Appendix I of 10 CFR Part 50. Because the guidelines of Appendix I for maximum individual exposures via atmospheric pathways are much more restrictive (by a factor of 100) than the standards of 10 CFR Part 20, the radioactive gaseous emissions from BLN meet the standards for concentrations of released radioactive materials in air at the locations of maximum annual dose to an individual and at all locations accessible to the general public as specified in Column 1 of Table 2 of 10 CFR Part 20.

Environmental Justice: Some of the activities affect minority or low income populations. However, there is no disproportionate impact on minority or low income populations. Thus, there are no unavoidable adverse impacts with respect to the goals of Environmental Justice.

10.1.4 REFERENCES

1. Tennessee Valley Authority, *Final Environmental Impact Statement for the Bellefonte Conversion Project*, 1997.

TABLE 10.1-1 (Sheet 1 of 10)
CONSTRUCTION-RELATED UNAVOIDABLE ADVERSE ENVIRONMENTAL IMPACTS

Category	Adverse Impact	Potential Actions to Mitigate Impacts	Unavoidable Adverse Impacts
Land Use	Approximately 200 additional acres of the 1600-ac. site is disturbed or cleared during construction, with the potential for erosion. Land is not available for other uses. Much of this impact continues into the operational phase.	Clear only areas necessary for installation of the power plant/ infrastructure. Enhance awareness of construction workers to environmental management practices. As appropriate, have environmental/safety officers supervise activities that can alter or harm the environment. Apply erosion controls and stabilization measures, such as those provided by applicable regulations and stormwater prevention practices and procedures. As feasible, limit activities to actual construction site and access ways. Locate soil stockpiles near the construction site. To the extent feasible, re-vegetate or restore affected temporary-use areas to approximately their native state after completion of construction. Comply with requirements of applicable federal, state and local construction permits/approvals and local ordinances.	Disturbance of approximately 200 additional acres of land occupied by the two units and associated infrastructure. Mitigation measures allow some of this land, particularly with respect to the transmission corridor, to be returned to its former state.

TABLE 10.1-1 (Sheet 2 of 10)
CONSTRUCTION-RELATED UNAVOIDABLE ADVERSE ENVIRONMENTAL IMPACTS

Category	Adverse Impact	Potential Actions to Mitigate Impacts	Unavoidable Adverse Impacts
	Maintenance of the existing transmission corridors. As much of this impact continues into the operational phase, it constitutes a long-term commitment of resources.	Restrict ground disturbing equipment to the existing corridor boundaries, as appropriate. Restore or re-vegetate disturbed areas, with attention to wildlife habitat or food plots. Reduce potential impacts through compliance with permitting requirements and BMPs, including sediment basins. Restrict maintenance access to existing roads.	Long-term commitment of land for the transmission corridor. Mitigation measures allow some of the disturbed land to be returned to its former state.
	Small potential to disturb buried historic, archaeological, or paleontological resources.	As necessary, perform sub-surface testing prior to start of ground-disturbing on-site work to identify buried historic, cultural, or paeleontological resources. Comply with established procedures to assess unanticipated historic, cultural, and paleontological resource discoveries, and as appropriate, stop work and contact the State Historic Preservation Office. As necessary, promote awareness of construction workers on applicable cultural resource practices.	Potential for unanticipated disturbances to historic, cultural, or paleontological resources is mostly or entirely mitigated.

TABLE 10.1-1 (Sheet 3 of 10)
CONSTRUCTION-RELATED UNAVOIDABLE ADVERSE ENVIRONMENTAL IMPACTS

Category	Adverse Impact	Potential Actions to Mitigate Impacts	Unavoidable Adverse Impacts
	Construction debris is disposed in permitted landfills.	Introduce waste minimization program to reduce the volume of debris generated. Train appropriate employees in procedures and methods for reducing waste.	Some land is used or dedicated to long-term disposal of construction debris and not available for other uses. This impact constitutes a commitment of land.
Hydrologic and Water Use	Construction on a short-term basis may potentially erode sediments into water, degrading water quality.	Comply with applicable regulations, permits, and plans. Apply BMPs as found in stormwater regulations and procedures. Install drainage controls to direct dewatering runoff.	A relatively small amount of water is consumed.
	Ground disturbing activities along river banks or stream banks (in the case of the transmission line) on a short-term basis, introduces sediments into Guntersville Reservoir.	Re-vegetate unused construction area in a timely manner, following clearing. Comply with BMPs. Install drainage controls.	Minimal or no unavoidable adverse impacts.

TABLE 10.1-1 (Sheet 4 of 10)
CONSTRUCTION-RELATED UNAVOIDABLE ADVERSE ENVIRONMENTAL IMPACTS

Category	Adverse Impact	Potential Actions to Mitigate Impacts	Unavoidable Adverse Impacts
	Use of equipment introduces the possibility of petroleum and other chemical spills that could enter surface water.	Invoke spill prevention procedures for construction activities. Use good maintenance practices to maintain equipment, and prevent spills and leaks. Train appropriate employees in methods for preventing and/or responding to spills.	Minimal or no unavoidable adverse impacts.
Aquatic Ecology	Construction at river's edge may cause a short-term loss of some organisms and temporary degradation of habitat.	Install coffer dams or similar engineering protective measures around the construction site.	Minimal or no unavoidable adverse impacts.
	Existing transmission line crossing streams may continue to cause minor disruption of some organisms and degradation of habitat.	Employ BMPs to minimize erosion and sedimentation. Install storm water drainage systems at large construction sites and stabilize disturbed soils.	Minimal or no unavoidable adverse impacts.

TABLE 10.1-1 (Sheet 5 of 10)
CONSTRUCTION-RELATED UNAVOIDABLE ADVERSE ENVIRONMENTAL IMPACTS

Category	Adverse Impact	Potential Actions to Mitigate Impacts	Unavoidable Adverse Impacts
Terrestrial Ecology	Operation of the BLN and transmission corridor continues to impact habitat and species.	Some of the land is re-vegetated and returned to a native state, which results in a reduction of ecological impacts over time. Follow procedures for minimizing noise. To the extent feasible, plan construction activities to take place on previously disturbed areas.	Minimal or no unavoidable adverse impacts.
	Clearing and grading could harm or displace some animals.	To the extent feasible, minimize disturbance to habitat and species. Limit vegetation removal and construction activities to construction site or corridor, and access roads.	Minimal or no unavoidable adverse impacts.
	Construction noises may startle or scare animals. This impact is intermittent and continues through the construction phase.	As practical, use modern equipment that is designed to minimize noise.	Minimal or no unavoidable adverse impacts.
	Birds may, on a short-term construction basis, periodically collide with tall construction equipment.	No measures or controls are necessary because impacts are small.	Minimal or no unavoidable adverse impacts.

TABLE 10.1-1 (Sheet 6 of 10)
CONSTRUCTION-RELATED UNAVOIDABLE ADVERSE ENVIRONMENTAL IMPACTS

Category	Adverse Impact	Potential Actions to Mitigate Impacts	Unavoidable Adverse Impacts
Socioeconomics	Construction workers and local residents are exposed to elevated levels of traffic that continues through the course of the construction phase.	Make public announcements or prior notification of atypical construction activities. Add turn lanes at construction entrances. Encourage use of buses, vans, carpools, or staggered shifts. Post signs near construction entrances and exits to make the public aware of potentially high construction traffic areas.	Level of service on nearby roadways is reduced, over the construction period, particularly during shift change. Mitigation measures reduce this adverse impact.
	Construction workers could be injured. The risk continues through the entire construction phase.	Develop work plans that include safety procedures. Provide on-site emergency first aid, establish arrangements with local hospital emergency rooms to accept trauma victims, and conduct health and safety monitoring awareness sessions. Provide appropriate safety meetings and job-training to construction workers. As appropriate, have environmental/safety officer oversee activities that are likely to result in injuries.	Minimal but some possible unavoidable adverse impacts.

TABLE 10.1-1 (Sheet 7 of 10)
CONSTRUCTION-RELATED UNAVOIDABLE ADVERSE ENVIRONMENTAL IMPACTS

Category	Adverse Impact	Potential Actions to Mitigate Impacts	Unavoidable Adverse Impacts
	Influx of construction workforce.	If any housing shortage occurs, buildings and land use ordinances can be re-evaluated and changed to encourage housing development. This action is not within the control of TVA. Land use plans can also be re-evaluated and changed to designate new areas for housing construction. This action is not within the control of TVA. Over time, builders and developers may meet increased demand for any additional housing. This action is not within the control of TVA.	Minimal or no unavoidable adverse impacts.

TABLE 10.1-1 (Sheet 8 of 10)
CONSTRUCTION-RELATED UNAVOIDABLE ADVERSE ENVIRONMENTAL IMPACTS

Category	Adverse Impact	Potential Actions to Mitigate Impacts	Unavoidable Adverse Impacts
	Construction workers and local residents are exposed to elevated levels of dust, exhaust emissions, and noise from construction and equipment.	Train and appropriately protect employees and construction workers to reduce the risk of potential exposure to noise, dust and exhaust emissions. Make public announcements or prior notification of atypically loud construction activities. Use dust control measures (such as watering, stabilizing disturbed areas, and covering trucks). Ensure construction equipment producing emissions or noise is maintained properly. Manage concerns from adjacent residents or visitors on a case-by-case basis. As feasible, have environmental/safety officers supervise activities that can harm the environment. Use modern equipment designed to reduce noise. Where possible, conduct communications using personal communication equipment, as opposed to loud speakers.	Small unavoidable impacts.

TABLE 10.1-1 (Sheet 9 of 10)
CONSTRUCTION-RELATED UNAVOIDABLE ADVERSE ENVIRONMENTAL IMPACTS

Category	Adverse Impact	Potential Actions to Mitigate Impacts	Unavoidable Adverse Impacts
	Initially, there is insufficient Infrastructure and classroom space on a short-term basis for the influx of construction workers families.	Increased tax revenues as a result of the large construction project may fund additional infrastructure and schoolrooms; however, such measures are not within the control of TVA.	In the short-term, there may be school crowding and some impact on infrastructure. Increased funding can reduce the strain on the educational system.
	Fire or police protection and other services in Jackson County are strained over the short-term by population influx.	Increased tax revenues can be used to fund additional services and purchase equipment; however, such measures are not within the control of TVA.	In the short-term, some community services may be strained. Increased tax revenue can mitigate much of this impact. Increased tax revenue can mitigate much of this impact.
Radiological	Construction employees working on Unit 4 are exposed to small incidental doses of radiation from the newly completed and operating Unit 3. This impact runs from the start of Unit 3 to the completion of Unit 4.	Train radiation workers in radioactive safety procedures. Develop work plans that consider methods for reducing radioactive exposures. Monitor doses received by workers to ensure they are within regulatory limits.	Small radiation exposure to construction workers. Exposure is well within applicable radiation standards.

TABLE 10.1-1 (Sheet 10 of 10)
CONSTRUCTION-RELATED UNAVOIDABLE ADVERSE ENVIRONMENTAL IMPACTS

Category	Adverse Impact	Potential Actions to Mitigate Impacts	Unavoidable Adverse Impacts
Environmental Justice	Some activities affect minority or low income populations.	There is no disproportionate impact on minority or low income populations.	No unavoidable adverse impacts that need to be mitigated.

