ENVIRONMENTAL REPORT

CHAPTER 10

ENVIRONMENTAL CONSEQUENCES OF THE PROPOSED ACTION

10.0 ENVIRONMENTAL CONSEQUENCES OF THE PROPOSED ACTION

This chapter presents the potential environmental consequences of constructing and operating a new U.S. EPR at the Bell Bend Nuclear Power Plant (BBNPP) site. The environmental consequences are evaluated in five sections:

- Unavoidable adverse impacts of construction and operations
- Irreversible and irretrievable commitments of resources
- Relationship between short-term uses and long-term productivity of the human environment
- Benefit-Cost balance
- Cumulative impacts

10.1 UNAVOIDABLE ADVERSE ENVIRONMENTAL IMPACTS

This section summarizes adverse impacts of BBNPP construction and operation that cannot otherwise be avoided, and for which there may be no practical means of mitigation. Chapter 4 and Chapter 5 provide supporting details.

10.1.1 UNAVOIDABLE ADVERSE ENVIRONMENTAL IMPACTS OF CONSTRUCTION

Most construction related environmental impacts can be avoided or minimized through the application of best management construction plans and conformance with applicable Federal, State and Local regulations that protect the environment. BBNPP requires use of a site footprint where permanent structures and roads are located. Construction activities, on the other hand, can be managed in ways that limit long-term loss of habitat and impacts to workers and the public.

Construction impacts and potential mitigation measures are discussed in Section 4.6, and summarized here in Table 10.1-1. Considering the planned mitigation measures, the level of unavoidable adverse impacts from construction is expected to be SMALL.

10.1.2 UNAVOIDABLE ADVERSE ENVIRONMENTAL IMPACTS OF OPERATIONS

Operational impacts of BBNPP are discussed in Chapter 5. Expected impacts and their mitigation are summarized in Table 10.1-2. Unavoidable impacts are limited to operation of the cooling water systems and the generation of additional non-radioactive and radioactive waste. Actions to minimize these impacts include use of closed-cycle cooling and waste minimization. As a result, the unavoidable adverse impacts of operation are also expected to be SMALL.

10.1.3 SUMMARY OF UNAVOIDABLE ADVERSE ENVIRONMENTAL IMPACTS FROM CONSTRUCTION AND OPERATIONS

Construction and operation will require the disturbance of approximately 630 acres (255 hectares) of land for construction, of which 365 acres (148 hectares) will be permanently committed to power plant structures for the BBNPP. The BBNPP will be located near the existing nuclear power plant site currently occupied by SSES Units 1 and 2. A new access road will be constructed to support BBNPP construction and will remain in place to support operations. Temporary storage and laydown areas will be restored following construction to reduce the size of the footprint affected during operations. The BBNPP will require the construction of a new substation, transmission towers and lines to connect BBNPP to the existing SSES switchyard and a planned 500 kV switchyard to the north of the site. All new transmission facilities and lines will be on site property. The use of existing offsite transmission right-of-ways for the BBNPP will eliminate the need for construction of new corridors, further limiting the plant's utilization of available land. In addition, no modifications to existing roads associated with off-site transmission corridors are anticipated. in summary, land impacts will be SMALL.

Protection of surface and subsurface water resources during construction will require limitations on the amount of groundwater withdrawn and the discharge of construction waste waters from dewatering activities. Best management practices will be implemented to limit construction related erosion and sedimentation of surface waters. Construction controls will include use of coffer dams, groundwater flow barriers, spill containment, silt screens, settling basins and dust suppression. Water quality monitoring will be conducted to verify that control measures are adequate. A limited amount of onsite water will be needed to support the construction of BBNPP, and will mostly involve the use of groundwater pumped from excavations for manufacture of concrete in the concrete batch plant, dust control and other construction purposes. Initially, most water required for construction will be trucked in, and

stored on-site in temporary tanks. Once a potable water line is brought to the site, local municipal water will be the primary source of water for construction. Long-term protection of surface waters will be managed through an onsite NPDES permit which is required under current regulations.

Certain natural resources on site will be affected including encroachment on surface waters and wetlands. One pond within the footprint of the power block will be eliminated and new stream channels created for portions of an onsite stream. Activities within these areas will conform to applicable state and federal regulations to ensure that impacts are limited and controlled. Impacts to aquatic resources are expected to be SMALL given the limited area to be committed to permanent use and the absence of threatened and/or endangered species. While a portion of the land utilized for construction will impact these resources, the fauna and flora found are typical of those that occur in comparable locations and are not otherwise unique to the BBNPP property. Where possible, sensitive onsite resources such as wetlands will be avoided or impacts minimized, and if required, mitigated. There are no significant mineral resources within the BBNPP site.

Construction of permanent BBNPP structures such as the reactor, turbine building and cooling towers will require the removal of a portion of the onsite mixed deciduous forest and fields.

Although 24 architectural resources were previously recorded within 1 mi (1.6 km) of the BBNPP site, none are located within the BBNPP footprint. Six archaeological sites were identified as occurring within the flood plain along the west bank of the Susquehanna River. Five architectural sites were found within the project viewshed, one of these, a section of the North Branch Pennsylvania Canal, was found along the flood plain adjacent to the proposed intake location. Phase Ib investigations and subsequent consultation with the Pennsylvania State Historic Preservation Officer (SHPO) will be performed to determine the presence of additional archaeological sites and to determine their eligibility for listing on the National Register of Historical Places. Preliminary results of the Phase Ib studies yielded 2,047 artifacts, eleven archaeological sites, and 26 prehistoric finds. Several of these sites are being reviewed for eligibility for listing on the National Register of Historic Places. Based on current assessments and a review of applicable state and federal databases, it is concluded that adverse impacts to historic or cultural resources from construction are unlikely and the impact is SMALL.

Measures to promote public health and safety will be implemented during construction and operation. The temporary increase in workforce during construction will require actions to minimize traffic congestion. A new access road would be built that would connect U.S. Route 11 to BBNPP to facilitate traffic flow during shift change over. The existing rail spur would be extended from the existing plants to BBNPP to transport heavy equipment and construction materials. A study of construction traffic identified measures to limit traffic congestion including stop lights and added traffic lanes at the intersection of Highway 11 and the new access road. Transportation routes during operations were predicted to provide acceptable levels of service (LOS) with a SMALL impact.

The impact of air emissions is expected to be SMALL. Noise levels at the site boundary are predicted to conform to applicable EPA and HUD criteria. Non-routine noise, such as blasting, will be limited to daytime. Measures to control fugitive dust and emissions from equipment will be implemented along with a general Safety and Health Plan. Emissions from the testing of diesel generators will conform to applicable Pennsylvania state permit requirements and related federal emission standards.

Radiological impacts are expected to be SMALL (see Section 4.5). Radiological dose to workers on site and to the general public have been calculated and are estimated to be well within applicable regulatory limits. Continuing monitoring of radioactivity in the environment surrounding the BBNPP site will ensure that radiological consequences of station operation are maintained within applicable environmental and health based standards. While some radioactive solid wastes will be created, efforts to control and limit their production will be implemented.

Impacts associated with the BBNPP cooling water systems include construction and operation of intake and discharge structures, as well as evaporative losses from operating the cooling towers. Construction of the BBNPP circulating water and raw water supply system makeup water intake structure will require temporary installation of a sheetpile coffer dam along the west bank of the Susquehanna River. Some sediment will become suspended during this installation, but impacts to aquatic organisms are expected to be SMALL and limited and temporary (see Sections 2.3 and 4.2.) Aquatic organisms found in this reach of the river are generally ubiquitous and no protected habitats were found there. Periodic maintenance dredging of the intake area may be required for the continued operation of the BBNPP. These activities will conform to applicable state and U.S. Army Corps of Engineers regulations, including proper disposal of dredge spoils

Since BBNPP will employ a closed-cycle cooling water system that conforms to the U.S. Environmental Agency (EPA) Phase I Clean Water Act 316(b) regulations, the impact of withdrawal of cooling water from the Susquehanna River will be SMALL (see Sections 2.3 and 4.2.) There will be limited impact on near shore hydrology and the potential effects of impingement and entrainment. Measures to further reduce impingement will include intake approach velocities of less than 0.5 ft/sec (0.15m/sec). Therefore, the impact from impingement and entrainment will also be SMALL.

Evaporative loss from the cooling towers will create visible plumes and have a SMALL impact. The extent of the plumes will vary seasonally. The average annual plume length is expected to be 0.29 mi (0.47 km). Deposition of solids is likely to occur but will be below NUREG-1555 significance levels at which visible damage to vegetation may occur. Offsite noise from tower operations is predicted to be within applicable EPA and HUD guidelines.

A portion of the BBNPP cooling tower's water will be discharged back into the Susquehanna River through a multi-port diffuser as blowdown to maintain water quality of the cooling water as it is recirculated. The temperature of this discharge will be several degrees above the ambient temperatures, creating a small thermal plume. The resulting thermal plume impact is predicted to be SMALL and should not pose a threat to the River's benthic community or to motile organisms in the area. The thermal discharge will contain small amounts of chemicals used in plant systems and small quantities of radioactive liquids. Concentrations of these waste water constituents will be limited by NPDES permit requirements and applicable NRC radiological release limitations.

Socioeconomic impacts of the BBNPP construction and operation are expected to be SMALL. It is estimated that many of the skilled construction laborers will commute to the site from outside the immediate geographic area and temporary housing and other related public services appear to be adequate to absorb both the temporary increase in workers during construction and the long-term, but smaller, increase in operational staff. Beneficial increases to the local economy from taxes and spending are likely to occur but are estimated to be a small percentage of the existing economy. The percentage of low-income and minority populations within the comparative environmental impact areas is low compared to state

averages. Therefore, it is not likely that these groups would be disproportionately affected by construction or operation.

10.1.4 REFERENCES

(NRC, 1999). Environmental Standard Review Plan, NUREG-1555, Nuclear Regulatory Commission, October 1999.

Table 10.1-1—Construction-Related Unavoidable Adverse Environmental Impacts

(Page 1 of 5)

Impact Category	Adverse Impact	Mitigation Measures	Unavoidable Adverse Environmental Impacts
Land Use	Approximately 630 acres (255 hectares) of land will be disturbed of which 365 acres (148 hectares) will be permanently committed to power plant structures and roads for BBNPP	Comply with applicable federal, state and local construction permits. Clear only areas necessary for installation of power plant infrastructure and implement construction Best Management Practices. Acreage will be restored/ revegetated following construction to the maximum extent possible. Use of existing transmission corridor right-of-ways. Implement Storm Water Pollution Prevention Plan (SWPPP), including sediment and erosion control. Implement Spill Prevention Control and Countermeasures (SPCC) Plan. Use site Best Management Practices (BMP) to protect resources such as wetlands and streams in vicinity. Reclaim and or restore wetlands not permanently committed to the power block. Obtain individual U.S. Army Corps of Engineers 404, Section 10 Rivers and Harbors Act Permit; PA DEP 105 Dam Safety Water- Way Management Permit. Comply with BMP requirements.	365 acres (148 hectares) of land will be permanently occupied by nuclear plant infrastructure.
Land Use (continued)	Potential to disturb archaeological and architectural sites during construction	Undertake extensive archaeological survey of site prior to construction. Review significance of sites with the Pennsylvania State Historic Preservation Officer (SHPO) and develop plans to avoid and/or minimize impacts to these sites. Develop procedures compliant with Federal and State laws to protect cultural, historical or paleontological resources or human remains in the event of discovery during construction.	Small potential for destruction of unanticipated historic and/or cultural resources.

Table 10.1-1—Construction-Related Unavoidable Adverse Environmental Impacts

(Page 2 of 5)

Impact Category	Adverse Impact	Mitigation Measures	Unavoidable Adverse Environmental Impacts
Hydrologic and Water Use	Construction has the potential to change drainage characteristics, flood handling, and erosion and sediment transport. One pond within the footprint of the powerblock. will be eliminated and a stream channelized and rerouted	Implement BMP and Storm Water Pollution Prevention (SWPPP) Plans according to applicable Local and State regulations to limit erosion and contamination of surface waters. Construction controls to include silt fences, coffer dams, groundwater flow barriers, settling basins. Comply with the U.S. Army Corps of Engineers 404 Permit.	Potential erosion of sediments into surface waters and local stream. One pond within the footprint of the powerblock will be eliminated permanently. Hydrology of Walker Run and associated wetlands will be altered.
	Surface and subsurface (groundwater) water quality could be affected by construction activities.	Use offsite water and avoid groundwater pumping. Monitor water quality in construction impoundments and compare to applicable criteria and historical data. Obtain individual U.S. Army Corps of Engineers 404, Section 10 Rivers and Harbors Act Permit; PA DEP 105 Dam Safety Water- Way Management Permit. Comply with BMP requirements. Protect resources such as wetlands and streams in vicinity to the extent possible. Implement Spill Prevention, Control, and Countermeasures (SPCC) Plan, BMP and SWPP	Potential for contamination of surface and subsurface water, surface waters will be reduced.
Aquatic Ecology	Several wetlands will be permanently affected, and several onsite ponds will be eliminated. See ER Sections 2.4, 4.2, 4.3. A small stream will experience temporary impairment resulting in elimination and/or displacement of aquatic species.	Implement BMP and SWPPP to limit erosion and sedimentation. Protect remaining ponds, and wetlands. See ER Sections 2.4, 4.2, 4.3. BBNPP surveys were performed to identify protected species and corrective actions.	A portion of site wetlands will be permanently lost and one pond within the footprint of the power block will be eliminated. Species present will be lost.

Table 10.1-1—Construction-Related Unavoidable Adverse Environmental Impacts

(Page 3 of 5)

Impact Category	Adverse Impact	Mitigation Measures	Unavoidable Adverse Environmental Impacts
	Susquehanna River aquatic life may be affected due to increased suspended sediment, dredging for the intake, and removal of substrate for the discharge structure.	Activities at the intake will occur within a sheet pile barrier. Dredging for the discharge will be confined to a small area and organisms will quickly recolonize based on prior experience. Implement SWPPP, including sediment and erosion control and the construction of new impoundments, as appropriate. Obtain individual U.S. Army Corps of Engineers 404, Section 10 Rivers and Harbors Act Permit; PA DEP 105 Dam Safety Water- Way Management Permit. Comply with BMP requirements. Implement SPCC Plan. No aquatic endangered or threatened species are expected to be impacted.	Benthic organisms in the dredged areas will be temporarily removed.
Terrestrial Ecology	Vegetation loss will occur in certain construction areas, including mixed forest, old field, and wetlands habitats.	Restore available old field not impacted by BBNPP and limit removal of mixed deciduous forest. Perform activities in wetlands in accordance with permit requirements of Section 404 of the Clean Water Act. Facilities will be sited to limit wetland encroachment. Review BBNPP historic survey database to identify important terrestrial species; conduct new surveys, as needed. Use site Resource Management Plan and BMP to protect resources. Preserve aesthetically outstanding tree clusters, as practical; harvest merchantable timber; use or recycle other woody material, as appropriate; develop reforestation plan. Obtain individual U.S. Army Corps of Engineers 404, Section 10 Rivers and Harbors Act Permit; PA DEP 105 Dam Safety Water- Way Management Permit. Comply with BMP requirements. Acreage will be restored following construction to the maximum extent possible.	A limited amount of mixed deciduous forest and fields will be lost. A portion of onsite wetlands will be lost.

