4.0 Environmental Impacts of Operation

Environmental issues associated with operation of a nuclear power plant during the renewal term are discussed in the *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (GEIS), NUREG-1437, Volumes 1 and 2 (NRC 1996, 1999).[(a)] The GEIS includes a determination of whether the analysis of the environmental issues could be applied to all plants and whether additional mitigation measures would be warranted. Issues are then assigned a Category 1 or a Category 2 designation. As set forth in the GEIS, Category 1 issues are those that meet all of the following criteria:

(1) The environmental impacts associated with the issue have been determined to apply either to all plants or, for some issues, to plants having a specific type of cooling system or other specified plant or site characteristics.

(2) A single significance level (i.e., SMALL, MODERATE, or LARGE) has been assigned to the impacts (except for collective offsite radiological impacts from the fuel cycle and from high-level waste and spent fuel disposal).

(3) Mitigation of adverse impacts associated with the issue has been considered in the analysis, and it has been determined that additional plant-specific mitigation measures are likely not to be sufficiently beneficial to warrant implementation.

For issues that meet the three Category 1 criteria, no additional plant-specific analysis is required unless new and significant information is identified.

Category 2 issues are those that do not meet one or more of the criteria for Category 1, and, therefore, additional plant-specific review of these issues is required.

This chapter addresses the issues related to operation during the renewal term that are listed in Table B-1 of Title 10, Part 51, of the *Code of Federal Regulations* (10 CFR Part 51), Subpart A, Appendix B, and are applicable to the Susquehanna Steam Electric Station, Units 1 and 2 (SSES). Section 4.1 addresses issues applicable to the SSES cooling system. Section 4.2 addresses issues related to transmission lines and onsite land use. Section 4.3 addresses the radiological impacts of normal operation, and Section 4.4 addresses issues related to the socioeconomic impacts of normal operation during the renewal term. Section 4.5 addresses issues related to groundwater use and quality, while Section 4.6 discusses the impacts of

(a) The GEIS was originally issued in 1996. Addendum 1 to the GEIS was issued in 1999. Hereafter, all references to the "GEIS" include the GEIS and its Addendum 1.

renewal-term operations on threatened and endangered species. Section 4.7 addresses potential new information that was raised during the scoping period, and Section 4.8 discusses cumulative impacts. The results of the evaluation of environmental issues related to operation during the renewal term are summarized in Section 4.9. Category 1 and Category 2 issues that are not applicable to SSES because they are related to plant design features or site characteristics not found at SSES are listed in Appendix F.

4.1 Cooling System

Category 1 issues in Table B-1 of 10 CFR Part 51, Subpart A, Appendix B, that are applicable to SSES cooling system operation during the renewal term are listed in Table 4-1. PPL stated in its Environmental Report (ER) (PPL 2006a) that it is not aware of any new and significant information associated with the renewal of the operational licenses (OLs) for SSES Units 1 and 2. The NRC staff has not identified any new and significant information during its independent review of the SSES ER (PPL 2006a), or the site audit, the scoping process, and evaluation of other available information, such as operation of SSES at a combined total power level of 7904 megawatts thermal (MW(t)) as a result of the recently-approved extended power uprate (EPU) license amendment. Therefore, the NRC staff concludes that there are no impacts related to these issues beyond those discussed in the GEIS. For all of the issues, the NRC staff concluded in the GEIS that the impacts would be SMALL, and additional plant-specific mitigation measures are not likely to be sufficiently beneficial to warrant implementation.

A brief description of the NRC staff's review and the GEIS conclusions, as codified in 10 CFR Part 51, Table B-1, for each of these issues follows:

Table 4-1. Category 1 Issues Applicable to the Operation of the SSES Cooling System During the Renewal Term

ISSUE–10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Section
SURFACE WATER QUALITY, HYDROLOGY, AND USE (FOR ALL PLANTS)	
Altered current patterns at intake and discharge structures	4.2.1.2.1
Temperature effects on sediment transport capacity	4.2.1.2.3
Scouring caused by discharged cooling water	4.2.1.2.3
Eutrophication	4.2.1.2.3
Discharge of chlorine or other biocides	4.2.1.2.4
Discharge of sanitary wastes and minor chemical spills	4.2.1.2.4
Discharge of other metals in wastewater	4.2.1.2.4

AQUATIC ECOLOGY (FOR ALL PLANTS)	
Accumulation of contaminants in sediments or biota	4.2.1.2.4
Entrainment of phytoplankton and zooplankton	4.2.2.1.1
Cold shock	4.2.2.1.5
Thermal plume barrier to migrating fish	4.2.2.1.6
Distribution of aquatic organisms	4.2.2.1.6
Premature emergence of aquatic insects	4.2.2.1.7
Gas supersaturation (gas bubble disease)	4.2.2.1.8
Low dissolved oxygen in the discharge	4.2.2.1.9
Losses from predation, parasitism, and disease among organisms exposed to sublethal stresses	4.2.2.1.10
Stimulation of nuisance organisms	4.2.2.1.11
AQUATIC ECOLOGY (FOR PLANTS WITH COOLING-TOWER-BASED HEAT DISSIPATION SYSTEMS)	
Entrainment of fish and shellfish in early life stages	4.3.3
Impingement of fish and shellfish	4.3.3
Heat shock	4.3.3
TERRESTRIAL RESOURCES	
Cooling tower impacts on crops and ornamental vegetation	4.3.4
Cooling tower impacts on native plants	4.3.5.1
Bird collisions with cooling towers	4.3.5.2
HUMAN HEALTH	
Microbiological organisms (occupational health)	4.3.6
Noise	4.3.7

- Altered current patterns at intake and discharge structures. Based on information in the GEIS, the Commission found that

  > Altered current patterns have not been found to be a problem at operating nuclear power plants and are not expected to be a problem during the license renewal term.

  The NRC staff has not identified any new and significant information during its independent review of the SSES ER, or the site audit, the scoping process, and evaluation of other available information, such as the environmental assessment (EA)

that evaluated impacts of the EPU at SSES (NRC 2007a). Therefore, the NRC staff concludes that there would be no impacts of altered current patterns at intake and discharge structures during the renewal term beyond those discussed in the GEIS.

- Temperature effects on sediment transport capacity. Based on information in the GEIS, the Commission found that

  > These effects have not been found to be a problem at operating nuclear power plants and are not expected to be a problem during the license renewal term.

  The NRC staff has not identified any new and significant information during its independent review of the SSES ER, or the site audit, the scoping process, and evaluation of other available information, such as the EA that evaluated a proposed uprate at SSES (NRC 2007a). Therefore, the NRC staff concludes that there would be no impacts of temperature effects on sediment transport capacity during the renewal term beyond those discussed in the GEIS.

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- Scouring caused by discharged cooling water. Based on information in the GEIS, the Commission found that

  > Scouring has not been found to be a problem at most operating nuclear power plants and has caused only localized effects at a few plants. It is not expected to be a problem during the license renewal term.

  The NRC staff has not identified any new and significant information during its independent review of the SSES ER, or the site audit, the scoping process, and evaluation of other available information, such as the EA that evaluated impacts of the EPU at SSES (NRC 2007a). Therefore, the NRC staff concludes that there would be no impacts of scouring caused by discharged cooling water during the renewal term beyond those discussed in the GEIS.

- Eutrophication. Based on information in the GEIS, the Commission found that

  > Eutrophication has not been found to be a problem at operating nuclear power plants and is not expected to be a problem during the license renewal term.

  The NRC staff has not identified any new and significant information during its independent review of the SSES ER, or the site audit, the scoping process, and evaluation of other available information, such as the EA that evaluated impacts of the

EPU at SSES (NRC 2007a). Technical reports reviewed included *Environmental Studies in the Vicinity of the Susquehanna Steam Electric Station – Water Quality and Fishes* and annual reports for the years of 1986, 1994, 2003, and 2005 (Ecology III 1987a, 1995, 2003, 2007). Therefore, the NRC staff concludes that there would be no impacts of eutrophication during the renewal term beyond those discussed in the GEIS.

- Discharge of chlorine or other biocides. Based on information in the GEIS, the Commission found that

  > Effects are not a concern among regulatory and resource agencies, and are not expected to be a problem during the license renewal term.

  The NRC staff has not identified any new and significant information during its independent review of the SSES ER, or the site audit, the scoping process, and evaluation of other available information, such as the EA that evaluated impacts of the EPU at SSES (NRC 2007a). Documents reviewed included the current Pennsylvania National Pollutant Discharge Elimination System (NPDES) permit for SSES (Permit No. PA-0047325), contained in the SSES ER as Attachment F (PPL 2006a), and the U.S. Environmental Protection Agency's (EPA's) *Envirofacts Data Warehouse*, which lists no past or current NPDES violations for SSES (EPA 2007). Therefore, the NRC staff concludes that there would be no impacts of discharge of chlorine or other biocides during the renewal term beyond those discussed in the GEIS.

- Discharge of sanitary wastes and minor chemical spills. Based on information in the GEIS, the Commission found that

  > Effects are readily controlled through NPDES permit and periodic modifications, if needed, and are not expected to be a problem during the license renewal term.

  The NRC staff has not identified any new and significant information during its independent review of the SSES ER, or the site audit, the scoping process, and evaluation of other available information, such as the EA that evaluated impacts of the EPU at SSES (NRC 2007a). Documents reviewed included the current SSES NPDES permit and the EPA's *Envirofacts Data Warehouse*, which lists no past or current NPDES violations for SSES (EPA 2007), as well as the "Pollution Incident History," located in Attachment 22A, Revision 9, of the SSES *Preparedness Prevention and Contingency (PPC) Plan* (PPL 2007). Therefore, the NRC staff concludes that there would be no impacts of discharges of sanitary wastes and minor chemical spills during the renewal term beyond those discussed in the GEIS.

- Discharge of other metals in wastewater. Based on information in the GEIS, the Commission found that

  > These discharges have not been found to be a problem at operating nuclear power plants with cooling-tower-based heat dissipation systems and have been satisfactorily mitigated at other plants. They are not expected to be a problem during the license renewal term.

  The NRC staff has not identified any new and significant information during its independent review of the SSES ER, or the site audit, the scoping process, and evaluation of other available information, such as the EA that evaluated impacts of the EPU at SSES (NRC 2007a). Documents reviewed included the current SSES NPDES permit and the EPA's *Envirofacts Data Warehouse*, which lists no past or current NPDES violations for SSES (EPA 2007). Therefore, the NRC staff concludes that there would be no impacts of discharges of other metals in wastewater during the renewal term beyond those discussed in the GEIS.

- Accumulation of contaminants in sediments or biota. Based on information in the GEIS, the Commission found that

  > Accumulation of contaminants has been a concern at a few nuclear power plants but has been satisfactorily mitigated by replacing copper alloy condenser tubes with those of another metal. It is not expected to be a problem during the license renewal term.

  The NRC staff has not identified any new and significant information during its independent review of the SSES ER, or the site audit, the scoping process, and evaluation of available information, such as the EA that evaluated impacts of the EPU at SSES (NRC 2007a). Therefore, the NRC staff concludes that there would be no impacts of accumulation of contaminants in sediments or biota during the renewal term beyond those discussed in the GEIS.

- Entrainment of phytoplankton and zooplankton. Based on information in the GEIS, the Commission found that

  > Entrainment of phytoplankton and zooplankton has not been found to be a problem at operating nuclear power plants and is not expected to be a problem during the license renewal term.

  The NRC staff has not identified any new and significant information during its independent review of the SSES ER, or the site audit, the scoping process, and

evaluation of other available information, such as the EA that evaluated impacts of the EPU at SSES (NRC 2007a). Documents reviewed included *Environmental Studies in the Vicinity of the Susquehanna Steam Electric Station – Water Quality and Fishes* and annual reports for the years of 1984, 1986, and 1994 (Ecology III 1985, 1987a, 1995). Therefore, the NRC staff concludes that there would be no impacts of entrainment of phytoplankton and zooplankton during the renewal term beyond those discussed in the GEIS.

- Cold shock. Based on information in the GEIS, the Commission found that

> Cold shock has been satisfactorily mitigated at operating nuclear plants with once-through cooling systems, has not endangered fish populations or been found to be a problem at operating nuclear power plants with cooling towers or cooling ponds, and is not expected to be a problem during the license renewal term.