TABLE 10.1-2 (Sheet 1 of 9)
OPERATIONAL-RELATED UNAVOIDABLE ADVERSE ENVIRONMENTAL IMPACTS

Category	Adverse Impact	Mitigation Measures	Unavoidable Adverse Impacts
Land Use	Continued commitment of land use over the operational life of this project, amounting to disturbance of approximately 200 additional acres of the 1600 ac. of the existing site for the BLN continued use of land for the existing transmission corridor.	Much of the site has been disturbed over the last 30 years and the project is consistent with current land use plans. Some of disturbed the land is re-vegetated following the end of construction. Comply with requirements of applicable federal, state and local construction permits/approvals and local ordinances.	Continued commitment of land use over the operational life of this project. Some of the land is returned to its former state following the end of construction.
	The BLN increases radioactive and nonradioactive wastes that are disposed of, on a long-term hazardous and nonhazardous basis, in permitted disposal facilities or permitted landfills.	Establish a waste minimization programs to minimize the volume of wastes.	Land dedicated on a long-term basis for the disposal of this waste and is not available for most other uses.
	Two cooling towers continue to be visible from nearby locations throughout plant operation, and constitute a relatively small aesthetic impact. The existing transmission corridors also result in a small visual impact.	The transmission corridors already exist and the towers are already erected and therefore do not contribute any additional impact to the viewscape. No mitigation measures are deemed necessary.	The viewscape continues to be impacted over the operational phase of this project, but no more so than at the present.

TABLE 10.1-2 (Sheet 2 of 9)
OPERATIONAL-RELATED UNAVOIDABLE ADVERSE ENVIRONMENTAL IMPACTS

Category	Adverse Impact	Mitigation Measures	Unavoidable Adverse Impacts
Hydrologic and 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.	Ensure discharges comply with National Pollutant Discharge Elimination System (NPDES) permit and applicable water quality standards. Prepare a stormwater pollution prevention plan to avoid/minimize releases of contaminated storm water. Prepare a Spill Prevention Countermeasures and Control (SPCC) Plan to avoid/minimize contamination from spills. Discharge radioactive effluents in compliance with applicable regulatory standards.	Little or no unavoidable adverse impacts.
	Routine/Maintenance activities at the site and along the transmission line may result in small episodic spills of petroleum or chemicals.	Prepare an SPCC plan to minimize or avoid contamination from spills. Comply with the SPCC plan when working on transmission lines.	Little or no unavoidable adverse impacts.

TABLE 10.1-2 (Sheet 3 of 9)
OPERATIONAL-RELATED UNAVOIDABLE ADVERSE ENVIRONMENTAL IMPACTS

Category	Adverse Impact	Mitigation Measures	Unavoidable Adverse Impacts
	Discharge of cooling water results in a thermal plume discharged to Guntersville Reservoir throughout the operational life of the BLN.	The differences between plume temperature and ambient water temperature is maintained within limits set in the NPDES permit. Cooling towers mitigate much of the heat that would otherwise be discharged to the reservoir.	Little or no unavoidable adverse impacts.
	The maximum surface water consumptive use is less than 1 percent of 7Q10. This withdrawal represents a commitment of water resources that continues throughout the operational life of this project.	No additional mitigation is deemed necessary.	Water lost to evaporation represents consumption of water that is not be available for other uses.
	Summaries of the predicted plume analysis data are provided in Table 5.3-2. For the maximum delta-T conditions, low river temperature 7Q10 downstream flow, the surface area within a 5°F temperature isotherm is estimated to be 25,213 sq. ft. These isotherms extend approximately 36 ft. from the discharge diffuser. The maximum width of the 5°F isotherm is approximately 379 ft., or about 23 percent of the width of the river, which is approximately 1640 ft. at normal reservoir pool condition. Therefore, the formation of a thermal barrier is precluded.	All plumes are well below regulatory and permit limits. No additional mitigation measures are deemed necessary.	Little or no unavoidable adverse impacts.

TABLE 10.1-2 (Sheet 4 of 9)
OPERATIONAL-RELATED UNAVOIDABLE ADVERSE ENVIRONMENTAL IMPACTS

Category	Adverse Impact	Mitigation Measures	Unavoidable Adverse Impacts
Aquatic Ecology	Routine maintenance activities may result in episodic chemical or petroleum spills near water that could affect aquatic life.	Prepare SPCC Plan to avoid/ minimize contamination from spills.	Little or no unavoidable adverse impacts.
	Routine plant operations result in discharge of small amounts of chemicals to Guntersville Reservoir that could affect aquatic life over the operational life of this project.	The NPDES permit limits are set to ensure that discharges do not affect aquatic populations or water quality.	Little or no unavoidable adverse impacts.
	The effects of entrainment or impingement result in a loss of fish and aquatic species.	The BLN uses a closed-loop cooling system which substantially reduces the loss of fish and aquatic species.	There is a small impact to aquatic species. Because a closed-loop cooling system is used, the impacts of entrainment or impingement on aquatic species are relatively innocuous.
Terrestrial Ecology	Salt drift is distributed in a region around each tower.	The amount of salt deposition is less than that expected to cause leaf or other biota damage. No mitigation is deemed necessary.	Little or no unavoidable adverse impacts.
	Birds may periodically collide with the cooling towers or the existing transmission line.	Bird collisions with existing towers and transmission lines do not represent a major problem. No mitigation is deemed necessary.	Little or no unavoidable adverse impacts.

TABLE 10.1-2 (Sheet 5 of 9)
OPERATIONAL-RELATED UNAVOIDABLE ADVERSE ENVIRONMENTAL IMPACTS

Category	Adverse Impact	Mitigation Measures	Unavoidable Adverse Impacts
	Periodic loud noises, such as maintenance at the site or along the existing transmission line, impacts nearby wildlife over the operational life of this project.	The potential problem is expected to be relatively minor and no mitigation measure are deemed necessary.	Little or no unavoidable adverse impacts.
Socioeconomics	Operation of the BLN is projected to increase the population in the region by approximately 1000 workers and their families, which increases traffic, school crowding, and puts an additional burden on community infrastructure and services. This impact is short-term and is expected to dissipate over time.	The increased tax revenues from construction supports upgrades to infrastructure and services. Housing availability is also expected to increase over time to meet any additional demand. No additional mitigation is deemed necessary.	Little or no unavoidable adverse impacts.
	Episodic loud noises from operation of the BLN, and routine maintenance on the corridors may impact nearby workers and residents over the course of this project.	Noise levels are not normally substantially above background at the site boundary. Protective equipment is provided to employees. Incidents are handled on a case-by-case basis. The public could be notified in advance of planned activities. No additional mitigation is deemed necessary.	Little or no unavoidable adverse impacts.

TABLE 10.1-2 (Sheet 6 of 9)
OPERATIONAL-RELATED UNAVOIDABLE ADVERSE ENVIRONMENTAL IMPACTS

Category	Adverse Impact	Mitigation Measures	Unavoidable Adverse Impacts
	The transmission line has the potential to produce electric shock to people working near the line or from fallen lines. This risk runs over the operational course of this project.	Construction of the transmission line is in accordance with applicable regulations and codes to minimize the risk of electric shock. Post signs or fences warning people of potential danger.	Little or no unavoidable adverse impacts.
	Operation of the BLN increases traffic on local roads during shift change. Outages at the BLN increase traffic even further.	Staggering the outage shifts to reduce plant-associated traffic on local roads may help mitigate traffic congestion. Programs can also be made to encourage use of mass transit and car pooling.	Little or no unavoidable adverse impacts.
	Air emissions from diesel generators and equipment, and vehicles have a small impact on workers and local residents over the operational life of this project.	Emissions are within limits established in permits. Maintain equipment that produce emissions certificates of operation. No additional mitigation is deemed necessary.	Little or no unavoidable adverse impacts.

TABLE 10.1-2 (Sheet 7 of 9)
OPERATIONAL-RELATED UNAVOIDABLE ADVERSE ENVIRONMENTAL IMPACTS

Category	Adverse Impact	Mitigation Measures	Unavoidable Adverse Impacts
	Plant operations and maintenance on the transmission corridor could result in employee accidents over the operational course of this project.	An employee training and safety program aid in reducing the risk of job related accidents. Workers are trained in first aid. Emergency medical supplies are stored on site. Work plans and procedures further reduce the risk of accidents.	Even with the best training and procedures, there is still the risk of job related accidents over the course of this project. However, the mitigation measures are expected to sharply reduce the risk of industrial accidents.
Radiological	Small radiological doses to workers and members of the public from releases to air and surface water occur over the operational life of this project.	Workers are trained in radiological procedures, work plans address safety measures, and a safety program includes radiological safety procedures. Releases are well below regulatory limits. Effluents are treated according to applicable regulatory standards before being discharged into Guntersville Reservoir. No additional mitigation is deemed necessary.	While there is some long-term dose to employees, the mitigation measures adherence to applicable regulatory standards reduce this exposure to a negligible impact.

TABLE 10.1-2 (Sheet 8 of 9)
OPERATIONAL-RELATED UNAVOIDABLE ADVERSE ENVIRONMENTAL IMPACTS

Category	Adverse Impact	Mitigation Measures	Unavoidable Adverse Impacts
	A low-level incidental external radioactive dose to plant operational workers occur over the operational life of this project.	Incidental external radioactive dose is reduced through careful monitoring, employee safety training programs, and strict adherence to work procedures and applicable regulations.	While there is some long-term dose to employees, the mitigation measures adherence to applicable regulatory standards 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 can be 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.	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. The mitigation measures substantially reduce potential impacts.
	A low-level radioactive and nonradioactive waste is stored, treated, and disposed. This impact 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.	There are some long-term I&I commitment of land that lasts for hundreds or thousands of years. However, the mitigation measures substantially reduce potential impacts.

TABLE 10.1-2 (Sheet 9 of 9)
OPERATIONAL-RELATED UNAVOIDABLE ADVERSE ENVIRONMENTAL IMPACTS

Category	Adverse Impact	Mitigation Measures	Unavoidable Adverse Impacts
	Permanent consumption of a finite supply of Uranium 235.	There are no practical mitigation measures (beyond the no action alternative) within the scope of this proposal for reducing the consumption of uranium.	There is a long-term commitment of uranium. However, the amount consumed by the operation of the BLN represents a very small amount of the world supply.
Atmospheric and Meteorological	Diesel generators and equipment contribute to air emissions over the course of this project.	Comply with permit limits and regulations for installing and operating air emission sources.	Little or no unavoidable adverse impacts.
	Cooling towers emit a plume of water vapor that results in a limited obstructed view of the sky and causes a shadowing effect on the ground that has a small effect on vegetation.	Comply with permit limits and regulations for installing and operating air emission sources. The plumes present little environmental effect on humans or the biota. No mitigation measures are deemed necessary.	Little or no unavoidable adverse impacts.
	Minor radioactive emissions from the two units.	Comply with permit limits and regulations for installing and operating air emission sources. Monitor air emissions.	Little or no unavoidable adverse impacts.

10.2 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

This section describes anticipated Irreversible and Irretrievable (I&I) commitments of environmental resources that are used in the construction and operation of the Bellefonte Nuclear Plant, Units 3 and 4 (BLN). The I&I commitments are summarized in Table 10.2-1.

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.