Table 10.1-1—Construction-Related Unavoidable Adverse Environmental Impacts

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Impact Category	Adverse Impact	Mitigation Measures	Unavoidable Adverse Environmental Impacts
Terrestrial Ecology (continued)	Designated bird species may be displaced or disturbed. Natural draft towers may cause bird impaction	Manage forest habitat removal specific to key bird species to limit habitat fragmentation. Reclamation of old fields will contribute to added habitat. Consult with appropriate agencies regarding avoidance and appropriate mitigation measures. Design construction footprint to account for important habitat. Strobe lights on towers and removal of habitat around the tower base.	Some bird impaction may occur.

Table 10.1-1—Construction-Related Unavoidable Adverse Environmental Impacts

(Page 5 of 5)

Impact Category	Adverse Impact	Mitigation Measures	Unavoidable Adverse Environmental Impacts
Socioeconomic	Construction workers, existing employees and local residents could be affected by increased dust, noise, emissions and traffic. Potential for additional demands on public services, e.g., for police and firefighters.	Onsite noise will be maintained within applicable EPA, HUD and OSHA noise-exposure limits. Limit construction activities resulting in non-routine noise levels to day time. Train construction workers and employees in use of appropriate personal protective equipment Develop fugitive dust and vehicle emissions control strategies in conformance with air quality standards and best management practices. Ameliorated traffic congestion with construction of an access road to connect HWY 11 with the BBNPP site and install appropriate traffic controls at affected intersections. Comply with applicable U.S. EPA and State air quality regulations.	No unavoidable impacts. Hiring additional public service employees.
Socioeconomic (continued)	Public services supporting construction activities and expanded work force may be impacted. Influx of workers may impact housing availability.	Minor aggregate socioeconomic impacts anticipated; mitigation not required. Town Comprehensive Plans address stressors associated with population growth. There are adequate numbers of vacant housing units to accommodate the influx of workers.	Small increase in emergency calls, number of new students, temporary housing. No unavoidable adverse impacts. No unavoidable adverse impacts.
Radiological	Construction workers will be exposed to small doses of radiation from existing units.	All radiological doses will be within 10 CFR 20.1301 limits. Implement As Low As Reasonably Achievable (ALARA) practices at construction site.	Small doses to construction workers.
Atmospheric and Meteorological	Construction will cause increased air emissions from traffic and construction equipment, and fugitive dust.	Train construction workers and employees on appropriate personal protective equipment. Develop fugitive dust and vehicle emissions control strategies in conformance with air quality standards and best management practices. Equipment maintenance plans. Comply with applicable U.S. EPA and State air quality regulations.	No unavoidable adverse impacts.
Environmental Justice	No disproportionate impacts to low income or minority groups were identified.	None.	No unavoidable adverse impacts.
Non-radiological Health Impacts	Risk to workers from accidents and occupational illness.	Implement construction site-wide health and safety program that conforms to OSHA requirements.	Industrial worker accidents may occur.

Table 10.1-2—Operations-Related Unavoidable Adverse Environmental Impacts

(Page 1 of 3)

Impact Category	Adverse Impact	Mitigation Measures	Unavoidable Adverse Environmental Impacts
Land Use	The BBNPP footprint will permanently occupy a portion of the site.	Limit area required during design and construction.	Land use is consistent with current operations at the site.
	Some potential impact on land and water courses from spills and discharges	Maintain Spill Prevention Control and Countermeasures (SPCC) Plan.	No unavoidable impacts
	Operation of the new unit will increase radioactive and non-radioactive waste disposal in landfills and onsite in long-term storage facilities.	Implement a waste minimization, pollution prevention program to limit waste generation.	Some land will be dedicated to offsite and onsite waste storage and will not be available for other uses.
	Onsite transmission line maintenance may have some impact on vegetation and wildlife.	Best management practices will mitigate potential impacts from vegetation control and other rights of way (ROW) activities.	Unavoidable but small impacts may occur as a result of keeping the ROWs in a safe condition.
Hydrologic and Water Use	Circulating water system makeup water will be withdrawn from the Susquehanna River potentially affecting near-shore hydrology.	Implement closed-cycle cooling and reduce water use.	No unavoidable impact.
	Evaporative loss of water from the cooling tower represents a consumptive use.	Institute a water treatment program that allows the cooling towers to be operated in a manner that minimizes the use of makeup water,	A limited amount of cooling water taken from the Susquehanna River will be consumed through evaporative loss.
Aquatic Ecology	Cooling water withdrawal will result in impingement and entrainment.	Implement closed-cycle cooling. Limit intake velocity by Instituting a water treatment program that allows the cooling towers to be operated in a manner that minimizes the use of makeup water,	Some limited entrainment and impingement will occur.
	Thermal plume may impact aquatic species abundance and distribution.	Meet all applicable state and federal regulatory requirements regarding the discharge of heat. The diffuser is being designed to rapidly disperse the thermal discharge.	A small thermal plume will be created.
	Biofouling and other process control chemicals will be discharged.	Meet all applicable state and federal Clean Water Act and NPDES permit regulations and limitations.	Chemicals will be discharged in small quantities.
	Recreational fishing may be impacted by impingement and entrainment.	Implement closed-cycle cooling.	No unavoidable adverse impacts.
Terrestrial Ecology	Operation of the cooling tower would result in a visible plume, and solid deposition.	No mitigation	The tower plumes will be visible from beyond the site boundary.

Table 10.1-2—Operations-Related Unavoidable Adverse Environmental Impacts

(Page 2 of 3)

Impact Category	Adverse Impact	Mitigation Measures	Unavoidable Adverse Environmental Impacts
	Solid deposition from the cooling tower operations will have some impact on terrestrial vegetation.	Meet NUREG-1555 vegetative criteria	No unavoidable adverse impacts.
	Bird collisions with the tower may occur.	Install tower strobe lights	Some bird impaction may occur.
Socioeconomic	Operating nuclear plants emit low noise.	Studies demonstrate noise levels on and offsite will meet applicable regulations.	No unavoidable adverse impacts.
	The additional transmission line has potential to cause electric shock onsite	Design to NESC code to minimize potential impacts.	No unavoidable adverse impacts.
	Cooling tower and plume may impact existing site aesthetics.	None. Neighboring site has cooling towers and visible plume	The cooling tower plume will be visible and vary seasonally.
	An additional 363 permanent staff will increase traffic during shift changes.	A new access road and interconnection with the BBNPP will limit traffic congestion. Heavy plant components will be brought in by truck and train.	No unavoidable adverse impacts.
	Air quality could potentially be affected due to onsite diesel generators. Population increases due to added staff may affect public services. Increased direct and indirect work force and increased population may impact housing availability.	Conform to state and federal emission standards and permit requirements. Existing capacity exists to absorb the increased population related services. The number of vacant housing units will be adequate to accommodate the increased work force.	No unavoidable adverse impacts. Small increase in emergency calls, students use of recreational facilities. No unavoidable adverse impacts.
	Potential for additional demands on public services, e.g., for police and firefighters.	Ameliorated traffic congestion with operation of the BBNPP plant.	Hiring additional public service employees.
Radiological	Potential doses to members of the public from releases to air and surface water.	All releases will be well below regulatory limits.	No unavoidable adverse impacts.
	General public and worker exposure to radiation during incident-free transport of fuel and wastes.	Detailed analysis performed in accordance with 10 CFR 51.52(b), yielding conservative results.	No unavoidable adverse impacts.
Atmospheric and Meteorological	The cooling tower plume will traverse the site.	No mitigation	The plume will be visible offsite.
Environmental Justice	No disproportionately high or adverse impacts on minority or low income populations are predicted	None required.	No unavoidable adverse impacts.

Table 10.1-2—Operations-Related Unavoidable Adverse Environmental Impacts

(Page 3 of 3)

Impact Category	Adverse Impact	Mitigation Measures	Unavoidable Adverse Environmental Impacts
Non-radiological Health Impacts	Potential growth of infectious organisms within the Essential Service Water System cooling towers.	Apply best management biocide treatment to limit growth and dispersal of harmful organisms.	No unavoidable adverse impacts.
	Risk to workers from occupational related accidents and illnesses.	Implement site-wide Safety and Medical Program.	Some accidents are likely to occur.

10.2 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

This section describes the expected irreversible and irretrievable environmental resource commitments used in the construction and operation of the Bell Bend Nuclear Power Plant (BBNPP). The information contained in this section satisfies the requirements of 10 CFR 51.45(b)(5) (CFR, 2007) and 10 CFR 51, Appendix A to Subpart A (CFR, 2007), with respect to consideration of irreversible and irretrievable commitment of resources.

Irreversible resource commitments are those that could not be restored at a later time to pre-existing conditions. Irretrievable resources are materials that will be used that could not, by practical means, be recycled or restored for other uses.

10.2.1 IRREVERSIBLE ENVIRONMENTAL COMMITMENTS

Irreversible environmental commitments resulting from installation of BBNPP in addition to materials used for nuclear fuel fabrication and onsite structural components include:

- Surface water
- Land
- Aquatic and terrestrial biota, and
- Releases to air and surface water.

10.2.1.1 Surface Water

Surface waters will be withdrawn from the North Branch of the Susquehanna River to support the Circulating Water System (CWS), the Raw Water Supply System (RWSS) and the Essential Service Water System (ESWS). Some of this water will be consumed as a result of evaporative loss from the cooling towers. The remainder will be returned to the Susquehanna River. The amount of water potentially lost from the CWS cooling towers due to evaporation is expected to be approximately 15,900 gpm (60,200 lpm), and because evaporative loss is consumptive, it will be unavailable for other uses.

The onsite inland wetlands that will be filled or otherwise modified to accommodate the construction of BBNPP represent 36 acres (14.6 hectares) or 4% of the total site area, while the overall percent of area to be affected is 630 acres (255.1 hectares) or 71% of the total site area. Additionally, 173 acres of upland forest will either be permanently or temporarily lost during construction. Those areas included within the BBNPP footprint will be permanently unavailable for reclamation in the future.

Groundwater withdrawals will not be needed to support either the construction or operation of BBNPP. Groundwater that is removed from the aquifer to support dewatering activities during construction will be consumed on-site or managed as surface water run off. The impact to this resource will be temporary and small. Because the resource use is consumptive, it will not be available for other uses.

10.2.1.2 Land Use

Land designated for the storage of radioactive and non-radioactive waste on and offsite is dedicated to that use and will be unavailable for other uses during the operational period. Following decommissioning and the development of permanent offsite storage, the onsite waste storage areas could be reclaimed.

10.2.1.3 Aquatic and Terrestrial Biota

Construction of BBNPP will require the removal of a portion of the onsite mixed deciduous forest and fields and will encroach on inland wetlands. These areas will be permanently occupied by plant structures during operations and will be unavailable for reclamation. The construction areas represent 41 percent (325 ac (131.5 ha) of 882 ac(357 ha) of the BBNPP Owner Controlled Area of the overall site acreage and do not contain any unique or otherwise protected aquatic or wetland species.

10.2.1.4 Releases to Air and Surface Water

Radioactivity, air pollutants and chemicals will be released to the environment during routine operations of BBNPP. Since these releases will conform to applicable Nuclear Regulatory Commission, U.S. Environmental Protection Agency and the Commonwealth of Pennsylvania regulations, their impact to the public health and the environment would be limited. Routine long-term monitoring of radioactivity in the environment and the measurement of chemical concentrations discharged will be performed to verify regulatory compliance.

10.2.2 IRRETRIEVABLE COMMITMENTS OF RESOURCES

Irretrievable commitments of resources during construction of BBNPP will be similar to that required for other major energy construction projects. Studies performed for the U.S. Department of Energy have summarized the amount of materials historically consumed for nuclear power plant construction (DOE, 2004a) (DOE, 2005).

For a typical new 1,300 MWe nuclear power plant, it can be estimated that reactor building steel-plate reinforced structures would require 12,239 yards of concrete and 3,107 tons of rebar. Approximately 2,500,000 linear feet of cable would be required for the reactor building, and 6,500,000 linear feet of cable and up to 275,000 feet of piping for the unit. Based on historical information from operating reactors (DOE, 2005), it is estimated that pressurized water reactors between 1,000 and 1,300 MWe require a total of approximately 182,900 cubic yards of concrete to construct the reactor building, major auxiliary buildings, turbine generator building and the turbine generator pedestal. A total of 20,512 tons of structural steel was typically required.

The rated electrical output for BBNPP is 1,710 MWe. This is approximately 30% higher than the largest plant referenced in the historical data. However, these historical estimates are representative of the quantities of materials that will be consumed during construction. Historical data for materials consumed for domestic nuclear power plant construction in the 1970's is summarized in Table 10.2-1 (DOE, 2005). The estimated amount of materials that will be consumed during construction of a U.S. EPR plant is summarized in Table 10.2-2.

While these quantities are large, their use provides a cost-effective allocation of resources given that energy from nuclear power plants is now increasingly cost competitive (DOE, 2004a) (DOE, 2005). Furthermore, nuclear energy provides environmental benefits consistent with current concerns relative to overall life cycle environmental effects caused by fuel extraction, emission of air pollutants and solid waste disposal typically associated with fossil fuel (DOE, 2004b) (WNA, 2005).

Irretrievable resources include uranium and the energy used to fabricate fuel. However, available supplies of uranium suggest that there is a considerable degree of security of supply to ensure the continued operation and expansion of nuclear power for the foreseeable future (NEA, 2002) (WNA, 2006).

The inventories of construction materials tabulated by the U.S. Census Bureau for 2000, 2005 and 2006 are shown in Table 10.2-3. In general, construction supplies increased from 2002 through 2006, suggesting that such commodities will continue to be available for the foreseeable future in response to demand (USCB, 2008a).

Similarly, inventories of minerals and related construction materials have remained relatively stable between 2000 and 2005 (Table 10.2-4) (USCB, 2008b). Another important measure is industry capacity in those sectors that may affect nuclear power plant construction. In general, the data suggest that most industries have surplus capacity (Table 10.2-5) USCB (2007). During the fourth quarter of 2006, U.S. domestic manufacturing plants collectively used only 70% of their full production capacity. (USCB,2007)

While a given quantity of material consumed during construction and operation of BBNPP will be irretrievable, except for materials recycled during decommissioning, the impact on their availability is expected to be small.