The NRC staff has not identified any new and significant information during its independent review of the SSES ER, or the site audit, the scoping process, and evaluation of other available information, such as the EA that evaluated impacts of the EPU at SSES (NRC 2007a). Documents reviewed included the Final Environmental Statement (FES) for the operation of SSES (NRC 1981) and *Thermal Plume Studies in the Susquehanna River at the Discharge Diffuser of the Susquehanna Steam Electric Station, 1986-87* (Ecology III 1987b). Therefore, the NRC staff concludes that there would be no impacts of cold shock during the renewal term beyond those discussed in the GEIS.

- Thermal plume barrier to migrating fish. Based on information in the GEIS, the Commission found that

> Thermal plumes have not been found to be a problem at operating nuclear power plants and are not expected to be a problem during the license renewal term.

The NRC staff has not identified any new and significant information during its independent review of the SSES ER, or the site audit, the scoping process, and evaluation of other available information, such as the EA that evaluated impacts of the EPU at SSES (NRC 2007a). Documents reviewed included the FES for the operation of SSES (NRC 1981) and *Thermal Plume Studies in the Susquehanna River at the Discharge Diffuser of the Susquehanna Steam Electric Station, 1986-87* (Ecology III 1987b). Therefore, the NRC staff concludes that there would be no impacts of thermal

plume barriers to migrating fish during the renewal term beyond those discussed in the GEIS.

- Distribution of aquatic organisms. Based on information in the GEIS, the Commission found that

  > Thermal discharge may have localized effects but is not expected to affect the larger geographical distribution of aquatic organisms.

  The NRC staff has not identified any new and significant information during its independent review of the SSES ER, or the site audit, the scoping process, and evaluation of other available information, such as the EA that evaluated impacts of the EPU at SSES (NRC 2007a). Documents reviewed included *Environmental Studies in the Vicinity of the Susquehanna Steam Electric Station – Water Quality and Fishes* and annual reports for the years of 1986, 1994, 2003, and 2005 (Ecology III 1987a, 1995, 2003, 2007). Therefore, the NRC staff concludes that there would be no impacts on distribution of aquatic organisms during the renewal term beyond those discussed in the GEIS.

- Premature emergence of aquatic insects. Based on information in the GEIS, the Commission found that

  > Premature emergence has been found to be a localized effect at some operating nuclear power plants but has not been a problem and is not expected to be a problem during the license renewal term.

  The NRC staff has not identified any new and significant information during its independent review of the SSES ER, or the site audit, the scoping process, and evaluation of other available information, such as the EA that evaluated impacts of the EPU at SSES (NRC 2007a). Therefore, the NRC staff concludes that there would be no impacts of premature emergence of aquatic insects during the renewal term beyond those discussed in the GEIS.

- Gas supersaturation (gas bubble disease). Based on information in the GEIS, the Commission found that

  > Gas supersaturation was a concern at a small number of operating nuclear power plants with once-through cooling systems but has been satisfactorily mitigated. It has not been found to be a problem at operating nuclear power plants with cooling towers or cooling ponds and is not expected to be a problem during the license renewal term.

The NRC staff has not identified any new and significant information during its independent review of the SSES ER, or the site audit, the scoping process, and evaluation of other available information, such as the EA that evaluated impacts of the EPU at SSES (NRC 2007a). Therefore, the NRC staff concludes that there would be no impacts of gas supersaturation during the renewal term beyond those discussed in the GEIS.

- Low dissolved oxygen in the discharge. Based on information in the GEIS, the Commission found that

  > Low dissolved oxygen has been a concern at one nuclear power plant with a once-through cooling system but has been effectively mitigated. It has not been found to be a problem at operating nuclear power plants with cooling towers or cooling ponds and is not expected to be a problem during the license renewal term.

  The NRC staff has not identified any new and significant information during its independent review of the SSES ER, or the site audit, the scoping process, and evaluation of other available information, such as the EA that evaluated impacts of the EPU at SSES (NRC 2007a). Therefore, the NRC staff concludes that there would be no impacts of low dissolved oxygen during the renewal term beyond those discussed in the GEIS.

- Losses from predation, parasitism, and disease among organisms exposed to sublethal stresses. Based on information in the GEIS, the Commission found that

  > These types of losses have not been found to be a problem at operating nuclear power plants and are not expected to be a problem during the license renewal term.

  The NRC staff has not identified any new and significant information during its independent review of the SSES ER, or the site audit, the scoping process, and evaluation of other available information, such as the EA that evaluated impacts of the EPU at SSES (NRC 2007a). Documents reviewed included *Environmental Studies in the Vicinity of the Susquehanna Steam Electric Station – Water Quality and Fishes* and annual reports for the years of 1986, 1994, 2003, and 2005 (Ecology III 1987a, 1995, 2003, 2007). Therefore, the NRC staff concludes that there would be no impacts of losses from predation, parasitism, and disease among organisms exposed to sublethal stresses during the renewal term beyond those discussed in the GEIS.

- Stimulation of nuisance organisms. Based on information in the GEIS, the Commission found that

  > Stimulation of nuisance organisms has been satisfactorily mitigated at the single nuclear power plant with a once-through cooling system where previously it was a problem. It has not been found to be a problem at operating nuclear power plants with cooling towers or cooling ponds and is not expected to be a problem during the license renewal term.

  The NRC staff has not identified any new and significant information during its independent review of the SSES ER, or the site audit, the scoping process, and evaluation of other available information, such as the EA that evaluated impacts of the EPU at SSES (NRC 2007a). Therefore, the NRC staff concludes that there would be no impacts from stimulation of nuisance organisms during the renewal term beyond those discussed in the GEIS.

- Entrainment of fish and shellfish in early life stages (cooling-tower-based heat dissipation). Based on information in the GEIS, the Commission found that

  > Entrainment of fish has not been found to be a problem at operating nuclear power plants with this type of cooling system and is not expected to be a problem during the license renewal term.

  The NRC staff has not identified any new and significant information during its independent review of the SSES ER, or the site audit, the scoping process, and evaluation of other available information, such as the EA that evaluated impacts of the EPU at SSES (NRC 2007a). Documents reviewed included the *Susquehanna Steam Electric Station 316(b) Entrainment Demonstration Program for National Pollution Discharge Elimination System Permit No. Pa. 004735 Special Condition C, Part C*, dated July 1982 (PPL 1982). Therefore, the NRC staff concludes that there would be no impacts of entrainment of fish and shell fish in early life stages for cooling-tower-based systems during the renewal term beyond those discussed in the GEIS.

- Impingement of fish and shellfish (cooling-tower-based heat dissipation). Based on information in the GEIS, the Commission found that

  > The impingement of fish and shellfish has not been found to be a problem at operating nuclear power plants with this type of cooling system and is not expected to be a problem during the license renewal term.

The NRC staff has not identified any new and significant information during its independent review of the SSES ER, or the site audit, the scoping process, and evaluation of other available information, such as the EA that evaluated impacts of the EPU at SSES (NRC 2007a). Documents reviewed included the *Susquehanna Steam Electric Station Annual Environmental Operating Report (Nonradiological)* for the years from 1999 to 2005, which each include a discussion of annual impingement rates (PPL 2000, 2001, 2002, 2003, 2004, 2005a, 2006c). As discussed in Section 4.3.3 of the GEIS, even low rates of impingement at closed-cycle cooling systems can be a concern when an unusually important resource is affected, such as an anadromous fish undergoing restoration. As an example, the GEIS cites the American shad (*Alosa sapidissima*) in the Susquehanna River, and reports that losses of shad at SSES are minimal or nonexistent; however, periodic monitoring is recommended. As part of its annual environmental monitoring program, SSES routinely monitors its intake screens for aquatic organisms, paying particular attention to the American shad. From 2001 to 2005, only one shad was collected from the intake screens. Therefore, the NRC staff concludes that there would be no impacts of impingement of fish and shellfish for cooling-tower-based systems during the renewal term beyond those discussed in the GEIS.

- Heat shock (cooling-tower-based heat dissipation). Based on information in the GEIS, the Commission found that

  > Heat shock has not been found to be a problem at operating nuclear power plants with this type of cooling system and is not expected to be a problem during the license renewal term.

  The NRC staff has not identified any new and significant information during its independent review of the SSES ER, or the site audit, the scoping process, and evaluation of other available information, such as the EA that evaluated impacts of the EPU at SSES (NRC 2007a). Documents reviewed included the FES for the operation of SSES (NRC 1981) and *Thermal Plume Studies in the Susquehanna River at the Discharge Diffuser of the Susquehanna Steam Electric Station, 1986-87* (Ecology III 1987b). Therefore, the NRC staff concludes that there would be no impacts of heat shock for cooling-tower-based systems during the renewal term beyond those discussed in the GEIS.

- Cooling tower impacts on crops and ornamental vegetation. Based on information in the GEIS, the Commission found that

  > Impacts from salt drift, icing, fogging, or increased humidity associated with cooling tower operation have not been found to be a problem at operating

> nuclear power plants and are not expected to be a problem during the renewal term.

The NRC staff has not identified any new and significant information during its independent review of the SSES ER, or the site audit, the scoping process, and evaluation of other available information, such as the EA that evaluated impacts of the EPU at SSES (NRC 2007a). Documents reviewed included *Effects of Simulated Salt Drift from the Susquehanna Steam Electric Station Cooling Towers on Field Crops Summary Report* (Ecology III 1987c). Therefore, the NRC staff concludes that there would be no cooling tower impacts on crops and ornamental vegetation during the renewal term beyond those discussed in the GEIS.

- Cooling tower impacts on native plants. Based on information in the GEIS, the Commission found that

> Impacts from salt drift, icing, fogging, or increased humidity associated with cooling tower operation have not been found to be a problem at operating nuclear power plants and are not expected to be a problem during the license renewal term.

The NRC staff has not identified any new and significant information during its independent review of the SSES ER, or the site audit, the scoping process, and evaluation of other available information, such as the EA that evaluated impacts of the EPU at SSES (NRC 2007a). Therefore, the NRC staff concludes that there would be no cooling tower impacts on native plants during the renewal term beyond those discussed in the GEIS.

- Bird collisions with cooling towers. Based on information in the GEIS, the Commission found that

> These collisions have not been found to be a problem at operating nuclear power plants and are not expected to be a problem during the license renewal term.

The NRC staff has not identified any new and significant information during its independent review of the SSES ER, or the site audit, the scoping process, and evaluation of other available information, such as the EA that evaluated impacts the EPU at SSES (NRC 2007a). Documents reviewed included *Environmental Studies in the Vicinity of the Susquehanna Steam Electric Station – Water Quality and Fishes* and annual reports for the years of 1984, 1986, and 1994 (Ecology III 1985, 1987a, 1995). A bird collision study was conducted in September and October of 1978 for the

meteorological tower and cooling tower, which was still under construction. These studies found 82 birds that were apparently killed by collisions with the towers. While there were 15 species of birds in this sample – the vast majority were red-eyed vireos (*Vireo olivaceus*) and various species of wood warblers – no endangered or threatened bird species were found (NRC 1981b). PPL is required to report and document any significant bird impacts, if they occur. No reports of significant bird strikes have been made by PPL to date. Therefore, the NRC staff concludes that there would be no impacts of bird collisions with cooling towers during the renewal term beyond those discussed in the GEIS.

- Microbiological organisms (occupational health). Based on information in the GEIS, the Commission found that

  > Occupational health impacts are expected to be controlled by continued application of accepted industrial hygiene practices to minimize worker exposures.

  The NRC staff has not identified any new and significant information during its independent review of the SSES ER, or the site audit, the scoping process, and evaluation of other available information, such as the EA that evaluated impacts of the EPU at SSES (NRC 2007a). Therefore, the NRC staff concludes that there would be no impacts of microbiological organisms on occupational health during the renewal term beyond those discussed in the GEIS.

- Noise. Based on information in the GEIS, the Commission found that

  > Noise has not been found to be a problem at operating plants and is not expected to be a problem at any plant during the license renewal term.

  The NRC staff has not identified any new and significant information during its independent review of the SSES ER, or the site audit, the scoping process, and evaluation of other available information, such as the EA that evaluated impacts of the EPU at SSES (NRC 2007a). Therefore, the NRC staff concludes that there would be no impacts of noise during the renewal term beyond those discussed in the GEIS.