10.2.1 IRREVERSIBLE ENVIRONMENTAL COMMITMENTS

Irreversible environmental commitments resulting from the BLN can include:

- Land use.
- Aquatic and terrestrial biota.
- Degradation of air and water resources.
- Land disposal of equipment and materials contaminated by hazardous and low-level radioactive waste.
- Commitment of underground geological resources for disposal of high-level radioactive waste and spent fuel.
- Destruction of geological resources during uranium mining.

10.2.1.1 Land Use

As described in Chapter 4 and 5, during the construction and operation of the BLN site, approximately 200 additional acres of the 1600 ac. site is disturbed during construction of the reactor and land is also committed for continued use for the existing transmission corridor; this land is largely unavailable for uses other than for which it is being used to support the construction and operation of the nuclear units. However, once the units cease operations, and the BLN is decontaminated and decommissioned in accordance with U.S. Nuclear Regulatory Commission (NRC) requirements, the land that supports the facilities 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.

10.2.1.2 Aquatic and Terrestrial Biota

Construction disrupts or destroys some flora and fauna on and near the BLN. However, no significant effect to species or habitats is expected to occur. After construction is complete, some of the disturbed areas that are no longer needed for the project are re-vegetated. Some flora and fauna may recover in areas that are no longer affected by construction or plant operations.

10.2.1.3 Degradation of Water and Air

The release of treated hazardous and radioactive effluents represents a small adverse degradation in water quality. Some hazardous constituents breakdown quickly while others may remain in the biosphere for an extended period of time. The persistence of radionuclides depends on the half-life and how long the radionuclides remain suspended in the air.

Similarly, the release of hazardous and radioactive air emissions results in a small adverse degradation in air quality. Some hazardous constituents breakdown or filter out of the air quickly while others may remain in the atmosphere for an extended period of time. The persistence of radionuclides in the atmosphere depends on the half-life and how long the radionuclides remain suspended in the air.

Releases of hazardous and radioactive emissions/effluents from the BLN are made in accordance with duly-issued permits. The releases are in compliance with applicable regulatory standards and are not expected to significantly affect air or water resources. Hazardous and radioactive air and water constituents are monitored.

10.2.1.4 Socioeconomic Changes

The project results in both short-term and long-term changes in the population, the nature and character of the local community, and the local socioeconomic structure. The project also spurs indirect or secondary growth and resulting changes in the character of the socioeconomic structure. Some of the impacts on infrastructure and services are mitigated through property and worker taxes and payments made in lieu of taxes, while other changes such as noise, traffic congestion, and crime rates may only be partially mitigated.

10.2.1.5 Disposal of Hazardous and Radioactively Contaminated Waste

The BLN generates radioactive, hazardous, and nonhazardous waste that requires 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.

10.2.1.6 Uranium Fuel Cycle

Table 5.7-2 presents environmental data on the Uranium Fuel Cycle. This data describes the contribution of the environmental effects related to uranium fuel cycle activities associated with operating a nuclear power reactor. Specifically, this data describes the contribution of environmental effects associated with uranium mining and milling, the production of uranium hexafluoride, isotopic enrichment, fuel fabrication, reprocessing of irradiated fuel, transportation of radioactive materials, and management of low-level and high-level wastes.

10.2.2 IRRETRIEVABLE ENVIRONMENTAL COMMITMENTS

Irretrievable environmental commitments resulting from the BLN include:

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

10.2.2.1 Construction and Irradiated Materials

Metals, concrete, and other materials used in the construction of the BLN 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.

Table 10.2-2 provides estimates of some common irretrievable commitments of materials used in new reactor construction. The estimate provided in the second column is based on a single AP1000 unit, while the estimate provided in the third column is based on two AP1000 units located at the BLN site. 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 (Reference 1).

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.

10.2.2.2 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.

10.2.2.3 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.

10.2.2.4 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 (Reference 2). 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 exceed 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 (Reference 3).

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 (Reference 4). 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.

10.2.3 REFERENCES

1. U.S. Department of Energy, *Study of Construction Technologies and Schedules, OHM Staffing and Cost, Decommissioning Costs and Funding Requirements for Advanced Reactor Designs*, Vol. 2 – MR.-2610, prepared by Dominion Energy Inc., Bechtel Power Corporation, TLG, Inc., and MPR Associates under Contract DE-AT01-020NE23476, 2004, Website, http://www.ne.doe.gov/np2010/reports/1DominionStudy52704.pdf. accessed June 5, 2007.

2. Uranium Information Center, "Nuclear Power in the World Today", Nuclear Issues Briefing Paper 7, January 2007, Website, http://www.uic.com.au/nip07.htm, accessed June 5, 2007.

3. Energy Information Administration, *Uranium Industry Annual 1996*, DOE/EIA-0478(96), U.S. Department of Energy, Washington, D.C., Website, http://tonto.eia.doe.gov/FTPROOT/nuclear/047896.pdf, accessed June 5, 2007.

4. World Nuclear Association, Supply of Uranium, Website, http://www.world-nuclear.org/info/inf75.html, accessed July 12, 2007.

TABLE 10.2-1 (Sheet 1 of 3)
SUMMARY OF IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF ENVIRONMENTAL RESOURCES

Environmental and Material Resource Issues	Irreversible	Irretrievable
Land Use	During the operation of the BLN, the 1600 ac. reactor site and continued commitment of land used for the transmission corridor is unavailable for uses other than that which supports the BLN. However, this is a temporary commitment and land, which can be reclaimed following decommissioning.	
Aquatic and Terrestrial Biota	Construction temporarily or permanently alters some habitat, and flora and fauna on and near the BLN site. Some areas affected by construction is re-vegetated and allowed to enter secondary successional stages during the operational phase of this project.	
Degradation of Air and Water	Release of hazardous and radioactive air emissions and water effluents result in a small adverse degradation in air and water quality.	
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 structure.	

TABLE 10.2-1 (Sheet 2 of 3)
SUMMARY OF IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF ENVIRONMENTAL RESOURCES

Environmental and Material Resource Issues	Irreversible	Irretrievable
Disposal of Hazardous and Radioactively Contaminated Waste	The generation of radioactive, hazardous, and nonhazardous waste that needs to be disposed. Land committed to the disposal of radioactive and nonradioactive wastes is an irreversible impact because it is committed to that use, and is largely unavailable for other purposes.	
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 resource unusable for thousands or tens of thousands or years.	
Destruction of Geological Resources During Uranium Mining and Fuel Cycle	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		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.

TABLE 10.2-1 (Sheet 3 of 3)
SUMMARY OF IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF ENVIRONMENTAL RESOURCES

Environmental and Material Resource Issues	Irreversible	Irretrievable
Water Consumption		Relatively small amounts of potable water are used during construction and operation of BLN. 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		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		The BLN reactors contribute a relatively small increase in the depletion of uranium that is used to fuel the reactors.

TABLE 10.2-2
ESTIMATED QUANTITIES OF IRRETRIEVABLY COMMITTED MATERIALS USED IN THE CONSTRUCTION OF TWO AP1000 UNITS[(a)]

Material	Quantities Used for One AP1000 Unit	Quantities Used for Two AP1000 Units
Concrete	77,200 cu. yds.	154,400 cu. yds.
Rebar	10,000 T.	20,000 T.
Structural Steel	6,400 T.	12,800 T.
Power Cable	810,000 linear ft.	1,620,000 linear ft.
Small Bore Piping (<3”)	230,000 linear ft.	460,000 linear ft.
Large Bore Piping	68,000 linear ft.	136,000 linear ft.

a) The quantities provided in this table are estimated values based on the referenced plant design. However, this information could change if the plant design is modified.

10.3 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" (Reference 1). Consistent with this NEPA requirement, this section focuses on describing the relationship between the proposed action's short-term use of environmental resources versus the maintenance and enhancement of long-term environmental productivity.

Adverse impacts of construction and operation are discussed in Section 10.1 and the irreversible and irretrievable commitment of resources are discussed in Section 10.2. 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 10.3-1 summarizes the proposed action's short-term uses and benefits versus the long-term consequences on environmental productivity.

For the purposes of this section, the term "short term" represents the period from start of construction to end of plant life, including prompt decommissioning. In contrast, the term "long-term" represents the period extending beyond the end of plant life, including the period up to and beyond that required for delayed plant decommissioning.

10.3.1 SHORT-TERM USES AND BENEFITS

There are a number of short-term benefits that are derived from construction and operation of the Bellefonte Nuclear Plant, Units 3 and 4 (BLN). These benefits are summarized below and described in detail in Section 10.4.

10.3.1.1 Electric Generation

The principle short-term benefit of BLN is the generation of electricity to meet the growing demand for electricity in TVA's power service area (See Chapter 8 and Section 10.4).

10.3.1.2 Fuel Diversity

Energy diversity is 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 BLN also advances the Congressional goal of obtaining a diversified mix of electrical generating sources. (Section 10.4)

10.3.1.3 Avoidance of Air Pollution and Greenhouse Gas Emissions

Natural gas, and in particular, coal fired electrical generation plants produce significant 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 and global warming. Beyond steam and water vapor, modern nuclear reactors produce virtually no air emissions, and only very minor levels of radioactive emissions. The generation of significant air emissions is avoided by forgoing construction of a comparably sized coal or gas fired alternative, and instead constructing BLN. (Section 10.4)

10.3.1.4 Land Use

The construction and operation of the BLN results in the continued commitment of land use at the existing site, as well as for the transmission corridor. 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.

10.3.1.5 Aquatic and Terrestrial Biota

Construction and operation of BLN 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.

10.3.1.6 Socioeconomic Changes and Growth

Construction of the BLN stimulates 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 congestion. 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 significant 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 BLN has been decommissioned. Socioeconomic changes brought about by the operation of the BLN 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.

10.3.2 MAINTENANCE AND ENHANCEMENT OF LONG-TERM ENVIRONMENTAL PRODUCTIVITY

As stated earlier, the assessment of long-term productivity impacts does not include the short-term effects related to construction and operation of the BLN. Potential long-term effects on the productivity of the human environment are described below.

10.3.2.1 Exposure to Hazardous and Radioactive Materials and Waste

Workers are exposed to low doses of radiation and trace amounts of hazardous materials and waste. Workers are carefully monitored to ensure that radioactive exposure is within regulatory limits. Construction worker exposure to radiation is discussed in Section 4.5. Local nonworkers also receive a very small incremental dose of radiation. Radiological impacts related to operation of BLN are described in Section 5.4. The doses are in compliance with applicable regulatory standards do not significantly affect humans, biota, or air or water resources. Section 6.2 describes the BLN radiological monitoring program.

The persistence of radionuclides depends on the half life of the radionuclides. Radioactive exposures are in accordance with duly issued permits. Section 3.5 describes the radioactive waste management system.

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

10.3.2.2 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 (see Chapter 7). 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. Nevertheless, if an accident did occur, the long-term environmental impacts could be severe.

10.3.2.3 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 (Reference 2). 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 by tenfold (Reference 3). The introduction of fast breeder reactors and other technologies could further reduce the gap between supply and demand.

10.3.2.4 Offset Usage in 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 scarce resource.

10.3.2.5 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 BLN (Section 4.2). A relatively modest quantity of cooling water is also consumed as loss through evaporation and drift (Subsection 3.3.1).