10.2.3 REFERENCES

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Table 10.2-1—Summary of Historical Data - Materials Consumed by Nuclear Power Plant Construction in the United States During the 1970's

	BWR 1074-1308 MWE	PWR 1116-1311 MWE	LWR 1074-1311 MWE
Building Volume (1,000,000 CF)	14.6	15.9	15.3
Concrete (1,000 CY)	195.7	182.9	188.7
Concrete CY/ Building (1,000 CY)	12.5	11.3	11.8
Structural Steel (TN)	13,642	20,512	17,389
Structural Steel LB/ Net KW	23.9	34.1	29.5
Structural Steel TN/ Building (1,000 CF)	0.94	1.30	1.13

Table 10.2-2—U.S. EPR Estimated Construction Materials (Tons)

Estimated Minimum Requirements	Estimated Tons
Civil Material	
Concrete	
Cement	188,525
Sand	282,787
Aggregate	377,050
Steel	
Rebar	55,331
Structural Steel	6,261
Misc. Steel	1,016
Mod Steel	225
Steel Liner	1,412
Embedded Steel	1,903
Siding and Roofing	2,056
Piping and Mechanical Material	
Large and Small bore pipe	7,500
Large bore hangers	2,788
Nuclear Island EM package	15,377
Tubine Island and BOP	1,000*
Consumables	1,000*
Electrical Equipment	
Conduit	1,356
Cable Tray	73
Power and Control Wire	4,496
NI Electrical Equipment	5,000
TI Electrical Equipment	5,000
* Truck Loads	

Table 10.2-3—Estimated Inventories of Construction Supplies Based on U.S. Merchant Wholesalers Data 2000, 2005 and 2006

	2000	2005	2006
Inventories ($x10E+06)			
Metals and Minerals	14,750	23,782	29,567
Electrical Goods/Equipment	28,188	32,098	35,747
Hardware, Plumbing, Heating equipment and supplies	12,855	15,385	16,635
Machinery, Equipment, and Supplies	53,495	65,237	70,866
Lumber & Other Construction Materials	10,300	16,524	17,080

Table 10.2-4—U.S. Mineral Production in 2000, 2005 and Estimated for 2006

	2000	2005	2006 (est.)
Inventories Per 1000 Metric Tons			
Aluminum (Per 1000 metric tons)	3,688	2,481	2,280
Copper (Per 1000 metric tons)	1,450	1,140	1,200
Iron Ore (million metric tons	61	53	53
Lead (Per 1000 metric tons)	449	426	430
Titanium (Per 1000 metric tons)	300	300	300
Zinc (Per 1000 metric tons)	805	748	725
Portland Cement (million metric tons)	84	94	94
Masonry Cement (million metric tons)	4	5	5
Construction Sand and Gravel (million metric tons)	1,120	1,270	1,280

Table 10.2-5— Percent Capacity Utilization Rates by Industry

	2002	2003	2004	2005	2006
Industry					
Primary Metal Manufacturing	71	72	74	79	73
Ferrous Metal Foundries	62	63	68	72	72
Nonferrous Metal Foundries	65	63	60	66	64
Fabricated Metal Products	59	61	66	68	70
Electrical Equipment	60	64	69	68	69

10.3 RELATIONSHIP BETWEEN SHORT-TERM USES AND LONG-TERM PRODUCTIVITY OF THE HUMAN ENVIRONMENT

The BBNPP environmental report provides information associated with the environmental and socioeconomic impacts of activities that occur during construction and operation. These activities are considered short-term for purposes of this section and include that period through prompt decommissioning. Long-term is considered to be that period from construction to end of plant life and beyond that required for delayed decommissioning. This section reviews the extent to which the proposed project use of the environment precludes any future, long-term use of the site.

The information contained in this Section satisfies the requirements of 10 CFR 51.45(b)(4) (CFR, 2007) and 10 CFR 51, Appendix A to Subpart A (CFR, 2007), with respect to consideration of irreversible and irretrievable commitment of resources.

10.3.1 CONSTRUCTION AND LONG-TERM PRODUCTIVITY

Section 10.1 summarizes the potential unavoidable adverse environmental impacts of BBNPP construction including measures being implemented to mitigate those impacts. While some impacts will remain following construction, none should preclude the future use of the site following decommissioning.

BBNPP is being constructed adjacent to the existing nuclear power plant site for SSES Units 1 and 2. As a result, construction related activities and permanent structures will be consistent with established site use. Construction activities will occupy a footprint larger than the permanent structures required for operations because of the need for additional temporary work force parking, equipment and material lay-down areas and construction buildings.

Approximately 630 acres (255 hectares) will be disturbed during construction, including existing mixed deciduous forest, fields and a portion of the site's existing surface waters and inland wetlands. Construction Best Management Practices, Erosion Control Plans and other protective measures will limit terrestrial impacts and protect long-term productivity. Various mitigation measures will be evaluated, including but not limited to, reforestation, wetlands restoration and/or wetland construction. Following construction, about 365 acres (148 hectares) of the overall disturbed area will be permanently converted to various plant-related structures and facilities.

Groundwater and surface waters will be temporarily disturbed during construction due to disruption of water courses, sediment loads related to grading activities, water withdrawal, creation of dewatering basins, and dewatering discharge. Farm Pond, which is located within the footprint of the Power Block, will be filled and a portion of Walker Run will be disrupted and relocated. Furthermore, a portion of the wetlands will be removed. Impacts to ground and surface waters will be minimized through various construction controls including coffer dams, groundwater flow barriers, spill containment, silt screens, settling basins and dust suppression. Effluents from dewatering activities will be directed to a storm water discharge and monitored. Following completion of construction, these impacts will cease and groundwater should recharge to pre-construction levels with no long-term loss of surface or subsurface water resources.

Potential archaeological and architectural sites located in the construction area will be managed in cooperation with the Pennsylvania Office of Historic Preservation so that sensitive artifacts are recovered or properly preserved in place where possible. Preconstruction surveys

of cultural resources will identify and allow for protection of any historical or archaeological sites within the BBNPP footprint.

Construction of the BBNPP intake and discharge structures will require some disturbance of sediments within the intake area of the Susquehanna River and in the area of the proposed discharge multi-port diffuser. As discussed in Sections 2.4 and 4.3, existing ecological studies performed for SSES Units 1 and 2 and BBNPP show that these impacts will not affect long-term ecological productivity of the North Branch of the Susquehanna River in the area of BBNPP, nor will protected species be impacted.

Noise above ambient levels will occur onsite due to some construction activities. However, at the site boundary, construction related noise is expected to conform to applicable state and federal environmental standards. Non-routine noise, such as blasting, will be limited to day time. Since construction noise is temporary, there would be no long-term impacts.

Temporary traffic increases will occur due to the numbers of additional workers required to support construction. A new site access road is proposed to alleviate onsite and offsite traffic during this period and through operations and decommissioning with no long-term impact. Construction of a railroad spur will provide access for heavy equipment and construction materials and thereby limit impact on nearby roads.

Economic benefits during construction accrue from the need for temporary housing and local spending. It is predicted that while this benefit is substantial, it will represent a small increment to the total economic base of the BBNPP site two-county area.

10.3.2 OPERATION AND LONG-TERM PRODUCTIVITY

The potential unavoidable adverse environmental impacts of BBNPP operation are also summarized in Section 10.1 along with proposed mitigation measures. Some impacts will occur during BBNPP operations but will largely terminate upon plant shut down and any residual environmental issues will be resolved during decommissioning such that long-term uses of the site are not precluded.

Environmental impacts during operations are largely related to operation of the CWS system , the RWSS, and ESWS and the generation of radioactive wastes. Impacts of the cooling water systems stem from withdrawal of water from the North Branch of the Susquehanna River via the intake structure, evaporative loss from the systems' cooling towers and the return of cooling water back to the Susquehanna River.

The use of closed-cycle cooling systems will substantially reduce these potential impacts such that, during and following operations, there would be no long-term loss of ecological productivity of aquatic resources in the Susquehanna River. The long-term reproductive viability of aquatic species potentially affected by entrainment or impingement is expected to be unaffected, resulting in no long-term power plant related loss in biomass.

Discharge of the thermal plume and associated power plant chemical additives will meet applicable permit regulatory requirements during operations and are not expected to have any long-term consequences for water quality in the Susquehanna River. Due to the use of closed-cycle cooling, the thermal plume is predicted to occupy a comparatively small area. Similarly the concentrations of chemicals released will be limited and will quickly disperse in the river with little or no long-term accumulation.

Evaporative loss of water from the cooling towers represents a consumptive use during operations but will cease following plant shutdown. Deposition from cooling tower drift during tower operations is not predicted to cause visible vegetative impacts, yet this potential impact will also cease following shutdown as well. It is expected that terrestrial plants and/or soil will quickly recover should impacts be observed.

Emission of fossil fuel combustion byproducts will increase during the periodic testing of the BBNPP diesel generators. The amount of emissions will be governed by applicable state permits and federal standards for air pollutants. Since the emissions are periodic and transient, and will cease following BBNPP shutdown, long term impacts to air quality are not expected.

Radiological releases will be controlled according to applicable state and federal standards to ensure protection of terrestrial and aquatic biota, and protection of workers and the general public. Onsite storage of radioactive wastes will be temporary and ultimately removed from site. Reclamation of the site, including removal of any radioactive contamination, will occur such that future long-term uses of the site are not precluded.

Socioeconomic benefits to the counties surrounding the BBNPP site will result from increased taxes, additional spending and housing. While the relative impact to the economic base is small, some benefit will continue up to and through decommissioning, particularly where increased tax revenues have been used to enhance public infrastructure and services.

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

The construction and operation of BBNPP will result in some limited short-term and unavoidable impacts to the environment. Mitigation measures have been proposed to limit both the short-term impacts of construction and those that may occur during the operational life of the power plant. Benefits accrue from the production of electricity and increases in the tax base that could support public infrastructure and services. Following site decommissioning, it is expected there will be no long-term impacts on productivity or the human environment that would preclude alternative uses of the site.

10.3.4 REFERENCES

CFR, 2007. Title 10, Code of Federal Regulations, Part 51, Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions, 2007.

10.4 BENEFIT-COST BALANCE

This section describes the benefit-cost balance resulting from the proposed construction and operation of the Bell Bend Nuclear Power Plant (BBNPP). It was prepared in accordance with the guidance provided in NUREG-1555 (NRC, 1999) i.e., "Environmental Standard Review Plan" (ESRP). Section 10.4.1 describes the benefits of the proposed project; Section 10.4.2 discusses the costs associated with the proposed project; and Section 10.4.3 provides a benefit-cost balance summary.

The information contained in this Section satisfies the requirements of 10 CFR 51.45(d) (CFR, 2007a) and 10 CFR 51, Appendix A to Subpart A (CFR,2007b), with respect to consideration of irreversible and irretrievable commitment of resources.

10.4.1 BENEFITS

This section discusses the benefits resulting from the proposed construction and operation of BBNPP. The information provided in this section was prepared in accordance with the guidance provided in NUREG-1555, ESRP 10.4.1 (NRC, 1999). Information provided in this section includes a summary of the following information:

- The evaluation that was performed to determine if there is sufficient demand for new electric power in the eastern part of the PJM classic area, which is the Region of Interest (ROI)/primary market area;
- The evaluation that was performed to determine an electric power generation source (i.e., coal, gas, nuclear, solar, wind);
- The evaluation that was performed to choose a location for the selected electric power generation source; and
- Benefits that the new electric power generation facility will provide.

Table 10.4-1 summarizes the benefits and costs of the proposed action. These benefits and costs include:

- Identification of appropriate plant production benefits;
- Calculation of the plant average annual electrical-energy generation in kilowatt-hours (kWh);
- Evaluation of the reliability of the electrical distribution system;
- Identification of other project benefits, including state and local tax revenues, regional productivity, enhancement of recreational and aesthetic values, environmental enhancement, creation and improvement of local roads or other facilities, and intangible benefits (e.g., reduced dependence on scarce fossil fuels);
- Quantification of benefits in monetary or other appropriate terms;
- Evaluation of the significance of the benefits on a political boundary or regional basis; and

- Assessment of any potential social or economic impacts as a result of the proposed project construction and operation

The potential cumulative adverse impacts at the site resulting from construction of a new power plant are summarized in Section 10.5

10.4.1.1 Need for Power

As discussed in Section 8.4, PJM planning is subject to review by its Board of Directors and advisory board. The PJM reliability planning processes are also confirmable by comparing forecasts to ReliabilityFirst Corporation (RFC) composite forecasts. Although the PJM forecasts are included in the RFC regional composite, the regional composite includes forecasts by many other generators and suppliers.

PJM uses commercially developed software to perform uncertainty analyses to account for forecasting uncertainty. Each uses econometric modeling that enables them to perform analyses of the sensitivity of results to changes in model inputs and to create high and low range forecasts. Uncertainty analysis is also used in establishing planning reserve margins, themselves an acknowledgement of uncertainty.

PPL Bell Bend, LLC concludes that PJM has the kind of reliability planning process that meets the NRC criteria for an acceptable regional need for power analysis. Similarly, PPL Bell Bend, LLC concludes that the RFC process for gathering need for power data provides further satisfaction of NRC criteria at the regional level. At the regional level, growth projections support the need for the power that the BBNPP would produce.

The purpose of the BBNPP is to satisfy the need for baseload power identified by PJM. The result of No Action, or not constructing the new facility, would mean that the need for power has not been satisfied, and other electricity generating sources would be needed to meet the forecasted electricity demands.

In summary, the benefits of the BBNPP include the following:

- The BBNPP would alleviate existing congestion in the west-to-east transmission of energy across the Alleghany Mountains.

- The BBNPP would provide much needed baseload power for an area that is expected to have the average annual peak forecast grow between 1.2 and 1.5 percent per year over the next 10 years.

- The BBNPP would allow PJM to continue to meet the growing demand for an average of 1,654 megawatts (MW) per year of added capacity.

- The BBNPP would enable PJM to sustain the reserve margins necessary to prevent a reduction in the supply of energy and to meet the expected future demand trends.

- Given concerns in Pennsylvania and throughout the northeastern United States about climate change and carbon emissions, the BBNPP will serve another important function by reducing carbon emissions in the state. The BBNPP would displace significant amounts of carbon as soon as the plant becomes operational, as compared to a coal fired power generating facility.

10.4.1.2 Energy Alternatives

This section provides a summary of the evaluation that was conducted in Section 9.2, to determine a suitable electric generating power source to meet the demand for new power in the ROI/primary market area. The evaluation identified alternatives that would require the construction of new generating capacity-such as wind, geothermal, oil, natural gas, hydropower, municipal solid wastes (MSW), coal, photovoltaic (PV) cells, solar power, wood waste/biomass, and energy crops, as well as any combination of these alternatives. In addition, alternatives that would not require new generating capacity were evaluated, including initiating energy conservation measures , reactivating or extending the service life of existing plants within the power system, and purchasing electric power from other sources.