The Category 2 issues related to cooling system operation during the renewal term that are applicable to SSES Units 1 and 2 are discussed in the sections that follow and are listed in Table 4-2.

4.1.1 Water Use Conflicts (Make-Up from a Small River)

NRC specifies in 10 CFR 51.53(c)(3)(ii)(A) that "if the applicant's plant uses cooling towers or cooling ponds and withdraws make-up water from a river whose annual flow rate is less than 3.15×10^{12} cubic feet per year (ft^3/yr) (9×10^{10} cubic meters per year), an assessment of the impact of the proposed action on the flow of the river and related impacts on instream and riparian ecological communities must be provided." For water use conflicts, the NRC further states in 10 CFR Part 51, Subpart A, Appendix B, Table B-1, "The issue has been a concern at nuclear power plants with cooling ponds and at plants with cooling towers. Impacts on instream and riparian communities near these plants could be of moderate significance in some situations." This issue is applicable to SSES because the plant uses cooling towers and the annual mean flow of the Susquehanna River at the location of SSES is approximately

Table 4-2. Category 2 Issues Applicable to the Operation of the SSES Cooling System During the Renewal Term

ISSUE–10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Section	10 CFR 51.53(c)(3)(ii) Subparagraph	SEIS Section
SURFACE WATER QUALITY, HYDROLOGY, AND USE (FOR ALL PLANTS)			
Water use conflicts (plants with cooling ponds or cooling towers using make-up water from a small river with low flow)	4.3.2.1	A	4.1.1
PUBLIC HEALTH			
Microbiological organisms (public health) (plants using lakes or canals, or cooling towers or cooling ponds that discharge to a small river)	4.3.6	G	4.1.2

4.6×10^{11} ft^3/yr (1.3×10^{10} m^3/yr) (Ecology III 2003), thus meeting the NRC's definition of a small river. Consumptive water use can adversely impact riparian vegetation and associated animal communities by reducing the amount of water available for plant growth, maintenance, and reproduction.

Once the EPU is implemented, SSES will withdraw an average of about 60.9 million gallons per day (mgd) (230 million L/d) of water from the Susquehanna River for cooling tower evaporative losses and other plant needs, with a maximum daily water withdrawal estimate of 65.4 mgd (248 million L/d). This represents a 4.5 and 12.2 percent increase, respectively, in intake water withdrawn from the Susquehanna River from pre-EPU conditions (NRC 2007a). Some of this water would be returned to the river as cooling tower blowdown, with the difference equaling the

amount of consumptive water use by SSES. Consumptive water use due to evaporation and drift of cooling water through the SSES cooling towers is expected to increase from 38 mgd (144 million L/d) to 44 mgd (166 million L/d). Based on the Susquehanna River's annual mean flow rate, an average annual loss of 0.5 percent of river water at the SSES location would result. During low-flow conditions, which usually occur in late August, the average evaporative loss at SSES could approach 1 percent of river flow (PPL 2006b).

Consumptive water usage at SSES is regulated by the Susquehanna River Basin Commission (SRBC), an independent agency that manages water usage along the entire length of the Susquehanna River, from New York State, through Pennsylvania and Maryland. The prior permit granted for SSES operation by SRBC allowed average monthly consumptive water usage up to 40 mgd (6.25×10^6 ft^3/d) (1.8×10^5 m^3/d) (Permit No. 19950301-1 EPUL-0578). In December 2006, PPL submitted an application to SRBC to eliminate the 40 mgd average monthly consumption limit and to approve a maximum daily river water withdrawal of 66 mgd (2.97×10^5 m^3/d) (Fields 2007). SRBC has approved this increase (SRBC 2007a). The SRBC permit is required for SSES operation, and PPL must adhere to the prescribed water usage limits and any applicable mitigative measures. SSES currently meets SRBC requirements by providing additional water (from the Cowanesque Lake Reservoir, operated by the U.S. Army Corps of Engineers) to the Susquehanna River during low-flow conditions (PPL 2006a).

The NRC staff has reviewed the available information, including that provided by the applicant, the site audit, the scoping process, discussions with SRBC, and other available sources. The NRC staff assumes that PPL would continue to adhere to SRBC regulations regarding consumptive water use and appropriate mitigative measures (given SRBC's regulatory authority), and, as such, the impact of water use would be SMALL.

The staff identified several measures that could mitigate potential impacts resulting from continued operation of the SSES cooling water system, although it should be noted the NRC cannot impose mitigation requirements on the applicant. Mitigation measures to reduce consumptive surface water use from the SSES cooling water system include reducing planned power production in order to use less cooling water, or providing dry cooling to supplement the natural draft cooling system. Reducing SSES power production may create a need for replacement power.

The staff did not identify cost/benefit studies applicable to these mitigation measures. The SRBC has the authority to require or enforce mitigation measures related to consumptive water use.

4.1.2 Microbiological Organisms (Public Health)

The effects of microbiological organisms on human health are listed as a Category 2 issue and require plant-specific evaluation before license renewal for those plants with closed-cycle cooling on a small river. The average annual flow of Susquehanna River in the vicinity of the SSES site is approximately 4.83×10^{11} ft^3/yr (1.37×10^{10} m^3/yr) (PPL 2006a), which is less than the 3.15×10^{12} ft^3/yr (9×10^{10} m^3/yr) threshold value in 10 CFR 51.53(c)(3)(ii)(G) for thermal discharge to a small river. Hence, the effects of its discharge on microbiological organisms must be addressed for SSES.

PPL consulted the Pennsylvania Department of Environmental Protection (PDEP), Bureau of Water Supply and Wastewater Management, Division of Water Quality Assessment and Standards, to determine whether there was any concern about the potential occurrence of thermophilic microorganism in the Susquehanna River at the SSES location (PPL 2005b). The PDEP indicated that it does not collect any microorganism data in the vicinity of the SSES site on the North Branch Susquehanna River (PDEP 2005a). Nevertheless, recreational uses of the Susquehanna River in the vicinity of the plant, which include boating, fishing, and canoeing, create the potential for human exposure to microbiological organisms.

The Category 2 designation is based on the magnitude of the potential public health impacts associated with thermal enhancement of enteric pathogens such as *Salmonella* spp. and *Shigella* spp., the *Pseudomonas aeruginosa* bacterium, the thermophilic Actinomyces fungi, the pathogenic strain of the free-living amoebae *Naegleria* spp., and a number of species from genus *Legionella* (NRC 1996). Thermophilic bacteria generally occur at temperatures of 77 to 176°F (25 to 80°C), with optimal growth occurring between 122 and 150°F (50 and 66°C) and minimum tolerance of 68°F (20°C) (Joklik and Willett 1976). However, thermal preference and tolerances vary across the bacteria family. Pathogenic microorganisms that are of concern in the nuclear power reactor operation typically have optimal growing temperatures of approximately 99°F (37°C) (Joklik and Smith 1972). Some of these microorganisms are discussed below.

Pseudomonas aeruginosa is an opportunistic pathogen that causes serious and sometimes fatal infections in immunocompromised individuals. The organism produces toxins that are harmful to humans and animals. It has an optimal growth temperature of 99°F (37°C) (Todar 2007). *Legionella* spp. consists of at least 46 species and 70 serogroups, and is responsible for Legionnaires' disease with the onset of pneumonia in the first two weeks of exposure. Risk groups for *Legionella* spp. include the elderly, cigarette smokers, persons with chronic lung or immunocompromising disease, and persons receiving immunosuppressive drugs. *Legionella* spp. grows best at 90 to 105°F (32 to 41°C) (CDC 2007a). *Salmonella typhimurium* and *S. enteritidis* are the two of the more common species of the Enterobacteriaceae that cause fever, abdominal cramps, and diarrhea (sometimes bloody).

Salmonella spp. can occasionally establish localized infection (e.g., septic arthritis) or progress to sepsis. The affected groups include all ages, but groups at greatest risk for severe or complicated disease include infants, the elderly, and persons with compromised immune systems. *Salmonella* spp. occur at temperatures between 50 and 120°F (10 and 49°C) (Aserkoff et al. 1970; CDC 2007b), with optimal growth occurring at 95 to 99°F (35 to 37°C) (ESR 2001). The pathogenic amoeba flagellate *Naegleria fowleri* is the causative agent of human primary amoebic meningoencephalitis. The affected groups include all ages, but groups at greatest risk for severe or complicated disease include infants, the elderly, and persons with compromised immune systems. *Naegleria* spp. is ubiquitous in nature and can be enhanced in thermally altered water bodies at temperatures ranging from 95 to 106°F (35 to 41°C) or higher, but this organism is rarely found in water cooler than 95°F (35°C), and infection rarely occurs at this water temperatures (Tyndall et al. 1989).

The ambient temperatures of the Susquehanna River near the SSES site vary from freezing (approximately 32°F [0.0°C]) in the winter to 85°F (29°C) in the summer. Therefore, ambient river conditions are not likely to support the proliferation of pathogenic organisms of concern.

During August, ambient river temperatures average 77°F (25°C) with a maximum temperature of 85°F (29°C) (NRC 1981). Blowdown temperature is 92°F (33°C) at an ambient river temperature of 85°F (29°C). Temperatures at the edge of the mixing zone were calculated to be 86°F (30°C) and 87°F (30.6°C) at medium and low river discharge flows of 3400 cfs (96,300 L/s) and 880 cfs (25,000 L/s), respectively (NRC 1981). These mixing zones are located 140 ft (43 m) and 115 ft (35 m) downstream of the discharge pipe, respectively (NRC 1981). The small mixing zone plume of <0.4 acre (0.16 ha) is at the lower range of the optimal growth rate for several of the thermophilic microbiological organisms. However, these organisms would be entrained through this thermal plume for about 0.5 to <8 min, based on river velocities of 0.3 to 5.5 ft/s (0.1 to 1.7 m/s) (NRC 1981). As the growth rate for microbiological organisms is measured in hours to days (e.g., Hendricks 1972), it is not expected that the short period of plume passage would notably affect growth rates of microbiological organisms compared to ambient river temperatures.

The current NPDES permit requires SSES to monitor fecal coliforms in the plant's sewage treatment effluent. Fecal coliform bacteria are classified within the family Enterobacteriaceae. The most common species of fecal coliform is *Escherichia coli*, which are prokaryotic, gram-negative, rod-shaped bacteria. The value of determining fecal coliform concentrations in a water source is to establish the extent to which the Susquehanna River has been polluted with fecal wastes. Its presence in the water is indicative of the potential for other pathogenic microbes, including those that cause typhoid fever, bacterial or viral gastroenteritis, or hepatitis A (NAS 2004). SSES has been collecting river water samples once per month for fecal coliform analysis and has been implementing a disinfection program of the SSES sewage treatment plant effluent in compliance with SSES NPDES permit requirements. In addition, the

NPDES permit requires SSES to control disease-producing organisms during the swimming season (May 1st through September 30th) through "effective disinfection" and impose a fecal coliform count limit of 200 cells per 100 milliliters.

The NRC staff independently reviewed the SSES ER, visited the SSES site, and reviewed the applicant's Commonwealth of Pennsylvania NPDES permit. Based on the evaluation presented above, thermophilic microbiological organisms are not likely to present a public health hazard as a result of SSES's discharges to the Susquehanna River. The NRC staff concludes that impacts on public health from thermophilic microbiological organisms from continued operation of SSES in the license renewal period would be SMALL. The staff identified a variety of measures that could mitigate potential thermophilic microbiological organism impacts resulting from continued operation of the SSES. These mitigation measures would include periodically monitoring for thermophilic microbiological organisms in the water and sediments near the discharge, as well as not allowing recreational use near the discharge plume. These mitigation measures could reduce human health impacts by minimizing public exposures to thermophilic microbiological organisms. The staff did not identify any cost benefit studies applicable to these mitigation measures.

4.2 Transmission Lines

The FES for SSES (AEC 1973; NRC 1981) described three short 230-kV ties, one 230-kV transmission line (Stanton-Susquehanna #2 line) and two 500-kV lines (Susquehanna-Wescosville-Alburtis and Sunbury-Susquehanna #2 lines), that connect SSES with the regional transmission grid. The transmission lines, as well as their ownership and responsibilities for their maintenance, are described in Section 2.1.7 of this draft SEIS. All of the transmission lines within the scope of this review are owned and operated by PPL.