10.3.2.6 Impacts Reviewed but Dismissed from this Section

Some of the adverse environmental impacts may remain after practical measures to avoid or mitigate them have been taken. As described earlier, the BLN site was originally designated for construction of nuclear reactors, therefore operation of the BLN represents a continuation of the originally planned land use of the site. After the reactors are shutdown, and the BLN is decommissioned to NRC standards, this land is available for other industrial or non-industrial uses. Therefore, land use impacts are not expected to constitute a long-term productivity issue. Some limited long-term impacts also result from salt deposition from cooling tower drift. However, the residual salt in the soil is not expected to have significant long-term effects on biological productivity.

Similarly, impacts such as air emission, water effluents, and other impacts described in Chapters 4 and 5, but not specifically mentioned in this section are insignificant and therefore not described in Table 10.3-1.

10.3.3 SUMMARY OF RELATIONSHIP BETWEEN SHORT-TERM USES AND LONG-TERM PRODUCTIVITY

The short-term beneficial impacts of usage outweigh the adverse impacts on 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 avoids the depletion of fossil fuels.

There are two key long-term adverse impacts on productivity. 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. Both of these environmental liabilities are governed by the half-lives of the respective radioisotopes.

Section 5.7 describes effects associated with the uranium fuel cycle. 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.

Table 10.3-1 compares the proposed action’s principal short-term benefits of usage versus the long-term impacts on productivity. Key environmental and socioeconomic issues are listed along the vertical axis of the table. The relationship between short-term benefits, and the maintenance and enhancement of long-term productivity are annotated in the second and third columns.

10.3.4 REFERENCES

1. The National Environmental Policy Act of 1969, 42 USC 4321 et seq.

2. Uranium Information Center, “Nuclear Power in the World Today,” Nuclear Issues Briefing Paper 7, September 2006, Website, http://www.uic.com.au/nip07.htm, accessed June 5, 2007.

3. World Nuclear Association, Supply of Uranium, Website, www.worldnuclear.org/info/printable_information_papers/inf75print.htm, accessed June 11, 2007.

TABLE 10.3-1 (Sheet 1 of 3)
SUMMARY OF THE PROPOSED ACTION'S PRINCIPAL SHORT-TERM BENEFITS VERSUS THE LONG-TERM IMPACTS ON PRODUCTIVITY

	Short-Term Uses and Benefits	Relationship to maintenance and enhancement of Long-Term Environmental Productivity
Land Use	The construction and operation of the BLN results in the continued commitment of land use at the existing site. In the short term, the project results in some potential loss in agricultural productivity, or natural habitats and woodlands.	Construction and operation of the BLN do not necessarily represent a long-term loss as the land could be released for other uses or returned to its natural state after the reactors are decommissioned.
Terrestrial and Aquatic Ecology	Construction and operation of BLN disrupts or destroys some flora and fauna on and near the BLN, and along the transmission corridor. However, 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.	The BLN does not result in any 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	The uranium provides a short-term supply of relatively clean energy.	Over the long term, the spent fuel must be managed as a High-Level Radioactive Waste, and either reprocessed or isolated from the biosphere for thousands or tens of thousands of years. This represents a long-term commitment of the local disposal area and the underground geological repository.

TABLE 10.3-1 (Sheet 2 of 3)
SUMMARY OF THE PROPOSED ACTION'S PRINCIPAL SHORT-TERM BENEFITS VERSUS THE LONG-TERM IMPACTS ON PRODUCTIVITY

	Short-Term Uses and Benefits	Relationship to maintenance and enhancement of Long-Term Environmental Productivity
Other Radioactive Waste	The radioactively contaminated reactor vessel and equipment are required for the short term production of nuclear energy.	Over the long term, the contaminated waste must be managed and isolation from the biosphere for hundreds or thousands of years.
Potential for Accident	Over the short term, the 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 LARGE.
Depletion of Uranium	As a reactor fuel, the uranium provides a short-term supply of relatively clean energy.	The construction and operation of the BLN contributes to the long-term cumulative depletion of the global uranium supply.
Offset Usage in Finite Fossil Fuel Supplies	During its operational life, BLN avoids the consumption of fossil fuels.	Avoids the cumulative long-term depletion of global fossil fuel supplies.

TABLE 10.3-1 (Sheet 3 of 3)
SUMMARY OF THE PROPOSED ACTION'S PRINCIPAL SHORT-TERM BENEFITS VERSUS THE LONG-TERM IMPACTS ON PRODUCTIVITY

	Short-Term Uses and Benefits	Relationship to maintenance and enhancement of Long-Term Environmental Productivity
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 reactors provide far more energy than is consumed in their construction.
Air Pollution	Operation of BLN avoids air pollutants that would likely be produced by fossil fuel plants if the two reactors were not constructed.	Operation of the two units results in a long-term cumulative avoidance of greenhouse emissions that would likely be produced by fossil fuel plants if the two units 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.

10.4 BENEFIT-COST BALANCE

This section provides a benefit-cost analysis of the two nuclear generating units at the Bellefonte Nuclear Plant, Units 3 and 4 (BLN).

10.4.1 BENEFITS

The benefits associated with construction and operation of BLN are described in this section. Chapter 9 provides an analysis comparing the BLN project, to projects that satisfies the electrical power needs using alternative energy technologies, alternative system designs and alternative sites. Section 9.3 discusses the site selection process and compares the selected BLN site with four alternative sites. The benefits of constructing and operating BLN are positive and no other measures have been identified as appropriate and practical to mitigate predicted environmental impacts of the BLN project. The beneficial impacts of avoided air pollutants are listed in Table 10.4-1. Table 10.4-2 includes a summary list of the benefits of the proposed project.

10.4.1.1 Monetary Benefits of Construction and Operation of BLN

The following sections consider the monetary benefits of constructing and operating BLN.

10.4.1.1.1 Tax and In-Lieu-of-Tax Payments

TVA makes in-lieu-of-tax payments on BLN over the duration of the two units' 40-year operating licenses. Unless specifically noted at the city or county level, the tax structure for all of Alabama is found in Title 40 of the Code of Alabama 1975 and its revisions. Jackson County is the tax district that is assumed to be most directly affected by construction and operation of BLN. Tax information for the site region is discussed in Subsection 2.5.2. Taxes related to construction of BLN are associated with the wages and salaries of the construction workers and are described in Subsection 4.4.2.2.1. Subsection 5.8.2.2.1 discusses regional and annual taxes related to operation of BLN.

The Tennessee Valley Authority (TVA) makes payments in lieu of taxation to states and local governments in which its power operations are carried on and in which it has acquired properties previously subject to state and local taxation in accordance with Section 13 of the TVA Act, 16 U.S.C. § 831l. Under Section 13, TVA pays 5 percent of its gross power revenues (less sales to government agencies) to such states and counties (see Subsections 2.5.2.3 and 5.8.2.2.1).

TVA's tax equivalent payments to the State of Alabama would be based 50 percent on the ratio of power sales within the state to TVA's total power sales during the previous year, and 50 percent on the ratio of the book value of the power property held by TVA in Alabama, including the BLN property, at the end of the preceding fiscal year, to the total book value of all property held by TVA on that date. The ratios for percent of power revenue and percent of book value are averaged, and then multiplied by TVA's total in-lieu-of-tax payments to determine the amount of the TVA's payment to the state.

The State of Alabama retains 17 percent out of its TVA payment for general fund purposes. The State of Alabama then distributes 78 percent of the TVA tax equivalent payments to the 16 TVA-served counties. These counties may share a portion of their payments with municipalities. Some of these payments may be used in support of school systems, hospitals, and other public services within their boundaries. The remainder of the tax equivalent payments is either retained for the State's general fund or distributed to counties not served by TVA. During FY 2007, the state of Alabama allocation was $112.1 million. The state paid $87.4 million to the TVA-served counties. Of this, Jackson County received $10.4 million.

Personal annual taxable income in excess of $6000 is taxed at a rate of 5 percent (Reference 9). During peak construction, there are an estimated 3250 construction workers on-site (see Subsection 4.4.2.1). U.S. Department of Labor reports that moderate-level construction workers in the Huntsville, Alabama, area were paid an average of $13.77 an hour in 2004 (Reference 10). At this wage and tax rate, site construction workers would add an estimated $3.7 million to the annual state tax base. During this same peak construction period, approximately 650 operations workers (security personnel are included among these operations workers) are also expected to begin working at the site. U.S. Department of Labor reports that engineering technicians in the Huntsville, Alabama, area were paid $24.37 an hour in 2004 (Reference 11). At this wage and the above tax rate, operations workers would add an estimated $1.4 million to the annual state tax base, for a total of $5.1 million added during peak construction. Based on information discussed in Subsection 4.4.2.2.1, the average person-year salary is expected to be $65,000. For the construction cycle of both units, a total of 10,631 person-years are expected, resulting in a total economic input as a result of wages of $691 million. Based on the RIMS II direct-effect economic multiplier for construction within the region, the total economic impact related to wages is expected to be approximately $994.7 million (Subsection 4.4.2.2.1).

Operation of BLN is expected to require approximately 1000 workers, which includes approximately 650 operations workers who began working during the construction period (see Subsection 5.8.2.2). Based on the above wage ($24.37 per hour) and tax rate (5 percent), operations workers would add an estimated $2.2 million to the annual state tax base.

The impacts of the plant operation on tax revenue in Jackson County is MODERATE and beneficial due to the increased revenues from the TVA property in the county. Most people generally consider the large in-lieu-of tax payments obtained from BLN assets to be a benefit to the taxing entity because they support the development of infrastructure and services that support the community and promote further economic development – in the case of BLN, Jackson County.

10.4.1.1.2 Local and State Economy

The in-migration of construction workers is likely to create new indirect service jobs in the area. Subsection 4.4.2.2 discusses the economic benefits related to construction of BLN. As stated there, every direct construction job at BLN provides 0.422 indirect jobs added to the regional economy. Each additional operations job results in an increase of 0.759 new jobs in the 50-mi. region (Subsection 5.8.2.2). During peak construction, BLN would employ approximately 3900 workers. These 3250 new construction and 650 operations workers would translate to approximately 1870 additional indirect jobs within the region. At the hourly construction and operations workers wages listed above, BLN would pay approximately $126 million annually for construction and operations workers during peak construction. At the average per capita income of $23,200 for Jackson County (Subsection 2.5.2.1), indirect jobs created during peak construction would generate approximately another $43 million annually for the regional economy. In addition to these benefits, every construction dollar spent is multiplied by 0.443 dollars in the regional economy. Estimated regional purchases total about $41 million throughout the construction period (Subsection 4.4.2.2).

The economic benefits of operation of BLN are discussed in Subsection 5.8.2.2. As stated there, each additional operations job results in an increase of 0.759 new jobs in the 50-mi. region. The employment of approximately 1000 operations workers (including the approximately 650 workers who begin working during the construction period) is expected to result in the addition of 760 indirect jobs in the region. At the hourly engineering technician wage listed above, operations workers would earn about $50,700 annually. This is considerably higher than the average per capita income of $23,200 for Jackson County (Subsection 2.5.2.1). BLN would pay approximately $51 million annually for the 1000 operations employees. At the average per capita income for Jackson County, the indirect jobs would add approximately another $18 million to the annual economy. In addition to these benefits, every operational-related dollar spent is multiplied by 0.331 dollars in the regional economy (Subsection 5.8.2.2).