The evaluation indicated that neither a coal-fired nor a gas-fired facility would appreciably reduce overall environmental impacts relative to a new nuclear plant. Furthermore, a coal-fired and a gas-fired facility would entail a significantly greater environmental impact on air quality than would a new nuclear plant. The analysis indicated that wind and solar facilities in combination with fossil facilities could be used to generate baseload power. However, wind and solar facilities in combination with fossil facilities would have higher costs and larger land requirements than a new nuclear plant and therefore are not preferable to a new nuclear plant.

Based on environmental impacts, it has been concluded that neither a coal-fired, nor a gas-fired, nor a combination of alternatives, including wind and solar facilities, would appreciably reduce overall environmental impacts relative to a new nuclear plant; therefore making nuclear power a suitable electric power generation source.

10.4.1.3 Alternative Locations for the Proposed Facility

The following paragraphs provide a summary of the evaluation that was conducted in Section 9.3 to identify a preferred location for the new nuclear power facility. The objective of the evaluation was to verify that no obviously superior location for the siting of a new nuclear unit exists.

Four alternative sites were chosen for analysis: the BBNPP site located near an existing nuclear facility, the Susquehanna Steam Electric Station (SSES), a greenfield site located adjacent to an existing coal-fired facility (Montour site), a brownfield site (Sandy Bend site), and a greenfield site (Martins Creek site). These sites were chosen because, based on the site selection process implemented, they met the site selection criteria and are among the best possible sites available. The sites were evaluated based on potential impacts to land use, air quality, water, terrestrial ecology and sensitive species, aquatic ecology and sensitive species, demographics, socioeconomics and environmental justice, and historic, cultural, and archeological resources.

The evaluation concluded that the preferred location for the new nuclear plant is located adjacent to an existing nuclear facility at the BBNPP site. Siting a new reactor at an existing nuclear facility offers a number of benefits:

- By collocating nuclear reactors, the total number of generating sites is reduced.
- Minimal additional land acquisitions are necessary, and the applicant can readily obtain control of the property. This reduces both initial costs to the applicant and the degree of impact to the surrounding anthropogenic and ecological communities.

- Site characteristics, including geologic/seismic suitability, are already known, and the site has already undergone substantial review through the National Environmental Policy Act (NEPA) process during the original selection procedure.

- The environmental impacts of both construction and operation of the existing units are known. It can be expected that the impacts of a new unit should be comparable to those of the operating nuclear plant.

- Collocated sites can share existing infrastructure, reducing both development costs and environmental impacts associated with construction of new access roads, waste disposal areas, and other important supporting facilities and structures. Construction of new transmission corridors may be eliminated or reduced because of the potential use of existing corridors.

- Existing nuclear plants have nearby markets, the support of the local community, and the availability of experienced personnel.

10.4.1.4 Benefits of the Proposed Facility

Locating the proposed new nuclear facility at the existing BBNPP property will afford benefits to the local economy. The BBNPP owners will pay property taxes on the proposed new unit for the duration of the operating license. BBNPP owners estimate that annual property tax payments could reach approximately $ [Proprietary Information - Withheld Under 10 CFR 2.390(a)(4) - See Part 9 of this COL Application] in 2018, the year of plant startup. Most people consider large tax payments a benefit to the taxing entity because they support the development of infrastructure that supports further economic development and growth.

The existing SSES employs a nuclear-related permanent workforce of approximately 1,200 employees and up to an additional 260 contract and matrixed employees (PPL, 2006a). As stated in Section 5.8.2, it is anticipated that construction and operation of the new facility would add a total of 363 direct employees to the onsite workforce. New jobs within approximately a 50 mi (80 km) radius of the plant would be created by the construction and operation of the new facility. Many of these jobs would be in the service sector and could be filled by unemployed local residents, lessening demands on social service agencies in addition to strengthening the economy. It is anticipated that the new jobs would be maintained throughout the life of the plant.

Construction and operation of the new nuclear facility at BBNPP would generate an economic multiplier effect in the area. The economic multiplier effect means that for every dollar spent an additional $0.60 of indirect economic revenue would be generated over the construction period within the region of influence (BEA, 2008). The economic multiplier effect is one way of measuring direct and secondary effects. Direct effects reflect expenditures for goods, services, and labor, while secondary effects include subsequent spending in the community. The economic multiplier effect due to the increased spending by the direct and indirect labor force created as a result of the construction and operation of the new nuclear reactor unit would increase economic activity in the region, most noticeably in Luzerne and Columbia Counties.

Given concerns in the ROI/primary market area about climate change and carbon emissions, BBNPP serves an important environmental benefit need by reducing carbon emissions in the State. Upon operation, BBNPP would displace significant amounts of carbon compared to a coal-fired generating plant. The costs of climate change, which have been quantified, will have a significant impact on the global and national economies.

10.4.2 COSTS

This section summarizes estimated costs for construction and operation of BBNPP. The information provided in this section was prepared in accordance with the guidance provided in NUREG-1555 (NRC, 1999), ESRP 10.4.2). The discussion below provides sufficient economic information to assess and predict costs and benefits.

Table 10.4-1 summarizes the benefits and costs of the proposed action. Section 10.5 summarizes the potential cumulative adverse environmental impacts at the proposed project site.

Internal costs are the monetary costs of construction and operation of the proposed new reactor unit. Internal costs can include capital costs of the facility, transmission lines, and operating costs (staffing, maintenance, and fuel), as well as decommissioning costs.

Construction costs and operation costs are generally discussed using established cost information developed by several resources. Many cost studies are available in the literature with a wide range of cost estimates. Four studies are believed to be the most authoritative because of the breadth and depth of their analyses. These four studies are as follows:

- Organization for Economic Co-operation and Development (OECD) study of projected electricity generating costs (NEA, 2005)
- University of Chicago (UC) study on the economic future of nuclear power (UC, 2004)
- Massachusetts Institute of Technology (MIT) study on the future of nuclear power (MIT, 2003)
- Energy Information Administration (EIA) annual energy outlook (EIA, 2004)

The four economic studies identified above provide sufficient economic information to assess and predict costs of the proposed project. By conducting a systematic review of the economics of nuclear power, the studies were able to generate a financial model that estimated the costs of new nuclear plants coming online in the future. To develop that model, several factors were investigated:

- Factors affecting the competitiveness of nuclear power, including leveled costs, comparisons with international nuclear costs, capital costs, effects of learning by doing, and financing issues
- An analysis of technologies that could reduce the costs of gas and coal fired electricity, future changes in fuel price, and the potential economic impact of greenhouse gas control policies and technology
- An analysis of several federal financing policy alternatives designed to make nuclear power competitive in the future

Using the information contained within the four studies identified above, the internal costs of constructing and operating the BBNPP was developed, meeting the intent of NUREG 1555. The construction and operating cost values accounted for aspects of pertinent construction and operating practices and methods unique to nuclear generating facilities and were based on industry standards, as outlined in the literature cited above.

10.4.2.1 Monetary - Construction

The phrase commonly used to describe the monetary cost of constructing a nuclear plant is "overnight capital cost." The capital costs are those incurred during construction, when the actual outlays for equipment and construction and engineering are expended, in other words, the cost resulting if one were to pay for 100% of the plant "overnight". Overnight costs are:

- expressed as a constant dollar amount versus actual nominal dollars,
- expressed in $/kW, and
- for the nuclear industry, the overnight capital cost does not include inflation, financing, extraordinary site costs, licensing, transmission or the initial fuel load.

Overnight costs are exclusive of interest and include engineering, procurement, and construction costs, owner's costs, and contingencies.

The four studies identified in Section 10.4.2 estimate overnight capital costs that range from $1,100/kW to $2,300/kW, with $1,500 to $2,000/kW being the most representative range. Many factors account for the range: the specific technology and assumptions about the number of like unit(s) built, allocation of first of a kind costs, site location and parity adjustments to allow comparison between countries, and allowances for contingencies. The estimates are not based on nuclear plant construction experience in this country and are more than 20 years old. Actual construction costs overseas have been less than most recent domestic construction, suggesting that the industry has learned from the domestic experience. There is an assumption that the overseas experience can be applied domestically, and the studies have found the overseas experience to be most applicable to estimating the cost of the new domestic nuclear plant construction.

The four studies identified in Section 10.4.2 tend to support $2,000/kW as a reasonable high end overnight capital cost estimate. The $2,300 value presented above is based on construction in Japan (NEA, 2005). While no explanation is offered for this value, 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 an island. For the purpose of the analysis in this Environmental Report (ER) and to avoid understating the cost, $2,000/kW value was chosen. According to Section 3.2, the U.S. Evolutionary Power Reactor (EPR) nuclear power-generating station for BBNPP will have a rated core thermal power of 4,590 megawatts thermal (MWt) and a rated net electrical output of greater than or equal to 1,600 megawatts electric (MWe). The estimated total project capital cost for BBNPP is identified in Section 4.4.2.6.2.

10.4.2.2 Monetary - Operation

Operation costs are frequently expressed as the levelized cost of electricity, which is the price at the busbar needed to cover operating costs and annualized capital costs. Overnight capital costs account for a third of the levelized cost, and interest costs on the overnight costs account for another 25% (UC, 2004). The four studies identified in Section 10.4.2 demonstrate a wide range of operation cost estimates. Levelized cost-of-electricity estimates range from $36 to $83/megawatt hour (MWh) ($0.036 to $0.083/kWh). Factors affecting the range include choices for discount rate, construction duration, plant life span, capacity factor, cost of debt and equity and split between debt and equity financing, depreciation time, tax rates, and premium for uncertainty. . According to the UC study, the projected cost associated with operating a new

nuclear facility (similar to the size of the BBNPP) is in the range of $31 to $46/MWh ($0.031 to $0.046/kWh) (UC, 2004).

Based on information found in PPL's 2006 report entitled, "Economic Benefits of PPL Susquehanna Nuclear Power Plant" (PPL, 2006b), PPL Susquehanna's 2005 production cost was $0.0155/kWh, compared to $0.0489/kWh for the rest of the Commonwealth of Pennsylvania. This information may provide more localized production data to which BBNPP may be compared.

In addition to nuclear plant costs, the four studies provide coal and gas fired generation costs for comparison. One study showed nuclear costs competitive with coal and gas (EIA, 2004). The other studies showed nuclear costs exceeding those of coal and gas. One study concluded that new nuclear power is not economically competitive, but went on to suggest steps the government could take to improve nuclear economic viability (MIT, 2003). Since the study was issued, the government has undertaken the following steps to improve economic viability of nuclear energy:

- The U.S. Department of Energy (DOE) has provided financial support for plants testing the NRC licensing processes for early site permits and combined operating licenses.
- The U.S. government has endorsed nuclear energy as a viable carbon free generation option.

Estimates include decommissioning but, because of the effect of discounting a cost that would occur as much as 40 years in the future, decommissioning costs have relatively little effect on the levelized cost. In addition, the Energy Policy Act of 2005 instituted a production tax credit for the first advanced reactors brought on line in the U.S. (PL, 2005), which would tend to lower this estimate.

10.4.3 SUMMARY

Table 10.4-1 summarizes the benefits and costs associated with the proposed construction and operation of BBNPP, including information regarding select mitigation measures for potential impacts. Benefits-cost information for the three alternative sites to BBNPP, the Montour, Sandy Bend, and Martins Creek sites, are also presented in Table 10.4-1. Costs that are environmental impacts are those anticipated after proposed mitigation measures are implemented. Section 10.5 addresses the environmental costs and cumulative impacts. In summary, there is a growing baseload demand and a growing shortfall in baseload supply in the ROI/primary market area. Energy alternatives were evaluated with nuclear power being the choice to meet the needed energy demands. Based on the site selection process, it was determined that the new nuclear facility should be located in Luzerne County, Pennsylvania. The BBNPP will result in a reduction in emissions with respect to comparably sized coal- or gas-fired alternative power-generating facilities. While the additional direct and indirect creation of jobs for the construction and operation of the new facility might place a temporary burden on local services and infrastructures, the annual taxes and revenue generated by the new workers would contribute to the local economy and the productivity of the region.

In conclusion, the construction and operation of the proposed project is needed, and the benefits outweigh the economic, environmental, and social costs.

10.4.4 REFERENCES

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Table 10.4-1—Benefits and Costs of the Proposed Project Summarized

(Page 1 of 13)

Benefit Category	Proposed Site BBNPP Site	Option 1 Montour Site	Option 2 Sandy Bend Site	Option 3 Martins Creek Site
Project Description	The BBNPP site is collocated with an existing nuclear power generating facility in Luzerne County, Pennsylvania.	The Montour site is a greenfield site located in Montour County, Pennsylvania, adjacent to the Montour coal-fired generating facility.	The Sandy Bend site is a brownfield site located in Mifflin County, Pennsylvania.	The Martins Creek site is a greenfield site located across the river in Warren County, New Jersey, from the Martins Creek natural gas-fired generating facility.
BENEFITS				
Electricity Generated and Generating Capacity	The EPR nuclear power generating station reactor for the BBNPP has a rated core thermal power of 4,590 MWt and a rated net electrical output of greater than or equal to 1,600 MWe.	It is assumed that the electricity generated and generating capacity would be similar to that of the BBNPP.	It is assumed that the electricity generated and generating capacity would be similar to that of the BBNPP.	It is assumed that the electricity generated and generating capacity would be similar to that of the BBNPP.
Fuel Diversity	Nuclear provides option to natural gas. Does not have price volatility of natural gas, fuel availability issues limited.	Nuclear provides option to natural gas. Does not have price volatility of natural gas, fuel availability issues limited.	Nuclear provides option to natural gas. Does not have price volatility of natural gas, fuel availability issues limited.	Nuclear provides option to natural gas. Does not have price volatility of natural gas, fuel availability issues limited.
Licensing Certainty	Resolution of design criteria through certification; resolution of site, construction and operational issues in Combined Operating License Application (COLA); reliance on nuclear as generation.	Resolution of design criteria through certification; resolution of site, construction and operational issues in COLA; reliance on nuclear as generation.	Resolution of design criteria through certification; resolution of site, construction and operational issues in COLA; reliance on nuclear as generation.	Resolution of design criteria through certification; resolution of site, construction and operational issues in COLA; reliance on nuclear as generation.
Carbon Emissions (reduction)	Coal: (1,908,000 carbon dioxide equivalents [CO2e]) Natural Gas: (623,000 CO2e) Nuclear: No carbon emissions.	Coal and Natural Gas: It is assumed that carbon emissions reduction would be similar to the BBNPP. Nuclear: No carbon emissions.	Coal and Natural Gas: It is assumed that carbon emissions reduction would be similar to the BBNPP. Nuclear: No carbon emissions.	Coal and Natural Gas: It is assumed that carbon emissions reduction would be similar to the BBNPP. Nuclear: No carbon emissions.
Increased Customer Choice	Retail choice of 'clean' energy source in addition to menu of renewable sources.	Retail choice of 'clean' energy source in addition to menu of renewable sources.	Retail choice of 'clean' energy source in addition to menu of renewable sources.	Retail choice of 'clean' energy source in addition to menu of renewable sources.