Table 4-3. Category 1 Issues Applicable to the SSES Transmission Lines During the Renewal Term

ISSUE–10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Sections
TERRESTRIAL RESOURCES	
Power line right-of-way management (cutting and herbicide application)	4.5.6.1
Bird collisions with power lines	4.5.6.2
Impacts of electromagnetic fields on flora and fauna (plants, agricultural crops, honeybees, wildlife, livestock)	4.5.6.3
Floodplains and wetlands on power line right-of-way	4.5.7

Table 4-3. Category 1 Issues Applicable to the SSES Transmission Lines During the Renewal Term

ISSUE–10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Sections
AIR QUALITY	
Air quality effects of transmission lines	4.5.2
LAND USE	
Onsite land use	4.5.3
Power line rights-of-way	4.5.3

Category 1 issues in 10 CFR Part 51, Subpart A, Appendix B, Table B-1 that are applicable to the within-scope transmission lines from SSES are listed in Table 4-3. PPL stated in its ER (PPL 2006a) that it is not aware of any new and significant information associated with issuance of the renewed SSES OLs. The NRC staff has not identified any new and significant information during its independent review of the SSES ER, or the site audit, the scoping process, and evaluation of other available information. Therefore, the NRC staff concludes that there would be no impacts related to these issues beyond those discussed in the GEIS. For all of those issues, the NRC staff concluded in the GEIS that the impacts would be SMALL, and that additional plant-specific mitigation measures would not likely be sufficiently beneficial to be warranted.

A brief description of the NRC staff's review and GEIS conclusions, as codified in 10 CFR Part 51, Table B-1, for each of these issues follows:

- Power line right-of-way management (cutting and herbicide application). Based on information in the GEIS, the Commission found that

  > The impacts of right-of-way maintenance on wildlife are expected to be of small significance at all sites.

  The NRC staff has not identified any new and significant information during its independent review of the SSES ER, or the site audit, the scoping process, consultation with the U.S. Fish and Wildlife Service (FWS), and evaluation of other information. Therefore, the NRC staff concludes that there would be no impacts of power line right-of-way maintenance during the renewal term beyond those discussed in the GEIS.

- Bird collisions with power lines. Based on information in the GEIS, the Commission found that

> Impacts are expected to be of SMALL significance at all sites.

The NRC staff has not identified any new and significant information during its independent review of the SSES ER, or the site audit, the scoping process, consultation with the FWS, and evaluation of other information. Therefore, the NRC staff concludes that there would be no impacts of bird collisions with power lines during the renewal term beyond those discussed in the GEIS.

- Impacts of electromagnetic fields on flora and fauna (plants, agricultural crops, honeybees, wildlife, livestock). Based on information in the GEIS, the Commission found that

> No significant impacts of electromagnetic fields on terrestrial flora and fauna have been identified. Such effects are not expected to be a problem during the license renewal term.

The NRC staff has not identified any new and significant information during its independent review of the SSES ER, or the site audit, the scoping process, and evaluation of other information. Therefore, the NRC staff concludes that there would be no impacts of electromagnetic fields on flora and fauna during the renewal term beyond those discussed in the GEIS.

- Floodplains and wetland on power line right of way. Based on information in the GEIS, the Commission found that

> Periodic vegetation control is necessary in forested wetlands underneath power lines and can be achieved with minimal damage to the wetland. No significant impact is expected at any nuclear power plant during the license renewal term.

The NRC staff has not identified any new and significant information during its independent review of the SSES ER, or the site audit, the scoping process, consultation with the FWS, and evaluation of other information. Therefore, the NRC staff concludes that there would be no impacts of power line rights-of-way (ROWs) on floodplains and wetlands during the renewal term beyond those discussed in the GEIS.

- Air quality effects of transmission lines. Based on the information in the GEIS, the Commission found that

> Production of ozone and oxides of nitrogen is insignificant and does not contribute measurably to ambient levels of these gases.

The NRC staff has not identified any new and significant information during its independent review of the SSES ER, or the site audit, the scoping process, and evaluation of other information. Therefore, the NRC staff concludes that there would be no air quality impacts of transmission lines during the renewal term beyond those discussed in the GEIS.

- Onsite land use. Based on the information in the GEIS, the Commission found that

  > Projected onsite land use changes required during ... the renewal period would be a small fraction of any nuclear power plant site and would involve land that is controlled by the applicant.

  The NRC staff has not identified any new and significant information during its independent review of the SSES ER, or the site audit, the scoping process, and evaluation of other information. Therefore, the NRC staff concludes that there would be no onsite land-use impacts during the renewal term beyond those discussed in the GEIS.

- Power line rights-of-way. Based on information in the GEIS, the Commission found that

  > Ongoing use of power line rights-of-way would continue with no change in restrictions. The effects of these restrictions are of small significance.

  The NRC staff has not identified any new and significant information during its independent review of the ER, or the site audit, the scoping process, and evaluation of other information. Therefore, the NRC staff concludes that there would be no impacts of power line ROWs on land use during the renewal term beyond those discussed in the GEIS.

There is one Category 2 issue related to transmission lines, and another issue related to transmission lines is being treated as a Category 2 issue, although it was not assigned a specific category in the GEIS. These issues are listed in Table 4-4 and are discussed in Sections 4.2.1 and 4.2.2.

Table 4-4. Category 2 and Uncategorized Issues Applicable to the SSES Transmission Lines During the Renewal Term

ISSUE–10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Sections	10 CFR 51.53(c)(3)(ii) Subparagraph	SEIS Section
HUMAN HEALTH			
Electromagnetic fields, acute effects (electric shock)	4.5.4.1	H	4.2.1
Electromagnetic fields, chronic effects	4.5.4.2	NA[(a)]	4.2.2

(a) Not addressed.

4.2.1 Electromagnetic Fields – Acute Effects

Based on the GEIS, the Commission found that electric shock resulting from direct access to energized conductors or from induced charges in metallic structures has not been found to be a problem at most operating plants and generally is not expected to be a problem during the license renewal term (see Table 4-4). However, site-specific review is required to determine the significance of the electric shock potential along the portions of the transmission lines that are within the scope of this Supplemental Environmental Impact Statement (SEIS).

In the GEIS, the NRC staff found that without a review of the conformance of each nuclear plant transmission line with National Electrical Safety Code (NESC) (IEEE 2002) criteria, it was not possible to determine the significance of the electric shock potential. Evaluation of individual plant transmission lines is necessary because the issue of electric shock safety was not addressed in the licensing process for some plants. For other plants, land use in the vicinity of transmission lines may have changed, or power distribution companies may have chosen to upgrade line voltage. To comply with 10 CFR 51.53(c)(3)(ii)(H), the applicant must provide an assessment of the impact of the proposed action on the potential shock hazard from the transmission lines if the transmission lines that were constructed for the specific purpose of connecting the plant to the transmission system do not meet the recommendations of the NESC for preventing electric shock from induced currents.

All transmission lines associated with SSES were constructed in accordance with NESC and industry guidance in effect at that time. The transmission facilities are maintained to ensure continued compliance with current standards. Since the lines were constructed, a new criterion has been added to the NESC for power lines with voltages exceeding 98 kV. This criterion states that the minimum clearance for a line must limit induced currents due to static effects to 5 milliamperes (mA).

PPL (2006a) has reviewed the transmission lines for compliance with this criterion. PPL indicated that all transmission lines within the scope of this review have been restudied and the results show there are no locations under the transmission lines that have the capacity to induce more than 5 mA in a vehicle parked beneath the lines. No induced shock hazard to the public should occur, since the lines are operating within original design specifications and meet current NESC clearance standards and land use adjacent to the lines has not changed.

The NRC staff has reviewed the available information, including the applicant's evaluation and computational results. Based on this information, the NRC staff evaluated the potential impacts for electric shock resulting from operation of SSES and its associated transmission lines. It is the NRC staff's conclusion that the potential impacts from electric shock during the renewal period would be SMALL.

The staff identified a variety of measures that could mitigate potential acute EMF impacts resulting from continued operation of the SSES's transmission lines. These mitigation measures would include erecting barriers along the length of the transmission line to prevent unauthorized access to the ground beneath the conductors, installing road signs at road crossings, and raising the elevation of the lowest energized conductor to increase the distance between it and a potentially exposed individual directly beneath it. These mitigation measures could reduce human health impacts by minimizing public exposures to electric shock hazards. NESC rules as specified in Part 2, Rules 232C1c and 232D3c contain provisions that are considered necessary for the protection of employees and the public from acute EMF hazards associated with transmission lines, including during the license renewal period. PPL currently meets these rules. The staff did not identify any cost benefit studies applicable to the mitigation measures mentioned above.

4.2.2 Electromagnetic Fields – Chronic Effects

In the GEIS, the chronic effects of 60-Hertz (Hz) electromagnetic fields from power lines were not designated as Category 1 or 2, and will not be until a scientific consensus is reached on the health implications of these fields.

The potential for chronic effects from these fields continues to be studied and is not known at this time. The National Institute of Environmental Health Sciences (NIEHS) directs related research through the U.S. Department of Energy (DOE).

The report by NIEHS (1999) contains the following conclusion, which is supported by the World Health Organization's recently published Environmental Health Criteria Monograph No.238 (WHO 2007):

> The NIEHS concludes that ELF-EMF (extremely low frequency-electromagnetic field) exposure cannot be recognized as entirely safe because of weak scientific evidence that exposure may pose a leukemia hazard. In our opinion, this finding is insufficient to warrant aggressive regulatory concern. However, because virtually everyone in the United States uses electricity and therefore is routinely exposed to ELF-EMF, passive regulatory action is warranted such as continued emphasis on educating both the public and the regulated community on means aimed at reducing exposures. The NIEHS does not believe that other cancers or noncancer health outcomes provide sufficient evidence of a risk to currently warrant concern.

This statement is not sufficient to cause the NRC staff to change its position with respect to the chronic effects of electromagnetic fields. The NRC staff considers the GEIS finding of "Not Applicable" still appropriate and will continue to follow developments on this issue.

4.3 Radiological Impacts of Normal Operations

Category 1 issues in 10 CFR Part 51, Subpart A, Appendix B, Table B-1, that are applicable to SSES in regard to radiological impacts are listed in Table 4-5. PPL stated in its ER (PPL 2006a) that it is not aware of any new and significant information associated with the renewal of the SSES OLs. The NRC staff has not identified any new and significant information during its independent review of the PPL ER, or the site audit, the scoping process, and evaluation of other available information. Therefore, the NRC staff concludes that there would be no impacts related to these issues beyond those discussed in the GEIS. For these issues, the NRC staff concluded in the GEIS that the impacts are SMALL, and additional plant-specific mitigation measures are not likely to be sufficiently beneficial to be warranted.

Table 4-5. Category 1 Issues Applicable to Radiological Impacts of Normal Operations During the Renewal Term

ISSUE–10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Sections
HUMAN HEALTH	
Radiation exposures to public (license renewal term)	4.6.2
Occupational radiation exposures (license renewal term)	4.6.3

A brief description of the NRC staff's review and the GEIS conclusions, as codified in Table B-1, for each of these issues follows:

Radiation exposures to the public (license renewal term). Based on information in the GEIS, the Commission found that

> Radiation doses to the public will continue at current levels associated with normal operations.

The NRC staff has not identified any new and significant information during its independent review of the SSES ER, or the site audit, the scoping process, and evaluation of other available information. Therefore, the NRC staff concludes that there would be no impacts of radiation exposures to the public during the renewal term beyond those discussed in the GEIS.

- Occupational radiation exposures (license renewal term). Based on information in the GEIS, the Commission found that

> Projected maximum occupational doses during the license renewal term are within the range of doses experienced during normal operations and normal maintenance outages, and would be well below regulatory limits.

The NRC staff has not identified any new and significant information during its independent review of the SSES ER, or the site audit, the scoping process, and evaluation of other available information. Therefore, the NRC staff concludes that there would be no impacts of occupational radiation exposures during the renewal term beyond those discussed in the GEIS.

There are no Category 2 issues related to radiological impacts of routine operations.