Operation of the two units is likely to constitute a positive impact on the economy, as they provide new business and job opportunities for local residents. In addition, businesses and employees generate additional profits, wages, and salaries, upon which taxes are paid. The impact from plant operation employees in Jackson County is expected to have a MODERATE beneficial impact due to the higher concentration of operation employees within Jackson County and the coinciding benefits.

10.4.1.2 Non-Monetary Benefits

The following sections consider the non-monetary benefits of constructing and operating BLN.

10.4.1.2.1 Net Electrical Generating Benefits

Chapter 8 describes the need for power. As discussed in Chapter 8, there is a growing baseload demand and growing baseload supply shortfall on TVA's generation system. Each unit at BLN can generate approximately 1117 net megawatts electric (MWe) power (2234 MWe for the two units combined). Assuming an average capacity factor of 90 percent, the two units can produce a combined average annual electrical-energy generation of approximately 17,625,000 MWh. These units provide a benefit to the TVA by meeting the growing industrial, commercial, and residential baseload needs (see Section 8.4).

10.4.1.2.2 Fuel Diversity, Dampened Price Volatility, and Enhanced Reliability

Energy diversity is an element fundamental to the objective of achieving a reliable and affordable electric power supply system. Achieving a balanced mix of electric generation technologies is crucial to the objectives of lowering the risk of future fuel disruptions, price fluctuations, and adverse consequences that result from changes in regulatory practices (Reference 1). Recent history indicates that it is particularly risky to develop an over-reliance on any single energy source. In fact, a balanced energy portfolio has been the key to providing the U.S. with a growing supply of affordable electricity for the past 30 years (Reference 2).

Maintaining fuel diversity is a matter of maintaining a balance of fuel mixes. Relying heavily on gas is a matter of choosing a more limited resource over more abundant fuels. The high natural gas prices and the intense, recurring periods of price volatility experienced in recent years have been driven, at least in part, by demand for natural gas used in the electric generation sector. The large number of new gas-fired electric plants built in the U.S. during the last decade has bolstered electric sector demand for natural gas. Natural gas plants have accounted for more than 90 percent of all new electric generating capacity added over the past 5 years. Natural gas has many desirable characteristics and should be part of the fuel mix, but “over-reliance on any one fuel source leaves consumers vulnerable to price spikes and supply disruptions” (Reference 3).

The intense volatility in natural gas prices experienced over the last several years is likely to continue and leave the U.S. economy vulnerable. New nuclear plants provide forward price stability that is not available from generating plants fueled with natural gas. Although nuclear plants are capital-intensive to build, the operating costs are stable and dampen the volatility elsewhere in the electricity market (Reference 3).

Moreover, natural gas is a finite energy source that has uses that are not readily served by other fuel choices, such as many manufacturing processes. This assessment led the U.S. House of Representatives to prepare a majority staff report that includes the following findings (Reference 4):

- To enhance competitiveness and protect American jobs, natural gas must not be used for baseload electricity generation or for new generating capacity. Natural gas should be reserved for industries that use it as a feedstock or for primary energy – and cannot substitute for it by fuel-switching.

- Nuclear energy must become the primary generator of baseload electricity, thereby relieving the pressure on natural gas prices and dramatically improving atmospheric emissions.

Operation of BLN advances the Congressional goal of obtaining a diversified mix of electrical generating sources. BLN also furthers the stated goal of creating new nuclear baseload generating capacity.

10.4.1.2.3 Effects on Regional Productivity

Construction of BLN is anticipated to require a peak workforce of 3900 people (see Section 4.4), which creates about 1870 indirect jobs, for a total of about 5770 new permanent or temporary jobs within the region during the peak construction period. Temporary construction workers and their families increase rental and property demand, spending on goods and services, and sales taxes that most people consider to be a benefit to the local economy. Operation of the plant is anticipated to require approximately 1000 direct jobs (650 of whom begin working during the construction period) (see Section 5.8) with an additional 760 indirect jobs for a total of 1760 new jobs in the region (500 of these indirect jobs associated with operations workers were accounted for in discussions of peak construction above).

10.4.1.2.4 Air Pollution and Emissions Avoidance

Natural gas, and in particular, coal fired electrical generation plants produce significant air pollutant emissions (e.g., nitrogen oxides, sulfur dioxide, and carbon dioxide) and mercury that potentially adversely affect human health depending on the concentration. With respect to all industrial sources, power plants account for the following emissions in the U.S.:

- Sulfur dioxide: 64 percent
- Nitrogen oxides: 26 percent
- Mercury: 13 percent
- Carbon dioxide: 36 percent

Coal-fired plants generate the majority of industry's emissions (Reference 4). Given the low operating costs, the coal-fired alternative is the most likely option to be followed if BLN is not constructed.

Beyond steam and water vapor, modern nuclear reactors produce virtually no air emissions, and only very minor levels of radioactive emissions. Nuclear power generation, therefore, avoids local and regional air quality impacts.

Section 9.2 analyzes coal- and gas-fired alternatives to BLN. The beneficial impacts of avoided air pollutant air emissions from building BLN in lieu of equivalent fossil fuel plants are summarized in Table 10.4-1.

As indicated in Table 10.4-1, two new nuclear units the size of BLN, with their combined annual electricity generation, provide substantial emissions reductions over gas- and coal-powered generation alternatives. Assuming that BLN replaces construction of a comparably sized gas- or coal-fired plant(s), BLN represents a substantial benefit in terms of air emission avoidance. The generation of significant air emissions is avoided by forgoing construction of a comparably sized coal- or gas-fired alternative, and instead constructing BLN. Some of the benefits of reduced emissions related to use of nuclear power for electricity generation are offset by emissions related to the uranium fuel cycle (e.g., emissions from mining and processing the fuel). However, similar types of emissions are associated with mining and production of coal and, to some extent, drilling for natural gas.

10.4.1.2.5 Greenhouse and Global Warming Avoidance

Fossil fuel air emissions, particularly carbon dioxide, are believed by many in the scientific community to contribute to the green-house effect and, consequently, global climate change and global warming. Based on growing national and international concerns about global warming and climatic change, it is reasonable to expect the United States to eventually place limitations on CO_2 emissions from fossil-fuel electric generation plants.

If environmental policies, agreements, or regulations greatly restrict carbon emissions in the future, the cost of building and operating fossil-fired plants is likely to increase by 50 to 100 percent. Currently, nuclear power is the only available and proven generation technology that provides a viable alternative to fossil-fired plants for baseload electrical generation. In view of the time that it takes to gear up the nuclear industry, the prospect of needing nuclear power to displace fossil fuel power is an important reason for maintaining a nuclear energy capability (Reference 5).

10.4.1.2.6 Waste products

Nuclear plants have the benefit that they do not produce the non-radioactive hazardous effluents and wastes products that are associated with fossil fuel plants, particularly coal-fired plants.

10.4.1.3 Other Benefits

Section 10.3 describes the relationship between short-term uses and long-term productivity of the human environment.

If the two reactors are pursued as part of a comprehensive U.S. nuclear power program, over time, it would contribute to a significant reduction in dependency on foreign energy supplies, a reduction in the foreign trade deficit, and would offset the depletion of fossil fuel supplies. These benefits are summarized in Table 10.4-2.

10.4.2 COSTS

This section describes the internal and external costs associated with construction and operation of BLN. The term “internal” generally refers to the monetary costs associated with a project, while the term “external” refers to non-monetary environmental costs of constructing and operating the two reactors. These costs are outlined in Table 10.4-3 and summarized in Table 10.4-2.

Many of the cost attributes described in this section are detailed in Section 10.1 (Unavoidable Adverse Environmental Impacts), Section 10.2 (Irreversible and Irretrievable Commitments of Resources), and Section 10.3 (Relationship Between Short-term Uses and Long-term Productivity of the Human Environment).

Under this proposal, existing transmission corridors would be used to transmit electricity to the user; no new corridor would be constructed. However, some maintenance and upgrades would need to be made to the existing lines and equipment. The project may involve some modest upgrades to the transmission system and continued maintenance along the corridors. Consequently, the transmission corridors are not addressed in detail in this section as they involve relatively little cost in terms of either monetary cost or environmental degradation.

10.4.2.1 Internal Costs

This section describes the monetary costs of constructing and operating BLN. Internal costs include capital costs of the plant and transmission lines, and operating costs (staffing, maintenance, fuel) as well as decommissioning costs.

10.4.2.1.1 Construction

The following section describes projected internal monetary costs related to construction of BLN based upon published literature. There are many cost studies available in the literature with a wide range of cost estimates.

Due to the depth of their analyses and the fact that other studies tend to be based on them, the following four studies are among the most authoritative sources:

- Organization for Economic Co-operation and Development (OECD) study of projected electricity generating costs (Reference 6).
- Massachusetts Institute of Technology (MIT) study on the future of nuclear power (Reference 7).
- University of Chicago (UC) study on the economic future of nuclear power (Reference 5).
- Energy Information Administration (EIA) annual energy outlook (Reference 8).

“Overnight capital cost,” is a term commonly used in describing the monetary cost of constructing large capital projects such as a power plant. Capital costs are those incurred during construction when actual outlays for equipment, construction, and engineering (including construction of any new transmission lines) are expended. Overnight costs are exclusive of interest and include engineering, procurement and construction costs, owner’s costs, and contingencies.

In these studies, estimates of overnight capital costs for constructing a nuclear reactor range from $1100 per kilowatt to $2500 per kilowatt, with $1500 to $2000 per kilowatt (in 2002 dollars) being the most representative range. Many factors account for the range in values; the specific technology and assumptions about the number of like-units built, allocation of first-of-a-kind costs, site location and parity adjustments to allow comparison between countries, and allowances for contingencies are some examples.

These cost estimates are not based on nuclear plant construction experience in the U.S., which is more than 20 years old. Actual construction costs overseas have been less than the most recent domestic construction, suggesting that the industry has learned how to reduce costs. An assumption in these studies is that the overseas’ experience can be applied domestically (Reference 5).

The selected studies tend to support $2000 per kilowatt as a reasonable high-end overnight capital cost estimate. The $2500 value is based on construction in Japan. While no explanation is offered as to why this amount is so high, it is reasonable to suggest that contributing factors are the high cost of living in Japan (labor accounts for more than 20 percent of costs) and difficulties associated with construction on a relatively small island. These costs do not reflect the fully loaded costs that include various utility owners’ costs. Owner’s costs typically include site work and preparation, cooling water intake structures and cooling towers, import duties on components, insurance, spare parts, development costs, project management costs, owner’s engineering, state and local permitting, legal fees, and operations staffing and training. Also, with the recent trends in commodity and labor pricing, the $2000 per kilowatt value may not be conservative. For the purposes of analysis and to avoid understating the cost, a range of $2850 to $3200 per kilowatt is chosen. This estimated range more closely reflects full plant costs which include such additional items as interest during construction, escalation to the year in which the dollars are spent, contingencies, and additional investment in the transmission infrastructure. Together with a combined installed capacity of 2234 MWe, the construction cost for the two units ranges from $6.4 to $7.1 billion.

10.4.2.1.2 Operation

Operational costs for power plants is frequently expressed as the levelized cost of electricity, which is the price at the busbar needed to cover operating costs (including transmission line maintenance) and annualized capital costs. Overnight capital costs account for approximately one-third of the levelized cost, and interest costs on the overnight costs account for another 25 percent. The University of Chicago study states that, in 2003 dollars, the cost of nuclear fuel is listed as $4.35 per megawatt hour. Variable operation and maintenance costs are $2.10 per megawatt hour and nuclear waste fees are $1 per megawatt hour (Reference 5).