Table 10.4-1—Benefits and Costs of the Proposed Project Summarized

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Benefit Category	Proposed Site BBNPP Site	Option 1 Montour Site	Option 2 Sandy Bend Site	Option 3 Martins Creek Site
Local Economy	Over 3,900 full-time equivalents will be added to the workforce for construction of the new facility (see Section 4.4.2). It is anticipated that a workforce of approximately 363 employees would be needed for operation (see Section 5.8.2). Construction and operation workforce impacts are MODERATELY and SMALL respectively.	A workforce similar to the size anticipated for the BBNPP is assumed.	A workforce similar to the size anticipated for the BBNPP is assumed.	A workforce similar to the size anticipated for the BBNPP is assumed.
Aesthetic Values	Selection of design and cooling tower technology allows for minimal esthetic impacts. Site contains existing nuclear power facility structures.	Selection of design and cooling tower technology allows for minimal esthetic impacts.	Selection of design and cooling tower technology allows for minimal esthetic impacts.	Selection of design and cooling tower technology allows for minimal esthetic impacts.
Air Quality	Major beneficial impact in terms of avoidance of fossil-fuel power plant emissions.	Major beneficial impact in terms of avoidance of fossil-fuel power plant emissions.	Major beneficial impact in terms of avoidance of fossil-fuel power plant emissions.	Major beneficial impact in terms of avoidance of fossil-fuel power plant emissions.
Land Use	Land to be used for the new reactor unit and appurtenant structures is owned by PPL. The required land will need to be rezoned for development of the nuclear facility.	Land adjacent to the existing Montour coal-fired generating facility is owned by PPL and is of sufficient size for a new reactor unit and appurtenant structures. The required land will need to be rezoned for development of the nuclear facility.	Land will need to be acquired for the Sandy Bend site. The required land will need to be re-zoned for development of the nuclear facility.	Buffer land across the river from the Martins Creek natural-gas generating facility in New Jersey is owned by a PPL subsidiary and is of sufficient size for a new reactor unit and appurtenant structures. The required land will need to be rezoned for development of the nuclear facility.

Table 10.4-1—Benefits and Costs of the Proposed Project Summarized
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Benefit Category	Proposed Site BBNPP Site	Option 1 Montour Site	Option 2 Sandy Bend Site	Option 3 Martins Creek Site
State/Local Tax Payments during Construction and Operations	Construction will generate tax revenues from sources including income tax, retail sales tax on materials, supplies, and selected construction services; retail sales tax on expenditures by workers; and corporate income taxes paid by contractors. During operation of the facility, local government tax revenues will accrue from property taxes and permitting and impact fees. Tax payments would occur annually over the life of the new reactor. Overall SMALL benefit to area from tax revenues (see Sections 4.4.2 and 5.8.2).	Construction will generate tax revenues from sources including income tax, retail sales tax on materials, supplies, and selected construction services; retail sales tax on expenditures by workers; and corporate income taxes paid by contractors. During operation of the facility, local government tax revenues will accrue from property taxes and permitting and impact fees. Tax payments would occur annually over the life of the new reactor unit and are expected to be similar to the BBNPP. Overall SMALL benefit to area from tax revenues.	Construction will generate tax revenues from sources including income tax, retail sales tax on materials, supplies, and selected construction services; retail sales tax on expenditures by workers; and corporate income taxes paid by contractors. During operation of the facility, local government tax revenues will accrue from property taxes and permitting and impact fees. Tax payments would occur annually over the life of the new reactor unit and are expected to be similar to the BBNPP. Overall SMALL benefit to area from tax revenues.	Construction will generate tax revenues from sources including income tax; retail sales tax on materials, supplies, and selected construction services; retail sales tax on expenditures by workers; and corporate income taxes paid by contractors. During operation of the facility, local government tax revenues will accrue from property taxes and permitting and impact fees. Tax payments would occur annually over the life of the new reactor unit and are expected to be similar to the BBNPP. Overall SMALL benefit to area from tax revenues.
Effects on Regional Productivity	Anticipate an increase in regional productivity through the influx of construction and station operation workers. Workers will create additional new indirect (service-related) jobs in the region through the multiplier effect of direct employment. Construction workforce and their families will increase the population in the area. The expenditures of construction and facility operation workers for food, shelter, and services will create jobs, which will have a SMALL to MODERATE positive impact on the economy of the region. Job creation will reduce unemployment and create business opportunities.	Anticipate an increase in regional productivity through the influx of construction and station operation workers. Workers will create additional new indirect (service-related) jobs in the region through the multiplier effect of direct employment. Construction workforce and their families will increase the population in the area. The expenditures of construction and facility operation workers for food, shelter, and services will create jobs, which will have a SMALL to MODERATE positive impact on the economy of the region. Job creation will reduce unemployment and create business opportunities.	Anticipate an increase in regional productivity through the influx of construction and station operation workers. Workers will create additional new indirect (service-related) jobs in the region through the multiplier effect of direct employment. Construction workforce and their families will increase the population in the area. The expenditures of construction and facility operation workers for food, shelter, and services will create jobs, which will have a SMALL to MODERATE positive impact on the economy of the region. Job creation will reduce unemployment and create business opportunities.	Anticipate an increase in regional productivity through the influx of construction and station operation workers. Workers will create additional new indirect (service-related) jobs in the region through the multiplier effect of direct employment. Construction workforce and their families will increase the population in the area. The expenditures of construction and facility operation workers for food, shelter, and services will create jobs, which will have a SMALL to MODERATE positive impact on the economy of the region. Job creation will reduce unemployment and create business opportunities.

Table 10.4-1—Benefits and Costs of the Proposed Project Summarized

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Benefit Category	Proposed Site BBNPP Site	Option 1 Montour Site	Option 2 Sandy Bend Site	Option 3 Martins Creek Site
Technical and Other Non-Monetary Improvements (e.g., New Recreational Facilities and Improvements to Local Facilities)	Located adjacent to an existing nuclear facility (SSES). Anticipate that existing local and county police, fire, and medical facilities and/or personnel would be able to accommodate the influx of construction and facility operation workers. Anticipate that the existing water supply and the township wastewater treatment facilities can accommodate the added increase in population. Anticipate that the existing education and social services facilities can accommodate the increase in population. Construction and operation activities should not have long-term, adverse impacts to recreational use of the surrounding area. It is anticipated that neither technical developments nor recreational enhancements are anticipated at this time from the construction and operation of the proposed nuclear facility. In addition, minor road improvements would occur near the proposed nuclear facility, on an as needed basis, to support construction and operation activities.	Located adjacent to the existing Montour Coal Plant. Anticipate the need for additional local and county police, fire, and medical facilities and/or personnel to accommodate the influx of construction and facility operation workers. Anticipate the need for a site-specific wastewater treatment facility/system - either onsite or municipal system if available - to accommodate the added increase in population. Anticipate the need for additional education and social services facilities to accommodate the increase in population. Construction and operation activities should not have long-term, adverse impacts to recreational use of the surrounding area. It is anticipated that neither technical developments nor recreational enhancements are anticipated at this time from the construction and operation of the proposed nuclear facility. In addition, minor road improvements would occur near the proposed nuclear facility, on an as needed basis, to support construction and operation activities.	Anticipate the need for additional local and county police, fire, and medical facilities and/or personnel to accommodate the influx of construction and facility operation workers. Anticipate the need for a site-specific wastewater treatment facility/system - either onsite or municipal system if available - to accommodate the added increase in population. Anticipate the need for additional education and social services facilities to accommodate the increase in population. Construction and operation activities should not have long-term, adverse impacts to recreational use of the surrounding area. It is anticipated that neither technical developments nor recreational enhancements are anticipated at this time from the construction and operation of the proposed nuclear facility. In addition, minor road improvements would occur near the proposed nuclear facility, on an as needed basis, to support construction and operation activities.	Anticipate the need for additional local and county police, fire, and medical facilities and/or personnel to accommodate the influx of construction and facility operation workers. Anticipate the need for a site-specific wastewater treatment facility/system - either onsite or municipal system if available - to accommodate the added increase in population. Anticipate the need for additional education and social services facilities to accommodate the increase in population. Construction and operation activities should not have long-term, adverse impacts to recreational use of the surrounding area. It is anticipated that neither technical developments nor recreational enhancements are anticipated at this time from the construction and operation of the proposed nuclear facility. In addition, minor road improvements would occur near the proposed nuclear facility, on an as needed basis, to support construction and operation activities.

Table 10.4-1—Benefits and Costs of the Proposed Project Summarized

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Benefit Category	Proposed Site BBNPP Site	Option 1 Montour Site	Option 2 Sandy Bend Site	Option 3 Martins Creek Site
Environmental Enhancement	Reduction in carbon emissions with the use of nuclear power. The BBNPP site has a smaller number of listed, threatened, or endangered species and critical habitat than the other sites. The need for transmission line upgrades is significantly less for the BBNPP site than the other sites.	Reduction in carbon emissions with the use of nuclear power.	Reduction in carbon emissions with the use of nuclear power.	Reduction in carbon emissions with the use of nuclear power.
INTERNAL COSTS				
Construction Cost Note: Cost value is a roll-up of the Internal Cost values for constructing the facility, which include land, labor, materials, and equipment).	The proposed reactor at BBNPP has a rated core thermal power of 4,590 MWt and a rated net electrical output of greater than or equal to 1,600 MWe. The estimated total project capital cost for BBNPP is provided in Part 9 of the COL Application.	It is anticipated that the installed reactor will be similar to the proposed reactor at the BBNPP. It is assumed that construction costs will be similar to the BBNPP site.	It is anticipated that the installed reactor will be similar to the proposed reactor at the BBNPP. It is assumed that construction costs will be similar to the BBNPP site.	It is anticipated that the installed reactor will be similar to the proposed reactor at the BBNPP. It is assumed that construction costs will be similar to the BBNPP site.

Table 10.4-1—Benefits and Costs of the Proposed Project Summarized

Benefit Category	Proposed Site BBNPP Site	Option 1 Montour Site	Option 2 Sandy Bend Site	Option 3 Martins Creek Site
Transmission System	The BBNPP site would be co-located with the existing Susquehanna Steam Electric Station (SSES) Units 1 and 2. As such, transmission lines would be located in the immediate vicinity of the proposed site and be using existing transmission corridors. New transmission lines will connect to the existing Susquehanna switchyard. Therefore, transmission system upgrade costs would be minimal compared to the other sites. Transmission system environmental impacts from construction and operation would be SMALL.	The Montour site would require a transmission system an upgrade. Approximately 30 mi (48.3 km) of transmission corridor would need to be upgraded or approximately 13 mi (20.9 km) of transmission corridor would have to be constructed to access the 500 kilovolt (kV) transmission system at its closest approach to the Montour site. Impacts to transmission corridors during construction would be MODERATE due to the commitment of land and construction impacts associated with the transmission system upgrades on ecological resources. Utilization of existing transmission corridor right-of-ways (ROWs) could present opportunities to minimize adverse impacts. Impacts during operation, such as visual inspection, maintenance of lines, and reclearing of the ROW, would be SMALL.	New transmission lines and corridors would be necessary to connect the proposed facility at the Sandy Bend site to an existing transmission system. It is anticipated that approximately 3.5 mi (5.6 km) of new transmission system corridor would be needed. Transmission corridor impacts during construction would be SMALL to MODERATE due to the commitment of land and construction impacts associated with the transmission system upgrades on ecological resources. Utilization of existing transmission corridor ROWs (if available) could present opportunities to minimize adverse impacts. Impacts during operation, such as visual inspection, maintenance of lines, and reclearing of the ROW, would be SMALL.	Transmission system upgrades (circuits, towers, lines, corridors) would be needed to connect Martins Creek site to the nearest 500-kV line, approximately 23 mi (37 km) away. Impacts to transmission corridors during construction would be MODERATE to LARGE due to the commitment of land and construction impacts associated with the transmission system upgrades on ecological resources. Utilization of existing transmission corridor ROWs could present opportunities to minimize adverse impacts. Impacts during operation, such as visual inspection, maintenance of lines, and reclearing of the ROW, would be SMALL.
Operating Cost Note: Cost value is a roll-up of the Internal Cost values for operating the facility which include labor, materials, and services).	Production cost is estimated to be [$0.0155/kWh.] (PPL, 2006)	Costs would be similar to those at the BBNPP site.	Costs would be similar to those at the BBNPP site.	Costs would be similar to those at the BBNPP site.

Table 10.4-1—Benefits and Costs of the Proposed Project Summarized

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Benefit Category	Proposed Site BBNPP Site	Option 1 Montour Site	Option 2 Sandy Bend Site	Option 3 Martins Creek Site
Land Use	The BBNPP is located on land already owned by PPL. Site is characterized primarily by farmland. As discussed in Section 4.1.1, construction activities will result in the permanent loss, through filling, of approximately 36 acres (14.6 hectares) of wetland habitat. Mitigation measures are described in Section 4.3.1.6. Siting of a nuclear facility at the BBNPP site would require a land use change. Overall land use impacts from construction are anticipated to be MODERATE, primarily due to loss of wetlands, and would require mitigation. Land use impacts from operation are anticipated to be SMALL.	The Montour site is on land located in a rural and agricultural area of Montour County, Pennsylvania, and owned by PPL. The surrounding land has been cleared for agricultural purposes. Siting of a nuclear facility at this site would require a land use change. Overall land use impacts from construction and operation are anticipated to be SMALL.	The Sandy Bend site is a brownfield site located in Mifflin County, Pennsylvania. The surrounding land has been cleared for agricultural purposes. Siting of a nuclear facility at this site would require a land use change. Overall land use impacts from construction and operation are anticipated to be SMALL	The Martins Creek site, which is owned by PPL, is a greenfield site located across the Delaware River from the Martins Creek natural-gas fired generating facility. The site consists of agricultural lands with some areas of undeveloped forest land. Siting of a nuclear facility at this site would require a land use change. Overall land use impacts from construction and operation are anticipated to be SMALL
Materials	Construction materials include: concrete, aggregate, rebar, conduit, cable, piping, building supplies, and tools. Operating materials include uranium fuel.	Construction materials include: concrete, aggregate, rebar, conduit, cable, piping, building supplies, and tools. Operating materials include uranium fuel.	Construction materials include: concrete, aggregate, rebar, conduit, cable, piping, building supplies, and tools. Operating materials include uranium fuel.	Construction materials include: concrete, aggregate, rebar, conduit, cable, piping, building supplies, and tools. Operating materials include uranium fuel.
Equipment	Typical construction equipment will include cranes, cement trucks, excavation equipment, dump truck, and graders. Equipment for the new facility would include the necessary components for the facility, such as the reactors, turbines, cooling systems, water processing/ treatment systems, and cooling towers.	Typical construction equipment will include cranes, cement trucks, excavation equipment, dump truck, and graders. Equipment for the new facility would include the necessary components for the facility, such as the reactors, turbines, cooling systems, water processing/ treatment systems, and cooling towers.	Typical construction equipment will include cranes, cement trucks, excavation equipment, dump truck, and graders. Equipment for the new facility would include the necessary components for the facility, such as the reactors, turbines, cooling systems, water processing/ treatment systems, and cooling towers.	Typical construction equipment will include cranes, cement trucks, excavation equipment, dump truck, and graders. Equipment for the new facility would include the necessary components for the facility, such as the reactors, turbines, cooling systems, water processing/ treatment systems, and cooling towers.