4.4 Socioeconomic Impacts of Plant Operations During the License Renewal Period

Category 1 issues in 10 CFR Part 51, Subpart A, Appendix B, Table B-1, that are applicable to socioeconomic impacts during the renewal term are listed in Table 4-6. As stated in the GEIS, the impacts associated with these Category 1 issues were determined to be SMALL, and plant-specific mitigation measures would not be sufficiently beneficial to be warranted. The NRC staff reviewed and evaluated the SSES ER, scoping comments, other available information, and visited the SSES site in search of new and significant information that would change the conclusions presented in the GEIS. No new and significant information was identified during this review. Therefore, it is expected that there would be no impacts related to these Category 1 issues during the renewal term beyond those discussed in the GEIS.

Table 4-6. Category 1 Issues Applicable to Socioeconomics During the Renewal Term

ISSUE–10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Sections
SOCIOECONOMICS	
Public services: public safety, social services, and tourism and recreation	4.7.3; 4.7.3.3; 4.7.3.4; 4.7.3.6
Public services: education (license renewal term)	4.7.3.1
Aesthetic impacts (license renewal term)	4.7.6
Aesthetic impacts of transmission lines (license renewal term)	4.5.8

The results of the NRC staff's review and a brief statement of GEIS conclusions, as codified in Table B-1 of 10 CFR Part 51, Subpart A, Appendix B, for each of the socioeconomic Category 1 issues are provided below:

- Public services: public safety, social services, and tourism and recreation. Based on information in the GEIS, the Commission found that

  > Impacts to public safety, social services, and tourism and recreation are expected to be of small significance at all sites.

  The NRC staff has not identified any new and significant information during its independent review of the SSES ER, or the site audit, the scoping process, and evaluation of other available information. Therefore, the NRC staff concludes that there would be no impacts on public safety, social services, and tourism and recreation during the renewal term beyond those discussed in the GEIS.

- Public services: education (license renewal term). Based on information in the GEIS, the Commission found that

  > Only impacts of small significance are expected.

  The NRC staff has not identified any new and significant information during its independent review of the SSES ER, or the site audit, the scoping process, and evaluation of other available information. Therefore, the NRC staff concludes that there would be no impacts on education during the renewal term beyond those discussed in the GEIS.

- Aesthetic impacts (license renewal term). Based on information in the GEIS, the Commission found that

  No significant impacts are expected during the license renewal term.

  The NRC staff has not identified any new and significant information during its independent review of the SSES ER, or the site audit, the scoping process, and evaluation of other available information. Therefore, the NRC staff concludes that there would be no aesthetic impacts during the renewal term beyond those discussed in the GEIS.

- Aesthetic impacts of transmission lines (license renewal term). Based on information in the GEIS, the Commission found that

  No significant impacts are expected during the license renewal term.

  The NRC staff has not identified any new and significant information during its independent review of the SSES ER, or the site audit, the scoping process, and evaluation of other available information. Therefore, the NRC staff concludes that there would be no aesthetic impacts of transmission lines during the renewal term beyond those discussed in the GEIS.

Table 4-7 lists the Category 2 socioeconomic issues, which require plant-specific analysis, and environmental justice, which was not addressed in the GEIS.

Table 4-7. Environmental Justice and Category 2 Issues Applicable to Socioeconomics During the Renewal Term

ISSUE–10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Section	10 CFR 51.53(c)(3)(ii) Subparagraph	SEIS Section
SOCIOECONOMICS			
Housing impacts	4.7.1	I	4.4.1
Public services: public utilities	4.7.3.5	I	4.4.2
Offsite land use (license renewal term)	4.7.4	I	4.4.3
Public services: transportation	4.7.3.2	J	4.4.4
Historic and archaeological resources	4.7.7	K	4.4.5
Environmental justice	Not addressed[(a)]	Not addressed[(a)]	4.4.6

(a) Guidance related to environmental justice was not in place at the time the GEIS and the associated revision to 10 CFR Part 51 were prepared. Therefore, environmental justice must be addressed in plant-specific reviews.

4.4.1 Housing Impacts During Operations

Appendix C of the GEIS presents a population characterization method based on two factors, "sparseness" and "proximity" (GEIS, Section C.1.4). Sparseness measures population density within 20 mi (32 km) of the site, and proximity measures population density and city size within 50 mi (80 km). Each factor has categories of density and size (GEIS, Table C.1), and a matrix is used to rank the population category as low, medium, or high (GEIS, Figure C.1).

According to the 2000 census, approximately 330,488 people lived within 20 mi (32 km) of SSES, which equates to a population density of 263 persons per square mile (PPL 2006a). This density translates to the least sparse Category 4 (greater than or equal to 120 persons per square mile within 20 mi [32 km]). Approximately 1,684,794 people live within 50 mi (80 km) of SSES (PPL 2006a). This equates to a population density of 215 persons per square mile. Applying the GEIS proximity measures, SSES is classified as proximity Category 4 (greater than or equal to 190 persons per square mile within 50 mi [80 km]). Therefore, according to the sparseness and proximity matrix presented in the GEIS, the SSES ranks of sparseness Category 4 and proximity Category 4 result in the conclusion that SSES is located in a high-population area.

Table B-1 of 10 CFR Part 51, Subpart A, Appendix B, states that impacts on housing availability are expected to be of small significance in a high-population area where growth-control

measures are not in effect. Since SSES is located in a high-population area and Luzerne and Columbia Counties are not subject to growth-control measures that would limit housing development, any SSES employment-related impact on housing availability would likely be SMALL. Since PPL has indicated that there would be no major plant refurbishment, employment levels at SSES would remain relatively unchanged with no additional demand for housing during the license renewal term. In addition, the number of available housing units has kept pace with or exceeded the low growth in the area population. Based on this information, there would be no impact on housing during the license renewal term.

4.4.2 Public Services: Public Utility Impacts During Operations

Impacts on public utility services are considered SMALL if there is little or no change in the ability of the system to respond to demand; thus, there is no need to add capital facilities. Impacts are considered MODERATE if service capabilities are overtaxed during periods of peak demand. Impacts are considered LARGE if services (e.g., water, sewer) are substantially degraded and additional capacity is needed to meet ongoing demand. The GEIS indicated that, in the absence of new and significant information to the contrary, the only impacts on public utilities that could be significant are impacts on public water supplies.

Analysis of impacts on the public water and sewer systems considered both plant demand and plant-related population growth. Section 2.1.3 of this draft SEIS describes the SSES permitted withdrawal rate and actual use of water.

As previously discussed in Section 2.2.8.2, SSES provides potable water for drinking, pump seal cooling, sanitation, and fire protection through the onsite groundwater well system. Three additional wells provide water to the Energy Information Center, Riverlands Recreation Area, and the West Building (former Emergency Operations Facility). SSES does not use water from a municipal system, and plant groundwater usage during the renewed license period of operations would be considered small. Further, no increase in plant demand is projected.

SSES operations during the license renewal term would also not increase plant-related population growth demand for public water and sewer services. Since PPL has indicated that there would be no major plant refurbishment, overall employment levels at SSES would remain relatively constant with no additional demand for public services. Both public and private water systems in the region would be adequate to provide the capacity and to meet the demand of residential and industrial customers in the area. Therefore, there would be no impact to public water and sewer services.

4.4.3 Offsite Land Use During Operations

Offsite land use during the license renewal term is a Category 2 issue (10 CFR Part 51, Subpart A, Appendix B, Table B-1). Table B-1 of 10 CFR Part 51, Subpart A, Appendix B, notes that "significant changes in land use may be associated with population and tax revenue changes resulting from license renewal."

Section 4.7.4 of the GEIS defines the magnitude of land-use changes as a result of plant operation during the license renewal term as follows:

SMALL – Little new development and minimal changes to an area's land-use pattern.

MODERATE – Considerable new development and some changes to the land-use pattern.

LARGE – Large-scale new development and major changes in the land-use pattern.

Tax revenue can affect land use because it enables local jurisdictions to provide the public services (e.g., transportation and utilities) necessary to support development. Section 4.7.4.1 of the GEIS states that the assessment of tax-driven land-use impacts during the license renewal term should consider (1) the size of the plant's payments relative to the community's total revenues, (2) the nature of the community's existing land-use pattern, and (3) the extent to which the community already has public services in place to support and guide development. If the plant's tax payments are projected to be small relative to the community's total revenue, tax-driven land-use changes during the plant's license renewal term would be SMALL, especially where the community has pre-established patterns of development and has provided adequate public services to support and guide development. Section 4.7.2.1 of the GEIS states that if tax payments by the plant owner are less than 10 percent of the taxing jurisdiction's revenue, the significance level would be SMALL. If the plant's tax payments are projected to be medium to large relative to the community's total revenue, new tax-driven land-use changes would be MODERATE. If the plant's tax payments are projected to be a dominant source of the community's total revenue, new tax-driven land-use changes would be LARGE. This would be especially true where the community has no pre-established pattern of development or has not provided adequate public services to support and guide development.

Population-Related Impacts

Since PPL has estimated that at most, five non-outage employees may be needed during the license renewal period, there would be no noticeable change in land-use conditions in the vicinity of the SSES site. Therefore, the NRC staff concluded that there would be no land-use impacts during the license renewal term.

Tax Revenue-Related Impacts

In the past, PPL paid real estate taxes to the Commonwealth of Pennsylvania for power generation, transmission, and distribution facilities. Under authority of the Pennsylvania Utility Realty Tax Act (PURTA), real estate taxes collected from all utilities (water, telephone, electric, and railroads) were redistributed to the taxing jurisdictions within the Commonwealth. In Pennsylvania, these jurisdictions include counties, cities, townships, boroughs, and school districts. The distribution of PURTA funds was determined by formula, and was not necessarily based on the individual utility's effect on a particular government entity.

In 1996, Electricity Generation Customer Choice and Competition Act became law, which allows consumers to choose among competitive suppliers of electrical power. As a result of utility restructuring, Act 4 of 1999 revised the tax base assessment methodology for utilities from the depreciated book value to the market value of utility property. Additionally, as of January 1, 2000, PPL was required to begin paying real estate taxes directly to local jurisdictions, ceasing payments to the Commonwealth's PURTA fund.

As previously discussed in Chapter 2, PPL pays annual real estate taxes to Luzerne County, Berwick Area School District, and Salem Township. For the 5-year period from 2000 through 2004, tax payments to Luzerne County represented between 1.8 and 2.4 percent of the County's total annual property tax revenues, and payments to the Berwick Area School District represented approximately 5.5 to 6.9 percent of the School District's total revenues. PPL's tax payments to Salem Township make up a much larger percentage of that township's tax collection. For the period 2001 through 2004, tax payments to Salem Township represented 50.3 to 53.9 percent of the township's total revenues. Since PPL started making payments to local jurisdictions, population levels and land use conditions in Salem Township have not changed significantly, which might indicate that these tax revenues have had little or no effect on land-use activities within the township. However, discontinuing the current level of tax revenues would likely have a significant negative economic impact on the township.

PPL has indicated that there would be no major plant refurbishment or license renewal-related construction activities necessary to support the continued operation of the SSES during the license renewal period. Accordingly, there would be no increase in the assessed value of SSES and annual property taxes to Salem Township, the Berwick Area School District, and Luzerne County would remain relatively constant throughout the license renewal period. Based on this information, there would be no tax revenue-related land-use impacts during the license-renewal term.

4.4.4 Public Services: Transportation Impacts During Operations

Table B-1, 10 CFR Part 51, states: "Transportation impacts (level of service) of highway traffic generated ... during the term of the renewed license are generally expected to be of small significance. However, the increase in traffic associated with additional workers and the local road and traffic control conditions may lead to impacts of moderate or large significance at some sites." All applicants are required by 10 CFR 51.53(c)(3)(ii)(J) to assess the impacts of highway traffic generated by the proposed project on the level of service of local highways during the term of the renewed license.

Since PPL has estimated that at most, five non-outage employees may be needed during the license renewal period, there would be no noticeable change in traffic volume and levels of service on roadways in the vicinity of the SSES site. Therefore, there would be no transportation impacts during the license renewal term.