The four studies described above show a wide disparity in the range of operational cost estimates. Levelized cost estimates range from $36 to $83 per MWe hour (3.6 to 8.3 cents per kilowatt hour). Factors affecting this range include: choices for discount rate, construction duration, plant lifespan, capacity factor, cost of debt and equity and the split between debt and equity financing, depreciation time, tax rates, and premium for uncertainty. These estimates also include decommissioning but, due to the effect of discounting a cost that occurs as much as 40 years into the future, decommissioning costs have relatively little effect on the levelized cost.

The four previously cited studies also provide coal- and gas-fired generation costs for comparison with nuclear generation costs. One study (Reference 6) showed nuclear costs competitive with those of natural gas and coal. The other studies showed nuclear costs exceeding cost estimates for gas and coal. One study (Reference 7) indicated that new nuclear power is not economically competitive but suggested steps for the government to take to improve nuclear economic viability. Since the study was published, the government has undertaken these steps as follows:

- The U.S. government has endorsed nuclear energy as a viable carbon-free generation option.
- The Energy Policy Act of 2005 instituted a production tax credit for the first advanced reactors brought on line in the U.S.
- U.S. Department of Energy provides financial support to plants engaged in testing the NRC licensing processes for early site permits and combined operating licenses.

Consequently, the recent government steps and incentives have negated the MIT study's conclusion that new nuclear power is not economically competitive.

10.4.2.2 External Costs

This section describes the external (non-monetary) environmental and social costs of constructing and operating BLN. In Subsection 9.3.3, Alternative Site Review, at various decision points, TVA evaluated environmental effects of construction and operation of the proposed project at 28 alternative sites. Through an iterative approach of re-evaluation, TVA reduced the list of appropriate sites down to the current set of candidate sites. These include BLN and alternatives Hartsville Nuclear Plant, Phipps Bend Nuclear Plant, Yellow Creek Nuclear Plant, and Murphy Hill. Impacts of construction and operation of the BLN project are described in Table 10.4-4. This table also provides details regarding potential mitigation and the unavoidable adverse impacts after mitigation has been considered. For a detailed comparison of the BLN site with alternative sites, please refer to Section 9.3. Because no other measures have been identified as appropriate and practical to mitigate predicted environmental impacts at the proposed project, potential impacts and mitigation measures for alternative sites are not addressed in this table.

Consistent with Regulatory Guide 4.2, each site was evaluated using preliminary reconnaissance level information. Consequently, the costs of mitigation are not easily determined at this time. Many would be built into the project design (e.g., scheduling to ensure that construction is completed in the shortest possible time; using construction best management practices to limit erosion, fugitive dust, runoff, spills, and air emissions; providing first aid stations at the construction site, etc.). Others would rely on a communication plan of early/frequent communication between BLN and the affected communities to minimize cost and ensure effective management.

10.4.2.2.1 Site Land Use

Loss of habitat is one of the costs of constructing Units 3 and 4. Land use related to construction of BLN is described in Section 4.1. No new land has been purchased for the siting of the two units. About 400 ac. of the 1600-ac. BLN site have been affected by prior construction which was deferred by TVA in 1988. Although construction is planned for previously disturbed areas, an estimated additional 200 ac. of the 1600-ac. site are expected to be affected by construction of the new facility. Potential environmental impacts related to maintenance of the transmission corridors are considered to be SMALL. Most of the remaining land consists of various stages of grassland or forest combination.

10.4.2.2.2 Terrestrial and Aquatic Biology

Ecological effects related to plant and corridor construction and operation are discussed in Sections 4.3 and 5.3, respectively. Some cost associated with loss of wildlife and their habits during construction is anticipated. However, these losses are not expected to be large enough to affect long-term stability of wildlife populations.

The closed-loop cooling system, in addition to the makeup-water-intake structures in the new embayment, is designed to reduce the loss of aquatic biota as a result of entrapment and entrainment. Construction of the new embayment and intake structures of the embayment should result in only minor and temporary effects to aquatic biology.

10.4.2.2.3 Hydrological and Water Use

Sections 4.2 and 5.2, respectively, discuss hydrologic alterations for construction and operation. As discussed in these sections, there are some costs associated with providing water for various needs during construction and operation. Construction activities require between 240 and 420 gpm of water for concrete batch plant operation, dust suppression, and sanitary needs. A peak use of 872,000 gpd could be required at startup. The use of portable toilets for sanitary needs reduces the quantity of water used during construction. Construction workforce potable water use is estimated at 11,700 gpd. (See Section 4.2)

During plant operation, cooling water is taken from the Guntersville Reservoir, an impoundment of the Tennessee River. Some of this water is lost to evaporation and therefore represents a permanent consumptive loss. The rate of withdrawal of reservoir water to replace that lost by evaporation, drift, and blowdown is 24,304 gpm and 48,608 gpm for one- and two-unit operations, respectively (Section 5.2). However, as described in Section 5.2, this loss represents only a small fraction of available water, even at low flow conditions.

Relatively small levels of non-radioactive and/or radioactive effluents are introduced into Guntersville Reservoir. Water quality effects of chemical effluents discharged to the Guntersville Reservoir during BLN operations are discussed in Subsection 5.2.2.2.1 and are described as small. Subsection 5.4.3 states that radioactive releases in liquid effluents meet the standards for concentrations of released radioactive materials in water as specified in Column 2 of Table 2 of 10 CFR Part 20. Cooling water blowdown that discharges to the Guntersville Reservoir results in a thermal plume. Section 5.3 states that, based on CORMIX modeling, the thermal plume does not adversely impact the temperature of river water.

10.4.2.2.4 Hazardous Emissions, Effluents, and Wastes

Relatively small amounts of air emissions from diesel generators and vehicles are generated. Cooling tower drift deposits some salt on the surrounding vicinity, but the level is unlikely to result in any measurable impact on plants and vegetation. The cooling tower also produces an atmospheric vapor plume.

Small amounts of hazardous effluents are discharged into the Guntersville Reservoir. Relatively small amounts of hazardous wastes are generated that need to be managed and disposed of pursuant to the Resource Conservation and Recovery Act (RCRA). Section 3.6 and Subsection 2.3.3 discuss non-radioactive waste systems.

10.4.2.2.5 Radioactive Emissions, Effluents, and Wastes

Operation of the proposed plant would include minor radioactive air emissions to the atmosphere. Relatively small levels of radioactive effluents are generated and discharged into Guntersville Reservoir (an impoundment of the Tennessee River).

Low-level radioactive wastes are generated that need to be stored, treated, and disposed of in a licensed landfill. High-level radioactive spent fuel is generated that needs to be isolated (or possibly reprocessed) in a geological repository for thousands or tens of thousands of years. Section 3.5 discusses the radioactive waste management system.

10.4.2.2.6 Materials and Energy

Construction of the nuclear unit results in an irreversible and irretrievable commitment of materials and energy (see Section 10.2). Operation of the reactors contributes to the depletion of uranium.

10.4.2.2.7 Fuel Cycle

The fuel cycle for more conventional energy sources, fossil fuels in particular, results in numerous environmental impacts. For instance, off-shore oil and gas drilling, drilling in arctic regions, transporting oil by oil tankers, and construction of refineries and pipelines are often controversial projects that can significantly impact environmental resources. Similarly, coal mining can degrade or destroy geological resources and can pollute soil, lakes, streams, and underground aquifers. Finally, mining operations can alter the natural landscape resulting in an adverse aesthetic impact.

Indirect adverse environmental effects associated with the uranium-fuel cycle include impacts resulting from uranium mining and milling, production of uranium hexafluoride, isotopic enrichment, fuel fabrication, reprocessing of irradiated fuel, transportation of radioactive materials, energy consumption, and management of hazardous and low-level wastes and high-level wastes. Environmental impacts of the Uranium Fuel Cycle are summarized in Table 5.7-2.

Construction of the two nuclear reactors can help defer the need for exploiting additional fossil energy resources. Thus, the uranium-fuel cycle impacts can partly or completely offset fossil-fuel cycle impacts that would occur if the two units were not constructed.

10.4.2.2.8 Potential for Nuclear Accident

Operation of the two nuclear units poses a very low likelihood of a nuclear accident, whose impacts range from SMALL to LARGE. Section 7.1 discusses design basis accidents. The results of the BLN analysis contained in Table 7.1-12 demonstrates that all accident doses meet the site acceptance criteria of 10 CFR 50.34. Severe accidents are discussed in Section 7.2. The environmental impacts of a postulated severe accident at the BLN site could be severe, but due to the low likelihood of such an accident, the impacts are considered to be SMALL.

10.4.2.2.9 Socioeconomic Costs

Sections 4.4 and 5.8, respectively, describe socioeconomic costs associated with construction and operation of BLN. Additional infrastructure and services are required to meet the demands of people moving into the area to support construction and operation of Units 3 and 4. However, these costs should be largely offset by increased tax revenues and economic input from those individuals and their families.

10.4.3 SUMMARY

As discussed in Section 8.4, there is a growing baseload demand and growing baseload supply shortfall for the region of interest. Timing is important in providing additional power generating sources. Delays in planning and preparation for meeting projected baseload supply shortfalls can result in widespread demand increases as power is drawn from other areas. Without additional capacity, TVA would neither be able to maintain an adequate power reserve margin, nor meet its public service obligations to provide adequate power. Additionally, TVA's ability to provide power to other electric service providers within the Southeastern Electric Reliability Corporation would be jeopardized. Given the lead time necessary to license and build new plants, delays can be especially critical. Conversely, having too much available power also has its adverse consequences. Overnight capital costs related to construction of new power plants, and nuclear power plants in particular, can be substantial. Having too much power, too soon, can extend the time period before those capital costs can be recovered. BLN helps meet growing baseload shortfall in the region by supplying an average annual electrical-energy generation of about 17,625,000 MWh.

The BLN site was selected over 28 potential sites, including four other alternate sites given serious consideration (see Section 9.3.2.2). Two of the alternate brownfields sites (Phipps Bend and Hartsville) are in Tennessee and one (Yellow Creek) is in Mississippi. The Murphy Hill, greenfield site, is located in Alabama. In the evaluation of alternative sites, the BLN site rated higher than the Tennessee sites and lower than the Yellow Creek, Mississippi, site in cooling system suitability and higher than all alternatives in the land use, barge access cost, transmission access cost, along with the land use and ownership assessment categories. It was found to be less suitable than the alternative brownfield sites with reference to atmospheric dispersion and cooling tower drift. Overall, the BLN site received the highest suitability rating (Table 9.3-1). Alternate technologies were also examined (Section 9.2). These technologies included utilization of renewable resources, such as wind and solar power, to more conventional technologies, such as coal- and natural gas-fired plants. The BLN units were found preferable to each of these alternatives.

The two BLN nuclear units generate electricity that results in substantive avoidance in emissions with respect to comparably-sized coal- or gas-fired alternatives. As discussed in this section, the BLN units also have important strategic implications in terms of lessening dependence of the U.S. on energy supplies, and their potential interruption, as well as vulnerability to volatile price changes or political whims. While the additional direct and indirect creation of jobs places some temporary burden on local services and infrastructure, the annual taxes and revenue generated by the new workers contribute to the local economy and fuel future growth.