Table 10.4-1—Benefits and Costs of the Proposed Project Summarized

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Benefit Category	Proposed Site BBNPP Site	Option 1 Montour Site	Option 2 Sandy Bend Site	Option 3 Martins Creek Site
Services	Support services and supplies would be needed during construction. Security, maintenance, trash removal, and/or landscaping services may be needed during operation of the facility.	Support services and supplies would be needed during construction. Security, maintenance, trash removal, and/or landscaping services may be needed during operation of the facility.	Support services and supplies would be needed during construction. Security, maintenance, trash removal, and/or landscaping services may be needed during operation of the facility.	Support services and supplies would be needed during construction. Security, maintenance, trash removal, and/or landscaping services may be needed during operation of the facility.
Water Use	As stated in Section 5.2.1.2, the average water demand from the Susquehanna River for operation of BBNPP is estimated at 25,721 gpm (97,354 Lpm). (Ref. 5.1-4) As stated in Section 4.2.1.3, the average construction water usage is estimated at 96 gpm (363 Lpm). The Susquehanna River will supply adequate surface water for plant use. Water use impacts associated with construction activities would be SMALL to MODERATE, while impacts associated with operations would be SMALL.	It is estimated that consumptive water use for a nuclear facility at the Montour site would be similar to that which is proposed for the BBNPP site. The Montour site would require routing makeup and blowdown pipelines approximately 14 miles to the Susquehanna River. Water use impacts associated with construction and operations are anticipated to be SMALL.	It is estimated that consumptive water use for a nuclear facility at the Sandy Bend site would be similar to that which is proposed for the BBNPP site. The Sandy Bend site would require routing makeup and blowdown pipelines approximately 2 miles to the river. Water use impacts associated with construction and operations are anticipated to be SMALL.	It is estimated that consumptive water use for a nuclear facility at the Martins Creek site would be similar to that which is proposed for the BBNPP site. The primary water source is the Delaware River. Construction-related water impacts are anticipated to be SMALL. Operations-related water use impacts are anticipated to be SMALL during periods of normal to high flow due to the relatively small percentage of flow that would be consumed. However, under periods of extreme low flow, the operations related water use impacts are anticipated to be MODERATE due to the consumptive water use being approximately 13% of the flow.
EXTERNAL COSTS				
Air Quality	The power facility must meet applicable federal, state, and local air quality permitting regulations. Air quality impacts from construction and operation are anticipated to be SMALL.	The power facility must meet applicable federal, state, and local air quality permitting regulations. Air quality impacts from construction and operation are anticipated to be SMALL.	The power facility must meet applicable federal, state, and local air quality permitting regulations. Air quality impacts from construction and operation are anticipated to be SMALL.	The power facility must meet applicable federal, state, and local air quality permitting regulations. Air quality impacts from construction and operation are anticipated to be SMALL.

Table 10.4-1—Benefits and Costs of the Proposed Project Summarized

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Benefit Category	Proposed Site BBNPP Site	Option 1 Montour Site	Option 2 Sandy Bend Site	Option 3 Martins Creek Site
Terrestrial Biology	Terrestrial species that are listed as threatened or endangered by U.S. Fish and Wildlife Service (USFWS) and the Commonwealth of Pennsylvania and have the potential to occur within Luzerne County are presented in Section 2.4.1. No rare, threatened, or endangered species are known to occur in the immediate vicinity of the site. Wetlands that may be impacted upon by construction of the proposed facility are discussed in Section 4.3. Terrestrial impacts from construction and operations are anticipated to be SMALL.	Terrestrial species that are listed as threatened or endangered by USFWS and the Commonwealth of Pennsylvania and have the potential to occur within Montour County are presented in Section 9.3.2. No rare, threatened, or endangered species are known to occur in the immediate vicinity of the site. Wetlands impacts from construction of the proposed facility are discussed in Section 9.3. Terrestrial impacts from construction are anticipated to be MODERATE, while terrestrial impacts from operations are anticipated to be SMALL.	Terrestrial species that are listed as threatened or endangered by USFWS and the Commonwealth of Pennsylvania and have the potential to occur within Mifflin County are presented in Section 9.3.2. No rare, threatened, or endangered species are known to occur in the immediate vicinity of the site. Wetlands that may be impacted by construction of the proposed facility are discussed in Section 9.3. Terrestrial impacts from construction are anticipated to SMALL to MODERATE, while terrestrial impacts from operations are anticipated to be SMALL.	Terrestrial species that are listed as threatened or endangered by USFWS and the State of New Jersey and have the potential to occur within Warren County are presented in Section 9.3.2. There are several State and federally listed protected terrestrial species that have the potential to occur in Warren County. Wetlands that may be impacted by construction of the proposed facility are discussed in Section 9.3. Terrestrial impacts from construction are anticipated to SMALL to MODERATE, while terrestrial impacts from operations are anticipated to be SMALL.

Table 10.4-1—Benefits and Costs of the Proposed Project Summarized

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Benefit Category	Proposed Site BBNPP Site	Option 1 Montour Site	Option 2 Sandy Bend Site	Option 3 Martins Creek Site
Aquatic Biology	No aquatic species that are listed as threatened or endangered by USFWS and the Commonwealth of Pennsylvania and have been collected at the site as described in Section 2.4.2. Proposed facilities at the site will include cooling towers that would reduce the amount of cooling water withdrawal required for plant operation. Through the use of cooling towers with an appropriate intake design, it is anticipated that potential adverse impacts from entrainment or impingement of aquatic organism would be minor and would not significantly disrupt existing populations. Operation under the National Pollutant Discharge Elimination System (NPDES) permit should result in the maintenance of a balanced, indigenous population of fish, shellfish, and other aquatic organisms in the vicinity of the discharge structure. Aquatic ecology impacts from construction and operations are anticipated to be SMALL.	Aquatic species that are listed as threatened or endangered by USFWS and the Commonwealth of Pennsylvania and have the potential to occur in Montour County are presented in Section 9.3.2. Proposed facilities at the site will include cooling towers that would reduce the amount of cooling water withdrawal required for plant operation. Through the use of cooling towers with an appropriate intake design, it is anticipated that potential adverse impacts from entrainment or impingement of aquatic organism would be minor and would not significantly disrupt existing populations. Operation under the NPDES permit should result in the maintenance of a balanced, indigenous population of fish, shellfish, and other aquatic organisms in the vicinity of the discharge structure. Aquatic ecology impacts from construction are anticipated to be MODERATE based on commitment of land and construction of pipeline and transmission system corridors. Aquatic ecology impacts from operations are anticipated to be SMALL.	Aquatic species that are listed as threatened or endangered by USFWS and the Commonwealth of Pennsylvania and have the potential to occur in Mifflin County are presented in Section 9.3.2. Proposed facilities at the site will include cooling towers that would reduce the amount of cooling water withdrawal required for plant operation. Through the use of cooling towers with an appropriate intake design, it is anticipated that potential adverse impacts from entrainment or impingement of aquatic organism would be minor and would not significantly disrupt existing populations. Operation under the NPDES permit should result in the maintenance of a balanced, indigenous population of fish, shellfish, and other aquatic organisms in the vicinity of the discharge structure. Aquatic ecology impacts from construction are anticipated to be SMALL to MODERATE based on expansion of the transmission system corridor. Aquatic impacts from operations are anticipated to be SMALL.	Aquatic species that are listed as threatened or endangered by USFWS and the State of New Jersey and have the potential to occur in Warren County are presented in Section 9.3.2. There is one federally listed threatened or endangered aquatic invertebrate species in Warren County. While the probability of the glochidia becoming entrained in the cooling water intake system is very low due to the relatively large volume of water in the Delaware River, there is a possibility of impact due to known populations existing in Warren County. Proposed facilities at the site will include cooling towers that would reduce the amount of cooling water withdrawal required for plant operation. Through the use of cooling towers with an appropriate intake design, it is anticipated that potential adverse impacts from entrainment or impingement of aquatic organism would be minor and would not significantly disrupt existing populations.

Table 10.4-1—Benefits and Costs of the Proposed Project Summarized

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Benefit Category	Proposed Site BBNPP Site	Option 1 Montour Site	Option 2 Sandy Bend Site	Option 3 Martins Creek Site
Aquatic Biology (continued)				Operation under the NPDES permit should result in the maintenance of a balanced, indigenous population of fish, shellfish, and other aquatic organisms in the vicinity of the discharge structure. Aquatic ecology impacts from construction are anticipated to be SMALL to MODERATE based on loss of habitat and wetlands associated with expansion of the transmission system. Aquatic impacts from operations are considered to be SMALL to MODERATE due to the presence and potential entrainment of a federally listed endangered species.

Table 10.4-1—Benefits and Costs of the Proposed Project Summarized

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Benefit Category	Proposed Site BBNPP Site	Option 1 Montour Site	Option 2 Sandy Bend Site	Option 3 Martins Creek Site
Socioeconomic	Socioeconomic impacts associated with the construction and operation of BBNPP is discussed in Section 5.8. Employment projections indicate a readily available workforce or employment during the construction and operation phase of the project. Most construction workers would come from within region surrounding the site. Should a larger-than-expected number of construction workers come from outside the region, there could be a noticeable increase in population, but it would not be excessive. Socioeconomic impacts (adverse and beneficial) from construction activities are expected to be SMALL to MODERATE. Beneficial impacts from operations activities are expected to be SMALL to LARGE.	Socioeconomic impacts associated with the construction and operation of a nuclear facility at the Montour site is discussed in Section 9.3. Employment projections within the area indicate a general upward trend in the availability of various construction jobs An increase of available jobs indicates additional competition in acquiring a workforce for the construction of the proposed facility. It is assumed that many of the direct and indirect jobs created by the proposed facility would require a largely migrating workforce. The impact of the proposed facility on the population and demographics of Montour County is expected to be SMALL.	Socioeconomic impacts associated with the construction and operation of a nuclear facility at the Sandy Bend site is discussed in Section 9.3. Employment projections within the area indicate a general upward trend in the availability of various construction jobs An increase of available jobs indicates additional competition in acquiring a workforce for the construction of the proposed facility. It is assumed that many of the direct and indirect jobs created by the proposed facility would require a largely migrating workforce. The impact of the proposed facility on the population and demographics of Mifflin County is expected to be SMALL.	Socioeconomic impacts associated with the construction and operation of a nuclear facility at the Martins Creek site is discussed in Section 9.3. It is expected that most construction workers would come from within region surrounding the site. Should a larger-than-expected number of construction workers come from outside the region, there could be a noticeable increase in population, but it would not be excessive. The overall population level is anticipated to be sufficiently large that the impact on area employment from construction and operation of the new unit would be low. It is expected that the impact on housing and community services would be negligible. The impact of the proposed facility on the population and demographics of Warren County is expected to be SMALL.
Housing	As identified in Section 4.4.2.4, there are adequate housing units available to address the influx of both temporary and permanent workforce required to support a nuclear power generating facility.	There are adequate housing units available to address the influx of both temporary and permanent workforce required to support a nuclear power generating facility.	There are adequate housing units available to address the influx of both temporary and permanent workforce required to support a nuclear power generating facility.	There are adequate housing units available to address the influx of both temporary and permanent workforce required to support a nuclear power generating facility.

Table 10.4-1—Benefits and Costs of the Proposed Project Summarized

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Benefit Category	Proposed Site BBNPP Site	Option 1 Montour Site	Option 2 Sandy Bend Site	Option 3 Martins Creek Site
Local Infrastructure	Local infrastructure surrounding the BBNPP site is discussed in Sections 2.1 and 2.2. Transportation routes near the site are limited to state and county roads, and include major highways in Luzerne County (near the BBNPP site), Pennsylvania. Emergency evacuation of the area is possible. The site is adjacent to the existing SSES Units 1 and 2 and brings the advantage of already having an emergency plan that could easily be adapted to include the new site. Increased traffic at beginning and end of shifts may increase traffic on highways to and from plant. Little impact on availability of services is anticipated. Overall impacts to local infrastructure would be SMALL.	Local infrastructure surrounding the Montour site is discussed in Section 9.3. Transportation routes near the site are limited to state and county roads. The proposed site would require the upgrade/construction of new roads to access the site. There is existing infrastructure for the Montour Coal Power Plant that could be used to support the proposed facility. Emergency evacuation of the area is possible. An emergency plan is already in place (for the Montour Coal Plant) that could easily be adapted to include the new site. Increased traffic at beginning and end of shifts may increase traffic on highways to and from plant. Little impact on availability of services is anticipated. Overall impacts to local infrastructure would be SMALL.	Local infrastructure surrounding the Sandy Bend site is discussed in Section 9.3. Infrastructure necessary to support a large industrial facility is currently not in place. Transportation routes near the site are limited to federal, state and county roads. The site is accessed from Sandy Bend Road, a local road which would most likely need to be improved to accommodate construction and operation activities. The site also has access to an active rail line adjacent to the site. Emergency evacuation of the area is possible. However, the site would require an emergency plan. Increased traffic at beginning and end of shifts may increase traffic on highways to and from plant. Overall impacts to local infrastructure would be SMALL.	Local infrastructure surrounding the Martins Creek site is discussed in Section 9.3. Transportation routes near the site are limited to county and local roads. Emergency evacuation of the area is possible. The site is across the Delaware River from the existing Martins Creek natural gas-fired generating facility and brings the advantage of already having an emergency plan that could easily be adapted to include the new site. Increased traffic at beginning and end of shifts will significantly increase traffic on county and local roads to and from plant. Overall impacts to local infrastructure would be MODERATE.
Radiological Heath	Radiological exposure below limits to workers and public.	Radiological exposure below limits to workers and public.	Radiological exposure below limits to workers and public.	Radiological exposure below limits to workers and public.
Loss of Resources	Loss of resources is discussed in Sections 10.1, 10.2, and 10.3. It is expected that losses will be mitigated to minimize the impact of the loss.	Loss of resources is discussed in Sections 10.1, 10.2, and 10.3. It is expected that losses will be mitigated to minimize the impact of the loss.	Loss of resources is discussed in Sections 10.1, 10.2, and 10.3. It is expected that losses will be mitigated to minimize the impact of the loss.	Loss of resources is discussed in Sections 10.1, 10.2, and 10.3. It is expected that losses will be mitigated to minimize the impact of the loss.
Measures and Controls to Reduce Environmental Impact	Costs associated with mitigation will be SMALL, since the nuclear unit would be built adjacent to an existing nuclear site. The existing nuclear plant's mitigation and environmental monitoring programs may be expanded to account for the proposed new unit, thereby potentially reducing mitigation costs.	Costs associated with mitigation will be MODERATE, since the nuclear unit would be built on an undeveloped site. Mitigation and environmental monitoring programs will need to be implemented to account for the new unit.	Costs associated with mitigation will be MODERATE, since the nuclear unit would be built on an undeveloped site. Mitigation and environmental monitoring programs will need to be implemented to account for the new unit.	Costs associated with mitigation will be MODERATE, since the nuclear unit would be built on an undeveloped site. Mitigation and environmental monitoring programs will need to be implemented to account for the new unit.