4.4.5 Historic and Archaeological Resources

The National Historic Preservation Act (NHPA), as amended, requires Federal agencies to take into account the effects of their undertakings on historic properties. Historic properties are defined as resources that are eligible for listing on the NRHP. The historic preservation review process mandated by Section 106 of the NHPA is outlined in regulations issued by the Advisory Council on Historic Preservation in 36 CFR Part 800. The issuance of a renewed OL for a nuclear power plant is an undertaking that could possibly affect either known or currently undiscovered historic properties that may be located on or near the plant site. In accordance with the provisions of the NHPA, the NRC is required to make a reasonable effort to identify historic properties in the areas of potential effect. If no historic properties are present or affected, the NRC is required to notify the State Historic Preservation Office (SHPO) before proceeding. If it is determined that historic properties are present, the NRC is required to assess and resolve possible adverse effects of the undertaking.

As discussed in Chapter 2, PPL contacted the Pennsylvania Historical and Museum Commission (PHMC) on March 24, 2005, regarding preparation of its application for license renewal (PPL 2006a). By letter dated May 20, 2005, the PHMC agreed that license renewal will have no adverse effect on significant cultural resources in the project area. In accordance with 36 CFR 800.8(c), the NRC contacted the PHMC (NRC 2006a), the Advisory Council on Historic Preservation (NRC 2006b), and the appropriate Federally recognized Native American Tribes with current and historic ties to the region in November 2006. These letters are listed in Appendix C.

On May 14, 2007, the NRC staff conducted a search of the PHMC files for the region around SSES. The area in and around the Susquehanna River Basin is rich in prehistoric deposits.

Since the construction of SSES, three onsite surveys have been conducted. The first survey examined the Knouse site, 36-LU-43, located on the eastern side of the Susquehanna River. The second survey focused on the western floodplain and identified three significant (36-LU-16, 36-LU-49, 36-LU-51) and one potentially significant (36-LU-15) prehistoric sites. Material from the sites range in date from Archaic to late Woodland periods, with one site containing material from the rare Transitional period between the Archaic and Woodland periods. The third survey examined the northern end of Gould Island and identified site 36-LU-105, a potentially eligible multi-component Archaic/Woodland site. In total, six prehistoric archaeological sites and several isolated finds have been identified on PPL property. Various other surveys conducted in close proximity to the SSES site have also identified archaeological sites dating from the late Archaic to Woodland periods. Consequently, there is the potential for historic and archaeological resources to be present on both undisturbed and minimally disturbed areas of the SSES site.

In addition to the prehistoric sites mentioned above, the SSES property also contains historic remains. Evidence of 19th and 20th century farmsteads is known to exist onsite. While no standing structures remain on these farmsteads, archaeological evidence may remain from these occupations. Portions of the North Branch Canal cross PPL property. PPL restored and maintains a section of the historic North Branch Canal. This canal is located at the Riverlands Recreation Area. Several historic (Native American) trails are reported to have followed the river. This also increases the potential for resources to be present onsite.

No impacts to known historic and archaeological resources are expected from license renewal. There are no planned expansions of the existing facilities and there are no planned refurbishment activities to support license renewal (PPL 2006a). Continued operations at SSES would likely protect any known archaeological sites present within the SSES site boundary by protecting those lands from development and providing secured access. PPL has demonstrated this by avoiding areas where known historic and archaeological sites are present. PPL has employed avoidance measures and has implemented mitigation measures recommended by the PHMC for sites that were deemed sensitive to operational activities. However, there is the potential for impacts to unknown historic and archaeological resources from continued operations. PPL maintains environmental review procedures to protect against impacts to historic and archaeological resources; however, the procedures only consider known historic and archaeological resources on plant property. There is a high potential for additional unknown cultural resources to be present at the SSES site, and the procedures do not address the treatment of inadvertent discoveries.

Based on the NRC staff's review of the PPL environmental review procedures, the PHMC files, archaeological reviews, surveys, assessments, and other information, the NRC staff concludes that the potential impacts on historic and archaeological resources at SSES could be MODERATE. PPL could mitigate this MODERATE impact by developing and implementing

improved procedures or by examining the entire plant site for historic and archaeological resources. All resources would then be known and protected accordingly. Revised procedures would need to consider the potential impacts of plant operations on both known and unknown historic and archaeological resources at SSES. Additionally, training of PPL staff in the Section 106 process would ensure that informed decisions are made when considering the effects of projects on historic and archaeological resources. Lands not previously surveyed would require investigation by a professional archaeologist prior to any ground disturbing activities. Any changes to these procedures should be developed in consultation with the PHMC. The staff did not identify any cost benefit studies applicable to these mitigation measures.

4.4.6 Environmental Justice

Under Executive Order 12898 (Volume 59, p. 7629, of the *Federal Register* (59 FR 7629)), Federal agencies are responsible for identifying and addressing potential disproportionately high and adverse human health and environmental impacts on minority and low-income populations. In 2004, the Commission issued a *Policy Statement on the Treatment of Environmental Justice Matters in NRC Regulatory and Licensing Actions* (69 FR 52040), which states, "The Commission is committed to the general goals set forth in E.O. 12898, and strives to meet those goals as part of its NEPA review process."

The Council on Environmental Quality (CEQ) provides the following information in *Environmental Justice: Guidance Under the National Environmental Policy Act* (CEQ 1997):

> **Disproportionately High and Adverse Human Health Effects.** Adverse health effects are measured in risks and rates that could result in latent cancer fatalities, as well as other fatal or nonfatal adverse impacts on human health. Adverse health effects may include bodily impairment, infirmity, illness, or death. Disproportionately high and adverse human health effects occur when the risk or rate of exposure to an environmental hazard for a minority or low-income population is significant (as defined by NEPA and appreciably exceeds the risk or exposure rate for the general population or for another appropriate comparison group.
>
> **Disproportionately High and Adverse Environmental Effects.** A disproportionately high environmental impact that is significant (as defined by NEPA) refers to an impact or risk of an impact on the natural or physical environment in a low-income or minority community that appreciably exceeds the environmental impact on the larger community. Such effects may include ecological, cultural, human health, economic, or social impacts. An adverse environmental impact is an impact that is determined to be both harmful and significant (as defined by NEPA). In assessing cultural and aesthetic environmental impacts, impacts that uniquely affect geographically dislocated or dispersed minority or low-income populations or American Indian Tribes are considered.

The environmental justice analysis assesses the potential for disproportionately high and adverse human health or environmental effects on minority and low-income populations that could result from the operation of SSES during the renewal term. In assessing the impacts, the following CEQ (1997) definitions of minority individuals and populations and low-income population were used:

Minority individuals. Individuals who identify themselves as members of the following population groups: Hispanic or Latino, American Indian or Alaska Native, Asian, Black or African American, Native Hawaiian or Other Pacific Islander, or two or more races meaning individuals who identified themselves on a census form as being a member of two or more races, for example, Hispanic and Asian.

Minority populations. Minority populations are identified when (1) the minority population of an affected area exceeds 50 percent or (2) the minority population percentage of the affected area is meaningfully greater than the minority population percentage in the general population or other appropriate unit of geographic analysis.

Low-income population. Low-income populations in an affected area are identified with the annual statistical poverty thresholds from the Census Bureau's Current Population Reports, Series PB60, on Income and Poverty.

Minority Population in 2000

According to 2000 census data, an average 3.8 percent of the population residing within a 50-mi (80-km) radius of SSES were minority individuals. The largest minority group was Hispanic (2.7 percent), followed by Black or African American (1.8 percent). About 4 percent of the Luzerne County population are minorities, with Black or African American being the largest minority group (1.6 percent), followed by Hispanic (1.2 percent).

Census block groups with minority populations exceeding 3.8 percent were considered minority block groups. Based on 2000 census data, Figure 4-1 shows minority block groups that exceeded the average for the area within 50 mi (80 km) of SSES.

Low-Income Population in 2000

According to 2000 census data, approximately 10.3 percent of the population residing within a 50-mi radius of SSES were identified as living below the Federal poverty threshold. The 1999 Federal poverty threshold was $17,029 for a family of four. According to 2000 census data, the median household income for Pennsylvania in 1999 was $40,106, while 11 percent of the State population was determined to be living below the 1999 Federal poverty threshold.

Luzerne County had one of the lower median household incomes ($33,771) and a similar percentage (11.1 percent) of individuals living below the poverty level when compared to the State. Columbia County also had one of the lower median household incomes ($34,094) and the highest percentage (13.1 percent) of individuals living below the poverty level when compared to other counties in the area.

Census block groups were considered low-income block groups if the percentage of the population living below the Federal poverty threshold exceeded 11 percent. Figure 4-2 shows low-income block groups within a 50-mi (80-km) radius of SSES, based on 2000 census data.

Analysis of Impacts

Consistent with the impact analysis for the public and occupational health and safety, the affected populations are defined as minority and low-income populations who reside within a 50-mi (80-km) radius of SSES. Based on the analysis of impacts for other resource areas, there would be no high and adverse impacts from the operation of SSES during the license renewal period.

The NRC staff also analyzed the risk of radiological exposure through the consumption patterns of special pathway receptors, including subsistence consumption of fish, native vegetation, surface waters, sediments, and local produce; absorption of contaminants in sediments through the skin; and inhalation of plant materials. The special pathway receptors analysis is important to the environmental justice analysis because consumption patterns may reflect the traditional or cultural practices of minority and low-income populations in the area.

Subsistence Consumption of Fish and Wildlife

Section 4-4 of Executive Order 12898 (1994) directs Federal agencies, whenever practical and appropriate, to collect and analyze information on the consumption patterns of populations who rely principally on fish and/or wildlife for subsistence and to communicate the risks of these consumption patterns to the public. In this draft SEIS, NRC considered whether there were any means for minority or low-income populations to be disproportionately affected, by examining impacts to American Indian, Hispanic, and other traditional lifestyle special pathway receptors. Special pathways that took into account the levels of contaminants in native vegetation, crops, soils and sediments, surface water, fish, and game animals on or near the SSES site were considered.

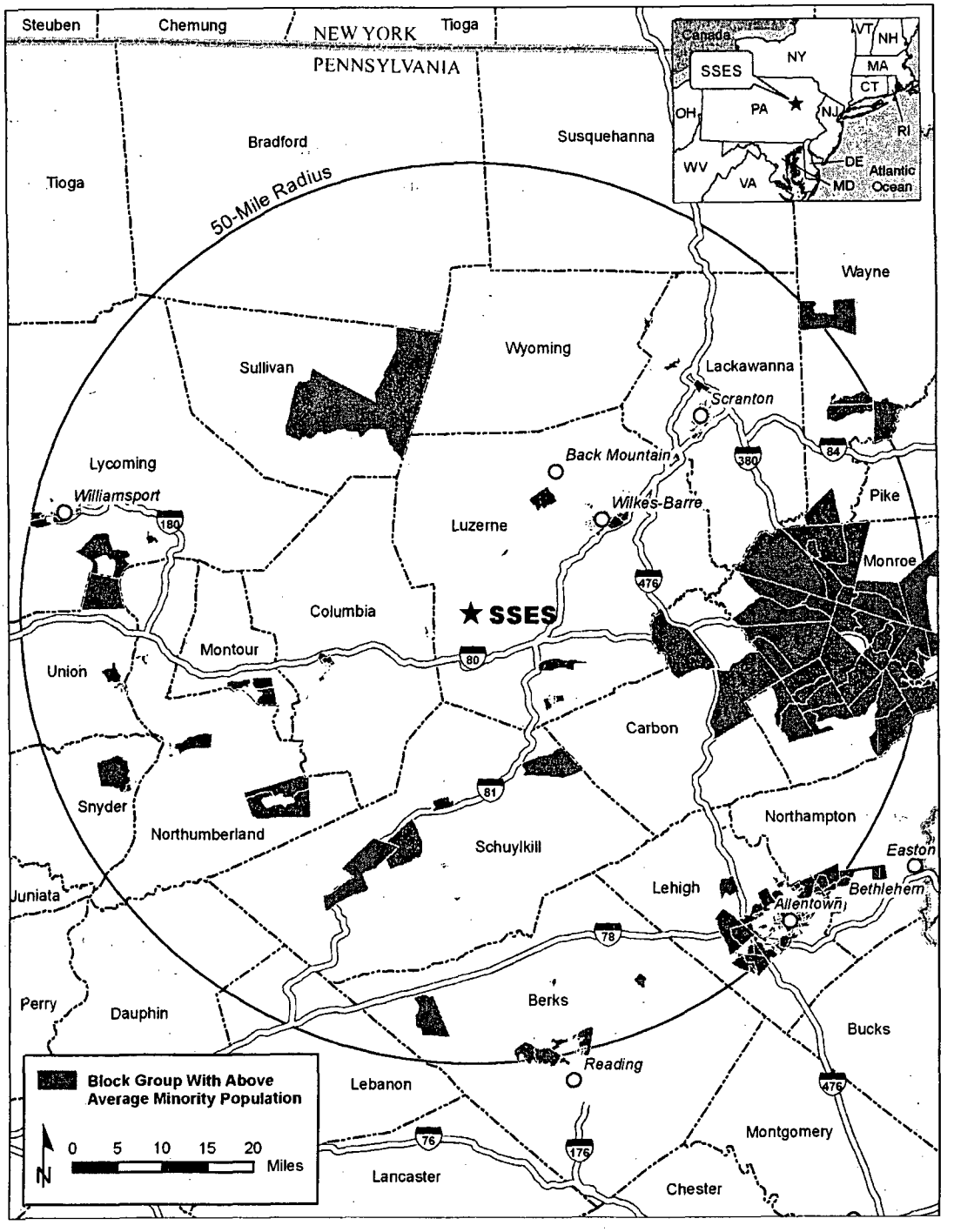

Figure 4-1. Minority Block Groups in 2000 Within a 50-mi (80-km) Radius of SSES (Source: USCB 2007)