On balance, the benefits of the two units substantively outweigh the economic, environmental, and social costs. Both the benefits and costs are summarized in Table 10.4-2. In terms of benefits versus costs, none of the examined alternatives are obviously superior to the proposed action.

On the basis of the assessments summarized in this environmental statement that the construction and operation of BLN, with no modifications, are needed by the service area in the time frame projected, and the accrued benefits outweigh the economic, environmental, and social costs. Further, the overall benefit-cost balance does not substantively improve by the selection of an alternative site or by use of an alternative generating system.

10.4.4 REFERENCES

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TABLE 10.4-1
AVOIDED AIR POLLUTANT EMISSIONS[a]

Pollutant	TVA Estimate of an Equivalent Gas-Fired Plant[b] English Tons per year (Tpy)	TVA Estimate of an Equivalent Coal-Fired Plant[b] English Tons per year (Tpy)
SO_2	168	6140
NOx	1785	1923
CO	743	1923
PM-2.5	94	325
PM-10	N/A	75

a) Assumes use of current standard air pollution mitigation technology

b) Computations are based on two combined equivalent units (2234 MWe)

TABLE 10.4-2 (Sheet 1 of 4)
SUMMARY OF PRINCIPAL BENEFITS AND COSTS FOR CONSTRUCTING AND OPERATING BELLEFONTE NUCLEAR PLANT, UNITS 3 AND 4

Attribute	Benefits	Costs
Capital and Operating Costs	Obtain a relatively clean and abundant form of baseload electricity that is relatively cost-competitive with fossil fuels.	Overnight Capital Costs are estimated to range between $2850 to $3200 per KW for a combined construction cost (two units) of $6.4 and $7.1 billion.
		Operational (two units) costs are estimated to range between $36 to $83 per MWh.
Taxes and Revenue	TVA pays 5 percent of its gross proceeds from power sales to states and counties where its power operations are conducted.	N/A
	TVA would pay in-lieu-of tax payments to Jackson County.	N/A
Regional Productivity	At peak construction, 3250 construction workers create 1370 permanent or temporary indirect jobs for a total of 4620 new jobs within the region (Subsection 4.4.2.2). That results in a MODERATE to LARGE beneficial impact on the local economy.	N/A
	An influx of 1000 direct operational jobs results in an additional 760 indirect jobs for a total of 1760 new jobs in the region (Subsection 5.8.2.2), that results in a MODERATE beneficial impact on local economy.	N/A
Net Electrical Generation	Combined electrical generation: 17,625,000 MWh.	N/A

TABLE 10.4-2 (Sheet 2 of 4)
SUMMARY OF PRINCIPAL BENEFITS AND COSTS FOR CONSTRUCTING AND OPERATING BELLEFONTE NUCLEAR PLANT, UNITS 3 AND 4

Attribute	Benefits	Costs
Fuel Diversity	Increases fuel mix diversity that reduces potential energy disruptions and other adverse consequences.	N/A
Electrical Reliability	Enhances electrical reliability.	N/A
Price Volatility	Dampens potential for price volatility.	N/A
Air Pollution	Major beneficial impact in terms of avoidance of power plant air emissions.	Generates some minor amounts of hazardous air emissions during construction and some minor levels of radioactive/hazardous air emissions during operations.
Aesthetics	N/A	There is a steam plume that can obscure the viewshed.
Global Warming and Climate Change	Significant beneficial impact in terms of avoidance of greenhouse gases that may contribute to the greenhouse effect.	N/A
Dependence on Foreign Energy	Reduces dependence on foreign energy and vulnerability to energy disruptions.	N/A
Foreign Trade Deficit	Reduced foreign trade deficit.	N/A
Fossil Fuel Supplies	Offsets usage of finite fossil fuel supplies.	Consumes finite supplies of uranium.

TABLE 10.4-2 (Sheet 3 of 4)
SUMMARY OF PRINCIPAL BENEFITS AND COSTS FOR CONSTRUCTING AND OPERATING BELLEFONTE NUCLEAR PLANT, UNITS 3 AND 4

Attribute	Benefits	Costs
Land and Land use	Consumes about the same amount of land as a comparably gas-fired plant and less land than a comparable sized coal-fired plant.	BLN occupies approximately 200 ac. of the approximately 1600 ac. existing BLN site and approximately 1550 ac. for the transmission corridor.
Hydrological and Water Use	Produces a cleaner form of energy than either coal- or gas-fired plants. Consume about the same amount of water as a coal- or gas-fired plant, but results in much less hazardous effluent discharges.	Consumes some water. Produces a thermal plume and small amounts of hazardous/radioactive waste are discharged into the reservoir.
Terrestrial and Aquatic Species	Produces a relatively clean form of energy with about the same level of impacts on terrestrial and aquatic species as is expected from either a comparable coal- or gas-fired plant.	Some cost to wildlife due to mortality as a result of construction and operation of the two units.
Hazardous and Radioactive Waste	N/A	Relatively small quantities of hazardous and low-level and high-level radioactive waste are generated that requires storage, treatment, and disposal. Storage, treatment, and disposal of high-level radioactive spent nuclear fuel. Commitment of underground geological resources for disposal of radioactive spent fuel.
Materials, Energy and Uranium	Reduces the amount of finite fossil fuels used if a comparable comparable coal- or gas-fired plant were built instead.	Irreversible and irretrievable commitments of materials and energy, including depletion of uranium.

TABLE 10.4-2 (Sheet 4 of 4)
SUMMARY OF PRINCIPAL BENEFITS AND COSTS FOR CONSTRUCTING AND OPERATING BELLEFONTE NUCLEAR PLANT, UNITS 3 AND 4

Attribute	Benefits	Costs
Potential Nuclear Accident	N/A	The costs of potential nuclear accidents would be large. However, the probability of nuclear accidents is very small. Therefore, the overall probability-weighted costs of potential nuclear accidents are SMALL.
Socioeconomic	These costs are more than offset by increased tax revenues generated directly and indirectly by plant construction and operation. Increased tax revenue supports improvements to public infrastructure and social services. Increased taxes and revenue spurs future growth and development.	Construction of BLN places additional burdens on public infrastructure and social services. The growth and development changes the local character of surrounding community.

TABLE 10.4-3 (Sheet 1 of 2)
INTERNAL AND EXTERNAL COSTS OF
BELLEFONTE NUCLEAR PLANT, UNITS 3 AND 4

Cost Category	Cost
	Internal Costs
Overnight Capital Costs	$2850 to $3200 per KW
Construction costs (two units)	$6.4 to $7.1 billion
Levelized Cost of Operation (two units)	$36 to $83 per MWh
Operation and Maintenance costs	$2.10 per MWh
	External Costs
Land and Land Use	Bellefonte Nuclear Plant, Units 3 and 4 (BLN) occupy approximately 200 ac. of the approximately 1600-ac. existing BLN site and continued use of land for the existing transmission corridor. Impacts related to land use are expected to be SMALL. Destruction of geological resources during uranium mining and fuel cycle. The effects related to potential loss of geological resources during mining are expected to be SMALL.
Hydrological and Water Use	There are some costs associated with providing water for various needs during construction and operation. Cooling water is taken from the Tennessee River. Effects related to site water use are anticipated to be SMALL. Relatively small levels of hazardous and/or radioactive effluents introduced into Guntersville Reservoir. Effects of effluent discharges to Guntersville Reservoir are expected to be SMALL. Thermal plume resulting from cooling water blowdown discharged to the Guntersville Reservoir. The effect of consumption of cooling water is relatively SMALL.

TABLE 10.4-3 (Sheet 2 of 2)
INTERNAL AND EXTERNAL COSTS OF
BELLEFONTE NUCLEAR PLANT, UNITS 3 AND 4

Cost Category	Cost
Terrestrial and Aquatic Species	Some cost to wildlife due to mortality during construction operations is anticipated. However, these costs do not affect long term wildlife populations. Wildlife mortality, including aquatic biota, during operation is expected to be SMALL.
Radioactive Effluents and Emissions	Radioactive waste is generated. The two units produce radioactive air emissions. Relatively small levels of radioactive effluents are introduced into Guntersville Reservoir (an impoundment of the Tennessee River). Effects of these effluents on Guntersville Reservoir are SMALL.
Hazardous and Radioactive Waste	Storage, treatment, and disposal of high-level radioactive spent nuclear fuel. Impacts are SMALL. Commitment of underground geological resources for disposal of radioactive spent fuel results in SMALL impacts.
Air Emissions	Cooling tower drift that deposits some salt on the surrounding vicinity, but the level is unlikely to result in any measurable impact on plants and vegetation. Cooling tower atmospheric plume discharge. Impacts are SMALL.
Materials, Energy, and Uranium	Irreversible and irretrievable commitments of materials and energy, including depletion of uranium. Impacts related to BLN are SMALL.
Potential Nuclear Accident	The costs of potential nuclear accidents would be large. However, the probability of nuclear accidents is very small. Therefore, the overall probability-weighted costs of potential nuclear accidents are SMALL.
Socioeconomic	Construction of BLN may pose additional costs to public and social services in the area. However, these costs are believed to be SMALL and more than offset by increased tax revenues generated directly and indirectly by plant construction and operation.

TABLE 10.4-4 (Sheet 1 of 8)
UNAVOIDABLE ADVERSE ENVIRONMENTAL IMPACTS OF THE BLN PROJECT

Category	Adverse Impact, Mitigation Measure, Unavoidable Adverse Environmental Impacts
	Construction-Related
Land Use	Adverse Impact – Section 4.1 describes land required for construction (including that previously disturbed), with potential for erosion. Land would not be available for other uses. Mitigation Measure – Mitigation measures related to land use and construction are discussed in Section 4.1. Unavoidable Adverse Environmental Impacts – Land, as described in Section 4.1, is occupied on a long-term basis by nuclear plant and associated infrastructure. Impact to land use from construction is expected to be SMALL.
	Adverse Impact – Transmission corridor occupies land as described in Section 4.1 and Subsection 10.4.2. Mitigation Measure – Mitigation measures related to transmission corridor land use and construction are discussed in Section 4.1. Unavoidable Adverse Environmental Impacts – Land use on some land would change from woodland or agriculture to open scrub or grassland (see Section 4.1). Impact to land use from construction is expected to be SMALL to MODERATE.
	Adverse Impact – Potential to disturb buried historic, archaeological, or paleontological resources. Mitigation Measure – Section 4.1 discusses mitigation measures related to construction and pre-historic, historic, and traditional cultural properties. Unavoidable Adverse Environmental Impacts – Potential for destruction of unanticipated historic, cultural, or paleontological resources. (See Sections 2.5 and 4.1.) Impacts to land use from construction is expected to be SMALL.
	Adverse Impact – Construction debris would be disposed in on-site or off-site landfills. Minimization Measure – Mitigation measures related to land use and construction are discussed in Section 4.1.