10.5 CUMULATIVE IMPACTS

Sections 10.1 through 10.3 summarize the adverse environmental impacts from construction and operation of the Bell Bend Nuclear Power Plant (BBNPP) that are potentially unavoidable, irreversible or irretrievable. Measures to mitigate these impacts are also discussed. Section 10.4 compares the environmental and economic costs and benefits of the facility. This section summarizes the potential cumulative adverse environmental impacts to the BBNPP region. Cumulative impacts include those that are incremental to past and ongoing activities on the site, along with those that are reasonably foreseeable in the future.

This evaluation of cumulative impacts is based on a comparison between the existing environmental conditions presented in Chapter 2 and the potential adverse environmental impacts of construction and operation detailed in Chapter 4 and Chapter 5, respectively. The evaluation also considers continued operation and license renewal of SSES Units 1 and 2.

The BBNPP Owner Controlled Area will consist of approximately 882 acres (357 hectares) located in Luzerne County. BBNPP will be located near the existing nuclear power plant site currently occupied by SSES Units 1 and 2. Approximately 630 acres (255 hectares) will be affected during construction and of these, approximately 365 acres (148 hectares) will converted to permanent structures and facilities. The BBNPP power block will occupy approximately 61 acres (25 hectares). The BBNPP site will consist of 424 ac (172 ha) within the BBNPP Owner Controlled Area.

The BBNPP site is approximately 1.5 mi (2.4 km) north and west of the Susquehanna River in Salem Township, Pennsylvania (PA). The site is approximately 5 mi (8 km) northeast of the borough of Berwick. The major facilities and/or employers located nearby include the Berwick Hospital, Berwick Offray, Berwick Retirement Village, Deluxe Building Systems, SSES and Wise Foods. The 50 mi (80 km) radius surrounding the site includes parts of 22 Pennsylvania counties.

Land use in Luzerne and Columbia Counties in the vicinity of the site is predominantly farm, forest and residential housing. The BBNPP site consists mostly of mixed deciduous forest, and fields associated with previous agricultural activities. BBNPP will occupy areas that currently include both farmland and forest, yet structures and construction activities will be located to minimize impacts on the remaining forest. The topography of the site is a gently rolling plateau with east-west trending ridges to the north. Grade elevations at the site range from 485 ft (148 m) mean sea level at the Susquehanna River to 650 ft (200 m) at the southwest corner of the site, and approximately 800 ft (244 m) on the hill north of the power block. The highest point of the finished grade level is approximately 673 ft (205 m) above sea level.

The eastern boundary of the BBNPP site is the Susquehanna River. The river is approximately 440 mi (708 km) long, originating at Lake Otsego in south-central New York, and discharging into Chesapeake Bay at Havre de Grace, Maryland (PPL, 2006). Freshwater input comes from several major tributaries upstream of the BBNPP site, and include the Lackawanna and Chemung Rivers. Total drainage upriver of the site is approximately 10,240 square miles (26,522 km^2).

10.5.1 CUMULATIVE IMPACTS FROM CONSTRUCTION

Construction impacts associated with BBNPP include grading and clearing, allocation of land to material lay-down and parking, use of ground and surface waters, equipment noise and emissions, increased traffic and use of public resources. These activities are consistent with those conducted during the construction of SSES Units 1 and 2. Many of the impacts will be

temporary and most can be mitigated through the use of best management construction practices and stormwater pollution prevention planning required under State and Federal regulation.

The principal sources of water for construction include local municipal water, Susquehanna River water and offsite water that will be trucked in. Limited amounts of groundwater pumped from excavations for manufacture of concrete will be used during construction. It is estimated that water use on work days will average from 77,800 gpd (294,000 lpd) to 138,000 gpd (522,000 lpd). Municipal water provided by the Berwick District of Pennsylvania American Water (PAW) will satisfy domestic needs. PAW obtains its water from groundwater wells located in Berwick, PA.

Impacts on wetlands, surface waters and groundwater resources may result from activities that change flow patterns such as construction of sedimentation impoundments, stream channelization, stormwater runoff and dewatering, or discharge of construction related waste effluents. It is anticipated that several ponds, streams and wetlands will be affected by these activities, totaling approximately 36 acres (14.6 hectares). Environmental controls will conform to applicable regulations and best practices to minimize these effects. Examples include sediment control, stormwater retention, spill prevention, and control of construction debris. Efforts to reclaim areas not occupied by permanent structures or to provide offsetting habitat such as reforestation and constructed wetlands will also be evaluated.

While much of the site has historically experienced alterations to support development such as agriculture, protection of important or otherwise unique terrestrial habitats will be considered in developing the construction plan for BBNPP. Surveys of the site were undertaken to identify sensitive locations and protected species, and efforts made to limit encroachment on these areas. Examples include locations with federally or state designated threatened or endangered species, wetland buffers and contiguous forest areas. While certain state or federal designated faunal species were found onsite or may occur in the site's vicinity, their presence was not found to be unique to areas potentially affected by construction. No rare, threatened or endangered plants were found on site.

Impacts to aquatic organisms found within freshwater ponds and streams on site and within the Susquehanna River may be realized to the extent onsite surface waters are removed, dredging is performed and water quality is affected. A survey of aquatic resources identified that no unique aquatic species occur within the construction zone. The fish communities within the onsite ponds were typical of warm water ponds, dominated by sunfish and catfish species generally considered ubiquitous and found in nearby waters. Walker Run, a free flowing stream, was more typical of a cold water habitat. Aquatic macroinvertebrates on site were dominated by dipteran, mayfly and caddisfly species. A portion of site wetlands will be permanently lost, and while they are considered a sensitive resource, the on-site wetlands are not unique or otherwise distinguishable from other wetlands in the area.

The Susquehanna River is a valuable natural resource in that it sustains active recreational fisheries for several fish species including smallmouth bass, muskellunge, northern pike, walleye and bullhead, among others. The river supports two mussel species listed by the Pennsylvania Natural Diversity Inventory as species of concern, the yellow lampmussel *(Lampsilis cariosa)* and the green floater *(Lasmigona subviridis)*. The Asiatic clam *(Corbicula fluminea)* is also found in the BBNPP vicinity. However, the river is typical of habitats found upstream and downstream of the BBNPP site and otherwise provides no unique or protected habitat. No migratory species have collected in the BBNPP reach of the river. Potential impacts

to the Susquehanna River would be associated with construction of the cooling water intake and discharge structures.

The Circulating Water System (CWS) and Raw Water Supply System (RWSS) will utilize a common intake structure located just to the south of the existing SSES Units 1 and 2 intake structure. Construction of the intake will involve installation of a cofferdam of interlocking sheetpile, and excavation to bedrock. Dredging of the areas approaching the new intake structure and the installation of sheet pile may create some suspended sediment and remove some benthic substrate. However, the river bed in this area is coarse sand and gravel and, as a result, excess turbidity during construction activities will be limited. The discharge diffuser installation process will be similar. Activities in navigable waters will conform to applicable Pennsylvania and U.S. Army Corps of Engineers regulations.

Impacts to aquatic macroinvertebrates in the river will be negligible as previous studies conducted for SSES Units 1 and 2 indicate that the benthic organisms are similar at locations upstream and downstream of the BBNPP site and are not otherwise unique. Upon removal of the coffer dams, the benthic substrate should stabilize, allowing benthic species to quickly recolonize. Further, there are no endangered or threatened aquatic species in the BBNPP site area of the river that could be affected by sedimentation or sediment removal. As a result, cumulative construction impacts to the Susquehanna River are not expected.

The BBNPP construction impact on onsite surface and groundwater resources will be MODERATE (see Section 4.2.1.9.) However, the preventive measures and corrective actions identified above and the short-term nature of construction activities should limit long-term cumulative impacts. As a result, the cumulative impact on regional surface and groundwater from BBNPP construction in conjunction with the continued operation of SSES Units 1 and 2 should be SMALL. Additionally, the use of the existing offsite transmission right-of-way will limit the amount of land and related natural resources potentially impacted by construction.

An archaeological survey identified historical sites in the vicinity of BBNPP that are potentially eligible for listing on the National Register of Historic Places. A total of 24 previously recorded sites were identified within 1 mi (1.6km) of the BBNPP site and five architectural resources within 0.5 mi (0.8 km). Six potential sites were located along the west bank of the Susquehanna River near the location of the new BBNPP intake structure. Phase Ib archaeological investigations on the BBNPP site, and subsequent consultation with the Pennsylvania State Historic Preservation Officer (SHPO) are underway to identify the presence of additional archeological sites and to determine their eligibility for listing on the National Register of Historic Places. Preliminary results of the Phase 1b studies yielded 2,047 artifacts, eleven archaeological sites, and 26 prehistoric finds. Construction activities will be managed to minimize encroachment on any sites potentially found. Appropriate disposition of historical sites that cannot be avoided will be determined in conjunction the PA SHPO.

Potential adverse cumulative impacts to public health and wellbeing stem from construction related noise, increased vehicular traffic, aesthetics and emissions. Noise levels will increase during construction with operation of heavy equipment and vehicles. While there are no local or state criteria for noise for the BBNPP site, EPA and the Housing and Urban Development Administration (HUD) have established criteria for acceptable outdoor noise. Excess noise levels that may occur during construction will be minimized at the site boundary as a result of distance, topography and surrounding forest. The nearest residence is approximately 1400 ft (427m) from the BBNPP site. For onsite workers, it will be necessary to meet Occupational Safety and Health Administration (OSHA) exposure limits through training and use of personal protective equipment. Cumulative impacts are not expected as construction related noise will

cease upon completion of the construction activities. The sources of noise from operations include the switchyard, transformers, cooling towers and traffic. A baseline noise survey of existing conditions showed that there was no observed offsite audible noise from the operation of SSES Units 1 and 2. Traffic noise will be limited to normal work day business hours during shift changes. Noise from the new onsite switchyard and transformers will be similar to that currently associated with SSES Units 1 and 2. It has been determined that, when taken together, the additional noise associated with BBNPP is not expected to alter predictions that noise levels offsite will not represent an adverse cumulative impact.

Traffic will increase during construction as workers commute from within and outside Luzerne County. The main highway 11, will experience additional traffic during shift change over. It is estimated that the peak construction workforce will exceed 3,900 full time equivalents. The total workforce potentially on site or traveling to the site during BBNPP construction, including the SSES Units 1 and 2 operations personnel, would approach approximately almost 5,200 individuals. During an outage at Units 1 and 2, the total workforce on site would approach 6,600 people.

A new access road will be constructed onsite to accommodate the excess traffic resulting from BBNPP construction. The access road will remain the primary entrance for BBNPP during operation when the number of workers is dramatically reduced. Heavy equipment, plant components and construction materials will be hauled in by rail, thus avoiding temporary blockage of local highways. Construction of the access road, use of rail for heavy equipment, and the decrease in workers following construction will limit the cumulative impacts of traffic. A traffic study of potential impacts identified mitigation alternatives for implementation during the construction period. These include appropriately placed traffic signals at nearby intersections and additional access lanes at the BBNPP access road intersection with Route 11. Dust, engine exhaust and other facility operations will result in construction related emissions. Protective actions will be required to ensure that applicable ambient air quality and hazardous pollutant regulations are met. Applicable permits will be obtained and construction practices, such as dust control, will be implemented so that cumulative impacts onsite from emissions are limited and are discontinued following construction.

Topography of the site and surrounding forest canopy will limit visibility of construction activities. However, as construction proceeds, structures such as the CWS cooling towers and containment structure will be visible from nearby vantage points. Except for activities related to the intake and discharge, construction will occur approximately 1 mile (1.6 km) inland of the river, further reducing visibility from the water surface during periods when leaves are on the trees. Following construction, the plant's discharge will be routed through a multi-port diffuser located on the bottom of the river. The intake structure will be confined to the southern end of the property, will be visible from the river, and its appearance will be consistent with the SSES Units 1 and 2 intake structure.

Socioeconomic benefits accrue from capital expenditures as well as the increased number of jobs created during construction and the additional spending that results. It is estimated that, during BBNPP construction, a total of between 966 and 1,690 households would move into the Region of Influence (ROI); 42% of these would relocate to Luzerne County and 45% to Columbia County. An increase of between 954 and 1,670 indirect workers would also occur. For each dollar spent, indirect revenue would be generated within the ROI. This influx may impact various public service institutions such as fire, EMS, education and recreational facilities. However, as a percentage, the increase in population is small and the financial benefit to local governments large, providing opportunities to address capacity.

No disproportionate impact on minority populations is anticipated due to relatively low percent occurrence of minority groups within the two-county ROI. The year 2006 U.S. census data show that only 5.2% of the population within Luzerne County was minority and only 3.0% within Columbia County, significantly less than the 16.2% within the Commonwealth of Pennsylvania population. Of the 314 census block groups within Luzerne County, only 4 block groups were defined as being a racial minority. Columbia County had no minority census block groups. The percentage of low income families within Luzerne County was 13.1%, somewhat higher than the state's average (12.1%). The percentage of low income families in Columbia was 10.7%. The median income in both counties was less than for the state and the U.S. To the extent additional higher paying jobs are provided by BBNPP, there will be a beneficial impact within the ROI.

Construction workers onsite could receive some radiation dose from the continued operation of SSES Units 1 and 2. Doses were calculated based on exposure to direct radiation, gaseous effluents and liquid effluents. The annual maximum dose was estimated to be less than the public dose criteria of 100 mrem/yr (1000 µSv/yr). Total collective dose during the construction period from all onsite sources is discussed in ER Section 4.5.5.

In summary, the construction of BBNPP will not result in long-term cumulative impacts that are inconsistent with existing land use. Activities that occur during construction will be managed using best management practices and compliance with applicable regulations to limit both short-term and long-term adverse impacts. Where necessary, actions to mitigate construction impacts will be evaluated and discussed with applicable regulatory agencies. Furthermore, impacts will cease following completion of BBNPP and efforts made to reclaim those areas not required for operations.