PPL has a comprehensive Radiological Environmental Monitoring Program (REMP) at SSES to assess the impact of site operations on the environment. Samples are collected from the aquatic and terrestrial pathways applicable to the site. The aquatic pathways include fish, surface waters, and sediment. The terrestrial pathways include airborne particulates and radioiodine, milk, food products, and direct radiation. During 2005, 1245 analyses were performed on 884 collected samples of environmental media as part of the required REMP and showed no significant or measurable radiological impact from SSES operations. Cesium-137 was detected in soil samples at very low levels and was attributed to fallout from historic aboveground nuclear weapons testing, conducted in locations around the world (none near SSES) and carried to the SSES site by wind currents. The 2005 results for all samples are consistent with the previous 5-year historical results and exhibit no adverse trends (PPL 2006d).

The results of the 2005 REMP demonstrate that the routine operation at the SSES site had no significant or measurable radiological impact on the environment. No elevated radiation levels were detected in the offsite environment as a result of plant operations and the storage of radioactive waste. The results of the REMP continue to demonstrate that the operation of the plant did not result in a significant measurable dose to a member of the general population or adversely impact the environment as a result of radiological effluents (PPL 2006d). The REMP continues to demonstrate that the dose to a member of the public from the operation of SSES remains significantly below the Federally required dose limits specified in 10 CFR Part 20, 40 CFR Part 190, and 10 CFR Part 72.

The PDEP, Bureau of Radiation Protection (BRP), maintains a comprehensive environmental radiation monitoring program in Pennsylvania, as required by the Radiation Protection Act (No. 1984-147). The purpose of the program is to evaluate long-term trends in environmental radiation levels; assess the environmental impact of particular sites, such as SSES; and provide this information to the public. The BRP currently maintains offsite environmental radiation monitoring programs around five nuclear power plants in Pennsylvania, including SSES.

Monitoring stations serve as indicators of any effects from plant operation and at control locations that are beyond the measurable influence of the facility. These stations also provide verification of utility effluent monitoring programs during routine operations.

Each year, BRP collects dosimetry, air, water, milk, fish, produce, and sediment samples in the vicinity of SSES. Fish samples are collected in the vicinity of the SSES discharge, and produce samples of pumpkin are collected from a truck garden 3.3 mi (5.3 km) southwest of the plant. The truck garden is irrigated with water drawn from downstream of the station discharge. In 2001 and 2002, BRP found traces of cesium-137 in two milk samples taken at different locations and different times of the year near SSES. Cesium-137 was also found in all sediment samples collected from both upstream and downstream of station discharges. The

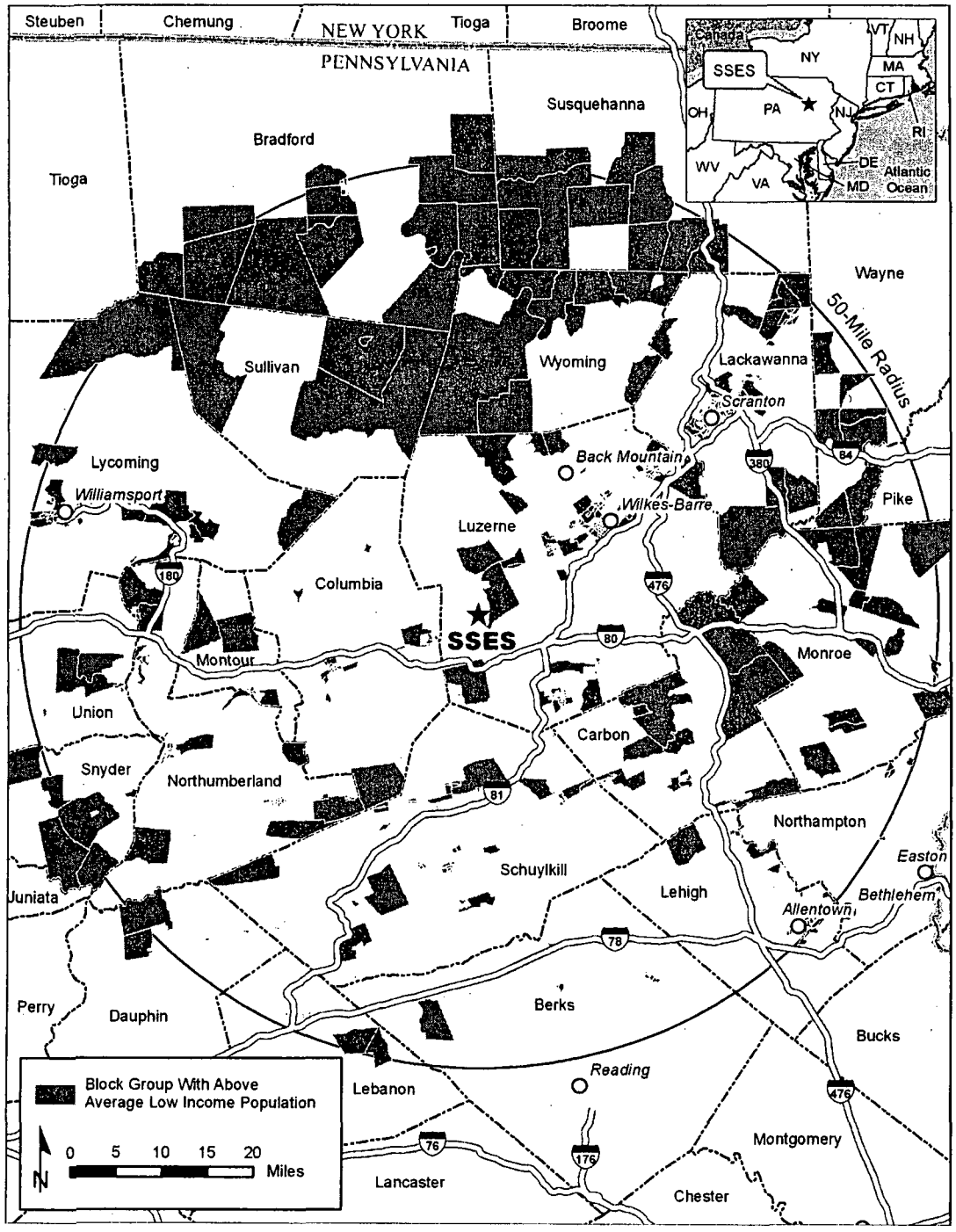

Figure 4-2. Low-Income Block Groups Within a 50-mi (80-km) Radius of SSES (Source: USCB 2007)

presence of this isotope is attributed to fallout from past weapons testing and the accident at Chernobyl in April 1986. The 2001 and 2002 environmental sampling program found no reactor-related radioisotopes in the fish or produce samples (PDEP 2005b).

The Academy of Natural Sciences of Philadelphia also conducts radiological environmental monitoring in the vicinity of SSES, which parallels (and partially overlaps) the SSES REMP. Called the Safety Net Program (SNP), this monitoring was initiated by PPL in 1979 as an extra measure to verify that the environment and public health are not impacted by the SSES. This non-mandatory program relies on the expertise provided by a consortium of independent, academically based experts to examine features of the natural environment not regularly studied by the REMP. The SNP monitors the aquatic and terrestrial pathways, and periodically expands the level of monitoring in each of these pathways.

Each year, the SNP consists of regular monitoring components and special research studies. Regular monitoring elements of the program are designed to maintain a continuous record of radionuclide concentrations in key living components of the terrestrial and aquatic environments near the SSES. Special studies conducted as part of the SNP have included a variety of activities in recent years, such as research projects designed to quantify radionuclide movement through aquatic and terrestrial food webs and surveys of angler and hunter activity and game meat consumption near the SSES. Using maximum concentrations of radionuclides measured in the 2000 SNP, the Academy calculated that the small hypothetical whole body effective dose that a person could expect to receive from the ingestion of food stuffs found in the vicinity of the SSES is primarily due to natural sources of radiation; these results were comparable to those found in previous years (Academy of Natural Sciences 2001).

As a special study in the 2000 SNP, the Academy performed an expanded, in-depth assessment of the health of the terrestrial environment. This consisted of a more rigorous radionuclide monitoring survey of terrestrial biota, including groups of animals and plants that have been examined historically as part of the SNP (e.g., squirrels, rabbits, and deer) as well as some groups (e.g., game birds) that have not been examined previously as part of the SNP. As was the case in previous years of the SNP, the Academy found in both the regular monitoring components and special research studies that no man-made radionuclides from the SSES were detected in the environment at concentrations that would pose any risk to either man or the natural ecosystem (Academy of Natural Sciences 2001).

Based on recent monitoring results, concentrations of contaminants in native vegetation, crops, soils and sediments, surface water, fish, and game animals in areas surrounding SSES have been quite low (at or near the threshold of detection) and seldom above background levels (PPL 2006d). Consequently, the NRC staff concludes that no disproportionately high and adverse human health impacts would be expected in special pathway receptor populations in the region as a result of subsistence consumption of fish and wildlife.

4.5 Groundwater Use and Quality

Table B-1 of 10 CFR Part 51, Subpart A, Appendix B, shows the Category 1 issues potentially applicable to each license renewal site. The item "groundwater use conflicts (potable and service water; plants that use <100 gallons per minute (gpm))" is applicable to SSES (see Table 4.8). PPL stated in its ER (PPL 2006a) that it is not aware of any new or significant information associated with the issuance of renewed SSES OLs including the EPU planned for

Table 4-8. Category 1 Issue Applicable to Groundwater Use and Quality During the Renewal Term

ISSUE–10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Section
GROUNDWATER USE AND QUALITY	
Groundwater use conflicts (potable and service water; plants that use <100 gpm)	4.8.1.1

2007. Evaluation by the NRC staff has not identified any new and significant information during its independent review of the SSES ER, or the site audit, the scoping process, and other report reviews. Therefore, the NRC staff concludes there would be no impacts related to this issue beyond those discussed in the GEIS. For the issue, the NRC staff concluded in the GEIS that the impact would be SMALL and that additional mitigative measures are not likely to be sufficiently beneficial to warrant implementation.

A brief description of the NRC staff's review and the GEIS conclusions, as codified in 10 CFR Part 51, Table B-1, follows:

- Groundwater-use conflicts (potable and service water; plants that use <100 gpm). Based on information in the GEIS, the Commission found that plants using less than 100 gpm are not expected to cause any groundwater-use conflicts.

As discussed in Section 2.2.2, SSES groundwater use is less than 100 gpm (400 L/min). The NRC staff has not identified any new and significant information during its independent review of the SSES ER, or the site audit, the scoping process, and evaluation of other available information. Therefore, the NRC staff concludes that there would be no groundwater-use conflicts during the renewal term beyond those discussed in the GEIS.