TABLE 10.4-4 (Sheet 2 of 8)
UNAVOIDABLE ADVERSE ENVIRONMENTAL IMPACTS OF THE BLN PROJECT

Category	Adverse Impact, Mitigation Measure, Unavoidable Adverse Environmental Impacts
	Unavoidable Adverse Environmental Impacts – Some land would be dedicated to disposal of construction debris and not available for other uses. Impact to land use from construction is expected to be SMALL to MODERATE.
Hydrological and Water Use	Adverse Impact – Construction has potential to erode sediments into water resources. Mitigation Measure – Mitigation measures related to construction and hydrological impacts are discussed in Section 4.2. Unavoidable Adverse Environmental Impacts – SMALL unavoidable adverse impacts.
	Adverse Impact – Construction would require about 420 gpm of surface water. Mitigation Measure – Mitigation measures related to construction and hydrological impacts are discussed in Section 4.2. Unavoidable Adverse Environmental Impacts – Use of surface water as source for construction water needs. Water use impacts during construction are anticipated to be SMALL.
	Adverse Impact – Use of heavy equipment introduces the possibility of petroleum spills that could enter surface water. Mitigation Measure – Mitigation measures related to construction and hydrological impacts are discussed in Section 4.2. Unavoidable Adverse Environmental Impacts – SMALL unavoidable adverse impacts.
Aquatic Ecology	Adverse Impact – Plant or transmission line construction at water's edge would cause the loss of some organisms, and temporary degradation of habitat. Mitigation Measure – Mitigation measures related to construction and aquatic ecology are discussed in Subsection 4.3.2. Unavoidable Adverse Environmental Impact – SMALL unavoidable adverse impacts, including effects of construction noise on fish, for which there is no known mitigation.

TABLE 10.4-4 (Sheet 3 of 8)
UNAVOIDABLE ADVERSE ENVIRONMENTAL IMPACTS OF THE BLN PROJECT

Category	Adverse Impact, Mitigation Measure, Unavoidable Adverse Environmental Impacts
Terrestrial Ecology	Adverse Impacts – Habitat loss would kill or displace animals. Clearing and grading would kill or displace animals. Construction noises could startle or scare animals. Mitigation Measure – Mitigation measures related to construction and terrestrial ecology are discussed in Subsection 4.3.1. Unavoidable Adverse Environmental Impacts – SMALL unavoidable adverse impacts.
	Adverse Impact – Birds may collide with tall construction equipment. Mitigation Measure – No measures or controls would be necessary because impacts would be SMALL. Unavoidable Adverse Environmental Impacts – SMALL unavoidable adverse impacts.
Socioeconomic	Adverse Impact – Construction workers and local residents would be exposed to elevated levels of dust, noise, and exhaust emissions from vehicles. Mitigation Measure – Mitigation measures related to construction, construction workers, and the local public are discussed in Subsection 4.4.1. Unavoidable Adverse Environmental Impacts – SMALL unavoidable adverse impacts.
	Adverse Impact – Construction workers and local residents would be exposed to elevated levels of traffic. Mitigation Measure – Mitigation measures related to construction, construction workers, and the local public are discussed in Subsection 4.4.1. Unavoidable Adverse Environmental Impact – Level of service on local highways and access roads leading to site would be reduced during shift change. Impacts are expected to be temporary and SMALL to MODERATE during peak construction.
	Adverse Impact – Construction workers could be injured. Mitigation Measure – Mitigation measures related to construction and construction workers are discussed in Subsection 4.4.1. Unavoidable Adverse Environmental Impacts – SMALL unavoidable adverse impacts.

TABLE 10.4-4 (Sheet 4 of 8)
UNAVOIDABLE ADVERSE ENVIRONMENTAL IMPACTS OF THE BLN PROJECT

Category	Adverse Impact, Mitigation Measure, Unavoidable Adverse Environmental Impacts
	Adverse Impact – Increase in demand for housing could increase rental rates and housing prices which may make housing unaffordable for some low income populations. Mitigation Measure – Mitigation measures related to construction impacts to local housing are discussed in Subsection 4.4.2. Unavoidable Adverse Environmental Impacts – Potential short-term shortage of affordable housing. Construction impacts upon housing availability are expected to be SMALL to MODERATE.
	Adverse Impact – Initially there may be insufficient classroom space for the influx of construction workers families. Mitigation Measure – Mitigation measures related to construction impacts to local schools are discussed in Subsection 4.4.2. Unavoidable Adverse Environmental Impacts – MODERATE to LARGE temporary unavoidable adverse impacts.
	Adverse Impact – Small increase in demand for public services in project county. Mitigation Measure – Mitigation measures related to construction impacts to local public services are discussed in Subsection 4.4.2. Unavoidable Adverse Environmental Impacts – SMALL unavoidable adverse impacts.
Atmospheric and Meteorological	Adverse Impact – Construction would cause increased air emissions from traffic and construction equipment, and fugitive dust. Mitigation Measure – Mitigation measures related to construction and air quality are discussed in Subsection 4.4.1. Unavoidable Adverse Environmental Impacts – SMALL unavoidable adverse impacts.
Environmental Justice	Adverse Impacts – No disproportionately high or adverse impacts to minority or low-income populations were identified. Mitigation Measure – No mitigation measure required. Unavoidable Adverse Environmental Impacts – SMALL unavoidable adverse impacts.

TABLE 10.4-4 (Sheet 5 of 8)
UNAVOIDABLE ADVERSE ENVIRONMENTAL IMPACTS OF THE BLN PROJECT

Category	Adverse Impact, Mitigation Measure, Unavoidable Adverse Environmental Impacts
	Operations-Related
Land Use	Adverse Impact – Operating the new units would generate radioactive and non-radioactive wastes that are required to be disposed in permitted disposal facilities or permitted landfills. Mitigation Measure – Mitigation measures related to operation and environmental impacts of various wastes are discussed in Section 5.5. Unavoidable Adverse Environmental Impacts – Some land would be dedicated to disposal of construction debris and not available for other uses. Impacts are anticipated to be SMALL.
Hydrological and Water Use	Adverse Impact – Operations would result in discharge of small amounts of chemicals to surface waters of the state. Mitigation Measure – Mitigation measures related to discharge of chemical effluents are discussed in Sections 3.6 and 5.2. Unavoidable Adverse Environmental Impacts – SMALL unavoidable adverse impacts.
	Adverse Impact – Maintenance activities at the site and along the transmission line could result in small petroleum spills. Mitigation Measure – Mitigation measures related to plant operations and hydrological impacts are discussed in Section 5.2. Unavoidable Adverse Environmental Impacts – SMALL unavoidable adverse impacts.
Aquatic Ecology	Adverse Impact – Operations would result in discharge of small amounts of chemicals to surface waters of the state. Mitigation Measure – Mitigation measures related to discharge of chemical effluents are discussed in Sections 3.6 and 5.2. Unavoidable Adverse Environmental Impacts – SMALL unavoidable adverse impacts.
	Adverse Impact – Routine maintenance activities could result in petroleum spills near water. Mitigation Measure – Mitigation measures related to plant operations and hydrological impacts are discussed in Section 5.2.

TABLE 10.4-4 (Sheet 6 of 8)
UNAVOIDABLE ADVERSE ENVIRONMENTAL IMPACTS OF THE BLN PROJECT

Category	Adverse Impact, Mitigation Measure, Unavoidable Adverse Environmental Impacts
	Unavoidable Adverse Environmental Impacts – SMALL unavoidable adverse impacts.
	Adverse Impact – Impingement, entrainment, and thermal discharges. Mitigation Measure – Mitigation measures related to plant operations and impingement, entrainment, and thermal discharges are discussed in Section 5.3. Unavoidable Adverse Environmental Impacts – SMALL unavoidable adverse impacts.
Terrestrial Ecology	Adverse Impact – Some birds would collide with the cooling towers or the transmission lines. Mitigation Measure – This has not been a problem at similar facilities and bird collisions with cooling towers would not be expected to be a problem at this site. Bird collisions with transmission lines are rare. No mitigation is necessary. Unavoidable Adverse Environmental Impacts – SMALL unavoidable adverse impacts.
	Adverse Impact – Salt drift would be distributed around each tower. Mitigation Measure – Mitigation measures related to salt drift and the cooling towers during operational activities are discussed in Section 5.3. Unavoidable Adverse Environmental Impacts – SMALL unavoidable adverse impacts.
	Adverse Impact – Episodic loud noises at the site or along transmission lines could frighten animals. Mitigation Measure – None necessary. Unavoidable Adverse Environmental Impacts – SMALL unavoidable adverse impacts.

TABLE 10.4-4 (Sheet 7 of 8)
UNAVOIDABLE ADVERSE ENVIRONMENTAL IMPACTS OF THE BLN PROJECT

Category	Adverse Impact, Mitigation Measure, Unavoidable Adverse Environmental Impacts
Socioeconomic	Adverse Impact – The plants emit low noise. Mitigation Measure – Noise levels would normally not be above background at the site boundary. No mitigation is necessary. Unavoidable Adverse Environmental Impacts – SMALL unavoidable adverse impacts.
	Adverse Impact – Episodic loud noises could annoy nearby residents. Mitigation Measure – Mitigation measures related to plant operation and noise issues are discussed in Section 5.1. Unavoidable Adverse Environmental Impacts – SMALL unavoidable adverse impacts.
	Adverse Impact – Energizing transmission line has potential to induce electric shock in people standing near the line. Mitigation Measure – Mitigation measures related to plant operation and transmission corridors and off-site areas are discussed in Section 5.1. Unavoidable Adverse Environmental Impacts – SMALL unavoidable adverse impacts.
	Adverse Impact – Cooling towers and plumes would impact existing viewscape. Mitigation Measure – The site layout and vicinity are described in Section 3.1 and Subsection 4.4.1.4. Unavoidable Adverse Environmental Impacts – SMALL unavoidable adverse impacts.
	Adverse Impact – Operation of two units would increase traffic on local roads during shift change. Outages would increase traffic even further. Mitigation Measure – Mitigation measures related to plant operation, local workers, and traffic are discussed in Subsection 5.8.1. Unavoidable Adverse Environmental Impacts – Level of service on local roads could be reduced during shift change. Impacts related to traffic and service on local roads during operation is expected to be SMALL.

TABLE 10.4-4 (Sheet 8 of 8)
UNAVOIDABLE ADVERSE ENVIRONMENTAL IMPACTS OF THE BLN PROJECT

Category	Adverse Impact, Mitigation Measure, Unavoidable Adverse Environmental Impacts
	Adverse Impact – Population increase as a result of influx of additional on-site operational workers and off-site workers needed to fill indirectly created new service jobs. Mitigation Measure – No mitigation required. The increased tax revenues from construction would support upgrades to additional infrastructure. Housing availability is adequate in the region. Unavoidable Adverse Environmental Impacts – SMALL unavoidable adverse impacts.
Radiological	Adverse Impact – Potential doses to members of the public from releases to air and surface water. Mitigation Measure – All releases would be well below regulatory limits. No mitigation required. (See Section 5.4.) Unavoidable Adverse Environmental Impacts – SMALL unavoidable adverse impacts.
Atmospheric and Meteorological	Adverse Impact – Entrained particles in plume from cooling towers would contribute to particulate emissions. Mitigation Measure – Mitigation measures related to air quality and the cooling towers during operational activities is discussed in Section 5.3. Unavoidable Adverse Environmental Impacts – SMALL unavoidable adverse impacts.
Environmental Justice	Adverse Impacts – No disproportionately high or adverse impacts to minority or low-income populations resulting from operation of the proposed units have been identified. Mitigation Measure – No mitigation measure required. Unavoidable Adverse Environmental Impacts – SMALL unavoidable adverse impacts.