10.5.2 CUMULATIVE IMPACTS OF OPERATIONS

Potential cumulative adverse impacts from operations include the withdrawal of water from the Susquehanna River, discharge of cooling tower blowdown, radiological dose consequences, waste generation, etiological agents, potential for electrostatic shock, electromagnetic interference, noise from the CWS and ESWS cooling towers and socioeconomic changes. Each of these potential impacts is discussed below.

Because BBNPP will utilize closed-cycle cooling, the amount of cooling water withdrawn from the Susquehanna River will be significantly reduced below that required for once-through cooling. The two natural draft CWS cooling towers are approximately 475 ft (145 m) high and 350 ft (107 m) in diameter. It is estimated that the BBNPP CWS and RWSS will withdraw approximately 25,729 gpm (97,384 lpm) on average to replace evaporative loss, drift, and blowdown. Blowdown to the retention basins of the CWS and Essential Service System (ESWS), and ultimately to the Susquehanna River, will total approximately 8,497 gpm (32,161 lpm). Maximum CWS and RWSS cooling water makeup demand is approximately 28,179 gpm (106,656 lpm).

The ESWS will utilize closed-cycle cooling, and will have 4 wet mechanical forced draft cooling towers above 4 rectangular pools. The ESWS cooling towers will typically be supplied with fresh water from the RWSS. Makeup flow to the ESWS cooling towers during normal operations will be approximately 1,713 gpm (7,124 lpm). Blowdown from the ESWS cooling towers will be routed to the retention basin, and ultimately the Susquehanna River, and will be approximately 569 gpm (2,154 lpm). Maximum ESWS cooling water makeup demand is approximately 3,426 gpm (12,967 lpm). Evaporative loss and drift from the CWS towers will be approximately 15,872 gpm (60,076 lpm), while evaporative loss and drift from the four ESWS towers will total 1,144 gpm (4,330 lpm).

Physical impacts of cooling system water withdrawal could include alteration of site hydrology in the immediate vicinity of the intake structure. However, it is estimated that the BBNPP makeup water withdrawal rate during normal operations would represent less than 1% of average Susquehanna River flow and approximately 7% at (7Q10) low flow. Since the amount of cooling water to be used for BBNPP and SSES Units 1 and 2 is a small fraction of river flow, there should be no incremental cumulative adverse impact to the Susquehanna hydrology.

Aquatic impacts attributable to operation of the BBNPP intake structure and cooling water systems include impingement of organisms on the traveling screens and entrainment of fish eggs and larvae within the cooling system. Use of closed-cycle cooling systems at BBNPP will significantly reduce these impacts compared to power plants that operate open-cycle (once-through) cooling. In addition, BBNPP will incorporate design criteria to limit intake approach velocities to less than 0.5 ft/sec (0.15 m/sec).

Although a small amount of entrainment will occur, studies indicate that the BBNPP site area is not a spawning area for key species of recreational value, and that entrainment at SSES Units 1 and 2 has not resulted in detectable changes in population levels. Further, the dominant species that occur in the BBNPP site area of the Susquehanna River have not been identified as requiring habitat protection.

Blowdown from the cooling towers is returned to the Susquehanna River through a submerged multi-port diffuser. The temperature of this discharge will be several degrees above ambient creating a small thermal plume. Modeling of this plume shows that its size and distribution will meet all State water quality criteria and will be sufficiently small that it is unlikely to cause impacts to the Susquehanna River's benthic community or motile organisms in the area.

Included in the blowdown discharge are chemicals used in biocide treatment and in plant process control. The concentrations discharged will be in conformance with National Pollutant Discharge Elimination System (NPDES) permit conditions and applicable water quality criteria. Additionally, the amount of water being discharged from the closed-cycle system will be small compared to river flow, such that concentrations of chemicals discharged will rapidly disperse. Solids will be allowed time for settlement and chemical treatment in the onsite retention basins, if required.

Because of the use of closed-cycle cooling, the incremental increase in surface water withdrawal from operation of BBNPP in addition to the SSES Units 1 and 2 should not result in cumulative adverse ecological impacts. The combined withdrawal at mean river flow conditions is about 1%.

Excess heat within the CWS will be dissipated to the environment using two natural draft cooling towers. A visible plume is created when a portion of the cooling water evaporates as it leaves the tower, undergoing partial condensation. Typical impacts from the resulting plume include fogging, icing, and water and solids deposition. The extent of these impacts was simulated using predictive models. The plume length varies with season. The average plume length for the BBNPP CWS cooling towers is predicted to range between a low of 0.274 mi (0.440 km) during summer and a high of 0.615 mi (0.990 km) during spring. The annual average predicted plume length would be 0.372 mi (0.599 km). Average plume height would range from 776 ft (236 m) in summer to 961 ft (293 m) in winter. Fogging and icing from the natural draft towers is not predicted to occur. Since heat loads from the four ESWS trains is only a small fraction (3%) of the CWS towers, impacts would be considerably less and any cumulative effect is expected to be small.

Some deposition of solids from operation of the CWS cooling towers is predicted to occur (ER Section 5.3.3.1). Model predictions indicate that the maximum deposition from the CWS cooling towers is expected to be below NUREG-1555 (NRC, 1999) significance levels for possible vegetation damage.

While the new cooling towers to be installed and operated as part of the BBNPP closed-cycle cooling water system will create a visible plume, the cumulative impact offsite is expected to vary by season and primarily be a function of viewpoint.

Elevated temperatures within cooling tower systems are known to promote the growth of thermophilic bacteria such as Legionella sp., amoeba such as Naegleria sp., and fungi. Thermophilic organisms are typically associated with freshwater and the Nuclear Regulatory Commission (NRC) has linked health issues to power plants that use cooling ponds, lakes and canals, and that discharge to small rivers. Given Susquehanna River flow, the growth and dispersion of thermophilic organisms is not expected to present a human exposure health threat. Biocide treatment of the CWS will limit the propagation and dispersal of thermophilic organisms. Furthermore, there is no evidence that the operation of the SSES Units 1 and 2 towers has caused any related health or aquatic impacts.

Cumulative impacts on land use and the terrestrial environment are expected to be minimal given that the final footprint of the BBNPP structures will be permanently established following construction and no new transmission corridors offsite will be required. Terrestrial vegetative and faunal species that are critical to structure and function have been identified and impacts are predicted to stabilize following construction. Implementation of a Stormwater Pollution Prevention Plan will also serve to limit future impacts of erosion and inadvertent releases from industrial activities onsite.

Bird mortality from collision is a concern particularly at sites where tall structures such as natural draft cooling towers extend well beyond the tree canopy. However, collisions with towers historically have shown to have only minor impacts on bird populations. Removal of habitat immediately surrounding the towers and the presence of strobe lights will limit bird impaction events.

With respect to increased potential for electrostatic effects (electric shock), the BBNPP switchyard would be electrically integrated with the existing Susquehanna 500 kV Yard, the new Susquehanna 500 kV Yard 2 by constructing two 500 kV, 4,260 MVA, lines on individual towers. The existing 500 kV transmission towers are designed and constructed to National Electric Safety Code (NESC) and PJM Transmission and Substation Design Subcommittee Technical Requirements. The design and construction of the BBNPP substation and transmission circuits would comply with this NESC provision, and the new towers added to support BBNPP will also conform to these criteria. As part of the design process, the transmission lines are analyzed to determine electrical field strengths and to verify conformance with NESC requirements on line clearance to limit shock from induced currents. Additionally, since these lines are not to be energized until the end of the project, exposure of the construction phase work force to field gradients would be minimal. Furthermore, any maintenance access roads are not anticipated to increase the public exposure to electric field gradients. Finally, it has been determined that occupants in cars and buses are generally safe from potential shock from overhead high voltage lines. The structures and equipment on the BBNPP site will be adequately grounded in the course of designing and constructing the BBNPP. As a result, cumulative impacts of electric shock are expected to be minimal. [Refer to Section 5.6.3]

Generally, electromagnetic interference with radio or television from transmission lines is caused by corona discharge from defective insulators or hardware. The existing BBNPP transmission lines are designed and constructed to minimize corona. The lines supporting BBNPP will also be designed and constructed to minimize corona. As such, it is expected that radio and television interference from these new lines will be minimal. [Refer to Section 5.6.3.7]

The sources of noise from operations include the switchyard, transformers, CWS and ESWS cooling towers and traffic. A baseline noise survey of existing conditions showed that there was no observed offsite audible noise from the operation of SSES Units 1 and 2. A modeled prediction of noise from the CWS cooling towers shows that day and nighttime noise levels beyond the site boundary will be below both the EPA and HUD acceptable outdoor level of 55 dBA. There are two residences to the west of the plant that appear to be within th 50 dBA sound contour, where noise would be perceptible during quiet periods of the day and imperceptible at other times. The noise from the ESWS two cell mechanical draft cooling towers will also be less than the EPA and HUD recommendations at these locations. Traffic noise will be limited to normal work day business hours during shift changes. Noise from the new onsite switchyard and transformers will be similar to that currently associated with SSES Units 1 and 2. Taken together, the additional noise associated with BBNPP is not expected to alter predictions that noise levels offsite will not represent an adverse cumulative impact.

Air emissions are limited by U.S. EPA standards and state permits as well as by OSHA worker health based standards. The primary sources of operational related emissions are the four emergency diesel generators and two station blackout diesel generators. Periodic testing of the diesels is required to ensure their operability. The diesel generator engines are designed and operated to meet the increasingly stringent emission standards.

Additional emissions reductions from the diesel generators will be achieved through the purchase of low sulfur fuels. Carbon dioxide production will be limited to that small amount attributed to testing of the diesel generators. By contrast, a typical coal plant produces greater than 1,000 g CO_2eq/kWh as compared to a typical nuclear power plant that produces on average approximately 5 g CO_2eq/kWh. Natural gas plants have a corresponding carbon footprint of approximately 500 g CO_2eq/kWh.

Exposure of the general public to radiation from the operation of BBNPP is a function of meteorology, relative location, population density, land use practices, harvest and consumption of food sources, and allowable radiological release limits. Dose consequences result from liquid and gaseous releases and from direct radiation. Each of these potential pathways has been analyzed to ensure that applicable public health exposure limits are met.

In addition, the potential dose from the operation of BBNPP has been combined with that predicted for SSES Units 1 and 2. Results show that applicable NRC exposure limits are met, and that while there will be dose consequences resulting from operation of BBNPP, exposure will remain within applicable limits and will not represent an adverse cumulative impact.

Conservative estimates of radiological dose to biota also demonstrate that exposure to key selected species should result in no observable effects. An existing long-term radiological monitoring program will continue to verify that dose consequences to the general public are as low as reasonably achievable (ALARA).

The uranium fuel cycle will contribute to cumulative impacts from fuel production, transportation, storage and disposal. Related environmental impacts are attributed to land and water use, electrical consumption, chemical effluents, radioactive effluents and waste

generation. The cumulative impacts from each of these sources has been reviewed based on an NRC mandated comparative assessment detailed in 10 CFR 51.51(a) (CFR, 2007).

Non-radioactive and mixed-wastes will be produced during BBNPP operations. Typically these consist of recyclables, solid waste debris, and sewage. Cumulative impacts will be managed through implementation of waste minimization practices including the procurement process, allocation of material for work, storage and recycling. Wastes that can not be recycled will be stored and disposed in accordance with applicable state and federal hazardous and non-hazardous waste regulations, and at licensed liquid and solid waste disposal locations. Properly sized and designed onsite facilities for storage will be provided and procedures put in place to deal with potential spills and emergency response.

Socioeconomic impacts (benefits) from long-term BBNPP operation result from the increased operational work force, facility taxes, and generation of competitively priced electricity. Approximately 363 additional employees will be required to support BBNPP operations. Most of these employees are expected to reside primarily within Luzerne and Columbia Counties. The BBNPP workforce will result in increased indirect employment of approximately 690 individuals.

An overall increase in population is expected as families relocate, acquire housing and utilize public services. It is estimated that the additional workforce will increase population within Luzerne and Columbia Counties by approximately 1,366 people compared to the existing 378,034 people (2006 Census) or an increase of approximately 0.4%. An analysis of available housing suggests that adequate supply is currently available to support the influx of operational employees.

BBNPP operational direct and indirect workforce would add about 268 and 284 new households to Luzerne and Columbia Counties, respectively. The number of students in these households would represent an increase of about 0.1% of the existing public and private student enrollment. Furthermore, existing police, fire, EMS, and school districts appear to have adequate capacity, and the additional tax revenue that Luzerne County would realize will provide for increased resources if needed.

While there will be an overall socioeconomic benefit from the operation of BBNPP, the cumulative impact, as a percentage, appears to be small. The median income of residents within Luzerne and Columbia Counties is below that of the state and U.S. To the extent workers are able to seek employment at BBNPP, there would be a net benefit to the ROI. Because the relative proportion of racial minorities in the ROI is small, the relative impact or benefit should not be disproportionate.

There are currently two known projects within the ROI that may compete for resources or otherwise increase demands on public services. These include a new 42 in (106.7 cm) natural gas pipeline in Luzerne County, PA and the Susquehanna-Roseland electrical transmission line. Transco proposes to expand its existing Leidy gas pipeline to allow additional transport of gas to southern New York. This project is estimated to cost approximately $121 million. Part of the pipeline is located in Luzerne County (FERC, 2006). The new electrical transmission line would run from a substation near Berwick, PA to Roseland New Jersey, a total of approximately 130 mi (209 km). The cost of the transmission line is expected to range between $900 and $1 billion (FERC, 2008). Cumulative impact of these projects, in combination with BBNPP, would be small with respect to competition for construction resources since the gas pipeline and electrical transmission line construction resource requirements are different from those required for BBNPP. Furthermore, only a small portion of gas pipeline and transmission line projects would

occur within the ROI. Additionally, plans are being reviewed for a possible Cargo Airport in Hazleton, Pennsylvania, however, funding has not been finalized at this time. However, collectively, these projects would likely provide an economic benefit from additional employment and expenditures within the ROI during the construction periods.

10.5.3 CUMULATIVE IMPACTS SUMMARY

The potential adverse short-term and long-term impacts from the construction and operation of BBNPP have been identified and actions to mitigate those impacts proposed. Activities to be undertaken during construction and operation of BBNPP are consistent with those currently in place for SSES Units 1 and 2. Except for the construction footprint, available land use and the terrestrial environmental will remain unchanged.

Operation of the new unit will require the use of certain natural resources including water withdrawal from the Susquehanna River for cooling and will result in the release of gaseous, liquid and solid wastes, all in conformance with applicable Local, State, and Federal permit requirements and standards. Economic benefits accrue from capital expenditures, additional tax revenue and the jobs created during construction and operation. The environmental assessment demonstrates that cumulative adverse impacts to the vicinity and to the region will be SMALL.

10.5.4 REFERENCES

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