The Category 2 issue related to groundwater use and quality during the renewal term is listed in Table 4-9. This issue requires a plant-specific analysis.

Table 4-9. Category 2 Issue Applicable to Groundwater Use and Quality During the Renewal Term

ISSUE–10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Sections	10 CFR Part 51.53(a)(3)(ii) Subparagraph	SEIS Section
GROUNDWATER USE AND QUALITY			
Groundwater-use conflicts (plants using cooling towers withdrawing make-up water from a small river)	4.8.1.3; 4.4.2.1	B	4.5

The issue of groundwater-use conflicts due to a plant taking make-up water from a small river is of potential concern because such surface water withdrawals could impact recharge to local groundwater resources. This issue is applicable to SSES because the plant uses cooling towers and the annual mean flow of the Susquehanna River at the location of SSES is approximately 4.6×10^{11} ft^3/yr (1.3×10^{10} m^3/yr) (Ecology III 2003), thus meeting the NRC's definition of a small river.

Including the recently-approved EPU, the amount of consumptive water usage due to evaporation and drift of cooling water through the SSES cooling towers is expected to increase from 38 mgd to 44 mgd (144 to 167 million L/d). Based on the Susquehanna River's annual mean flow rate, this results in an average annual loss of 0.5 percent of river water at the SSES location. During low-flow conditions, which usually occur in late August, the average evaporative loss at SSES may approach 1 percent of the low-flow river value (PPL 2006a). This relatively low amount of surface water loss is expected to have negligible effect on the recharge of local shallow aquifers.

The NRC staff has reviewed the available information, including that provided by the applicant, the NRC staff's site audit, the scoping process, discussions with SRBC, and other available sources. The NRC staff assumes that PPL and SSES will continue to adhere to SRBC regulations regarding consumptive water use and appropriate mitigative measures given SRBC's regulatory authority. As SSES uses a small fraction of the Susquehanna River's flow even during low-flow conditions, and as SRBC will continue to regulate SSES' water withdrawal and consumption, the impact of water use from continued operation would be SMALL.

The NRC staff identified several measures that could mitigate potential impacts resulting from SSES ground water use, although the NRC cannot impose mitigation requirements on the applicant. Mitigation measures addressing the plant's groundwater consumption could include a reduction in potable water use or recycling of gray water. Mitigation measures that would reduce the quantity of water removed from the Susquehanna River could include reducing

planned power production to use less cooling water or providing dry cooling to supplement the existing natural draft cooling, as discussed in 4.1.1.

The staff did not identify cost/benefit studies applicable to these mitigation measures. Further, the SRBC holds the authority to require or enforce mitigation measures related to consumptive water use.

4.6 Threatened or Endangered Species

Threatened or endangered species are listed as a Category 2 issue in 10 CFR Part 51, Subpart A, Appendix B, Table B-1. This issue is listed in Table 4-10.

Table 4-10. Category 2 Issue Applicable to Threatened or Endangered Species During the Renewal Term

ISSUE—10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Section	10 CFR 51.53(c)(3)(ii) Subparagraph	SEIS Section
THREATENED OR ENDANGERED SPECIES (FOR ALL PLANTS)			
Threatened or endangered species	4.1	E	4.6

This Category 2 issue requires consultation with appropriate agencies to determine whether threatened or endangered species are present and whether they would be adversely affected by continued operation of SSES during the license renewal term. The characteristics and habitat of threatened or endangered species in the vicinity of the SSES site are discussed in Sections 2.2.5 and 2.2.6 of this draft SEIS.

On November 15, 2006, the NRC contacted FWS to request information on Federally listed threatened and endangered species and the impacts of license renewal (NRC 2006c). In response, on October 11, 2007, FWS provided information regarding Federally listed species that could occur in the vicinity of SSES or along the transmission line ROWs (FWS 2007).

On November 17, 2006, the NRC contacted the Pennsylvania Department of Conservation and Natural Resources (PDCNR) to request information on State-listed threatened and endangered species and the impacts of licensing renewal (NRC 2006d). In response, on January 8, 2007, PDCNR provided information regarding State-listed species that could occur in the vicinity of SSES or along the transmission line ROWs (PDCNR 2007a).

4.6.1 Aquatic Species

The NRC staff has reviewed the information provided by the applicant and publicly available information and has contacted the FWS, the PDCNR, and the Pennsylvania Fish and Boat Commission. No Federally listed threatened or endangered aquatic species or critical habitat occur in the Susquehanna River, in the vicinity of the SSES site, or in the water bodies crossed by the transmission line ROWs. Therefore, the NRC staff concludes that license renewal of SSES would have no effect on any Federally listed aquatic species.

4.6.2 Terrestrial Species

As discussed in Section 2.2.6.2, one Federally listed species – the endangered Indiana bat (*Myotis sodalis*) – was identified by the FWS as occurring near the SSES site and its associated transmission lines (FWS 2007). Due to the proximity of hibernacula, Indiana bats may occur at the site and along the transmission line ROWs. Because this species roosts and raises its young in trees in the summertime, impacts to the species could occur if large trees were disturbed or removed. The FWS has requested consultation regarding the removal of any trees larger than 5 in. (13 cm) diameter. Assuming the applicant continues the current practice of avoiding removal of large trees during months when Indiana bats may be roosting in trees (May to October) and consults with the FWS if such removal is necessary, no significant adverse impacts to the Indiana bat during the license renewal term are anticipated (FWS 2007).

As presented in Section 2.2.6.2, a number of State-listed species have been identified as occurring at or near the SSES site or transmission line ROWs. These include several birds – short-eared owl (*Asio flammeus*), upland sandpiper (*Bartramia longicauda*), American bittern (*Botaurus lentiginosus*), black tern (*Chlidonias niger*), least bittern (*Ixobrychus exilis*), osprey (*Pandion haliaetus*), bald eagle (*Haliaeetus leucocephalus*), peregrine falcon (*Falco peregrinus*), sedge wren (*Cistothorus platensis*); butterflies and skippers: the northern pearly-eye (*Enodia anthedon*), long dash (*Polites mystic*), mulberry wing (*Poanes massasoit*), Aphrodite fritillary (*Speyeria aphrodite*), and Baltimore checkerspot (*Euphydryas phaetonis*); and a wide variety of plant species.

PPL has environmental procedures – essentially instructional checklists – in place for new projects such as new roads, parking lots, and other construction activities related to operations during the license renewal term. These procedures currently consist of a generic evaluation performed by a biologist to determine potential impacts to threatened or endangered species and wetlands.

During the NRC staff's review, no significant adverse impacts to federally-listed terrestrial threatened or endangered species have been identified or are expected (FWS 2007). If PPL

successfully applies existing environmental procedures during the license renewal term, the NRC staff believes that adverse impacts during the renewal term would be SMALL.

The staff identified a variety of measures that could mitigate potential impacts to listed species resulting from continued operation of SSES. Mitigation measures could include increasing the time period during which PPL avoids removing trees in transmission line ROWs, preventing development or degradation of current onsite or ROW habitats, providing nesting or roosting sites for threatened or endangered bird species, and preserving or establishing butterfly habitat. The staff did not identify any cost benefit studies applicable to these mitigation measures.

4.7 Evaluation of New and Potentially Significant Information on Impacts of Operations During the Renewal Term

The NRC staff has not identified new and significant information on environmental issues listed in 10 CFR Part 51, Subpart A, Appendix B, Table B-1, related to operation during the renewal term. The NRC staff also determined that information provided during the public comment period did not identify any new issues that require site-specific assessment. The NRC staff reviewed the discussion of environmental impacts in the GEIS and conducted its own independent review (including public scoping meetings) to identify new and significant information. Processes for identification and evaluation of new information are described in Section 1.2.2.

4.8 Cumulative Impacts

The NRC staff considered potential cumulative impacts on the environment resulting from the incremental impact of license renewal when added to other past, present, and reasonably foreseeable future actions. For the purposes of this analysis, past actions are those related to the resources at the time of the power plant licensing and construction, present actions are those related to the resources at the time of current operation of the power plant, and future actions are considered to be those that are reasonably foreseeable through the end of plant operation, including the 20-year license renewal term. The geographic area over which past, present, and future actions are assessed is dependent on the affected resource.

The impacts of the proposed action, as described in Chapter 4, are combined with other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. These combined impacts are defined as "cumulative" in 40 CFR 1508.7 and include individually minor but collectively significant actions taking place over a period of time. It is possible that an impact that may be SMALL by itself could result in a MODERATE or LARGE impact when considered in combination with the impacts of other actions on the affected resource. Likewise, if a resource is regionally declining

or imperiled, even a SMALL individual impact could be important if it contributes to or accelerates the overall resource decline.

The NRC staff has has identified reasonably foreseeable actions occurring in the future that are considered in this review for its cumulative impacts on the environment. A potentially-significant reasonably foreseeable future action involves an application to construct and operate one or two new nuclear reactor units at the SSES site.

Two letters of intent to submit a combined construction and operating license (COL) application for a new unit at the site were sent to the NRC by PPL on May 24 and June 13, 2007 (PPL Generation 2007). The letters state that a COL application could be submitted to the NRC during the third quarter of 2008. In addition, in a conference call held on July 19, 2007, between the NRC staff and representatives of PPL Susquehanna, LLC and PPL Generation, PPL Generation indicated that either one or two additional units are being considered for the SSES site (NRC 2007b).

The specific cumulative impacts of the COL action will depend on the actual design, characteristics, and construction practices that could be proposed by the applicant. Such details are not available at this time, but if such an application is submitted to the NRC the detailed environmental impacts of the COL action at the SSES site would be analyzed and addressed in a separate NEPA document prepared by NRC staff.

Submitting a COL application does not commit PPL to build one or two new nuclear units, and does not constitute approval of the proposal by the NRC. If such an application is submitted, it will be evaluated on its merits and after considering the safety and environmental implications of the proposal, the NRC will decide whether to approve or deny a license.

The following sections include a qualitative discussion of potential impacts associated with one or two additional nuclear generating units at the site, as well as the impacts associated with other past, present, and reasonably foreseeable future actions. While the description might be limited due to unavailability of specific information, the NRC staff based its assessment on scientific principles and professional judgment.

4.8.1 Cumulative Impacts on Aquatic Resources and Surface Water

This section assesses the impacts of the proposed action that relate to the withdrawal and discharge of river water by the SSES closed-cycle cooling system, combined with other past, present, and reasonably foreseeable future actions that occur within the defined geographic area of the Susquehanna River. The Susquehanna River Basin encompasses land in New York, Pennsylvania, and Maryland. The SRBC has divided the basin into subbasins according to geographic features of the land and the corresponding drainage area. For the

purpose of this analysis, the geographic area considered for cumulative impacts on aquatic resources at SSES focuses on the portion of the Susquehanna River in the Middle Susquehanna Subbasin (Figure 4-3). Starting at the northern end of the Middle Susquehanna Subbasin, the Susquehanna River runs southeast through Towanda, in Bradford County, continues through the center of Wyoming County, and joins the Lackawanna River before turning and flowing southwest through Luzerne and Columbia Counties to Sunbury (SRBC 2007b). SSES is located in Luzerne County about 2 mi (3 km) upstream from where Wapwallopen Creek enters the river.

The drainage area of the Middle Susquehanna Subbasin is almost 2.5 million ac (1 million ha), and the Lackawanna River is the major tributary to the river. Approximately 16 percent of the entire Susquehanna River Basin population resides in the Middle Susquehanna Subbasin. The major population area of the Middle Susquehanna Subbasin is Wyoming Valley, stretching from Carbondale in the north and along the Lackawanna River to Nanticoke in the south, along the Susquehanna River. Scranton, Wilkes-Barre, Carbondale, and Sunbury are the major cities that comprise this highly populated coal mining region (SRBC 2007b). Pollution from commercial, residential, and industrial development and agricultural practices in the Middle Susquehanna Subbasin has contributed to water quality issues in the Susquehanna River. According to the Chesapeake Bay Foundation (CBF), more than 60 percent of the Susquehanna River's phosphorous, nitrogen, and sediment pollution can be attributed to agricultural runoff, including livestock manure, fertilizers, and topsoil, and urban and suburban storm water flows. Other sources of anthropogenic pollution in the Middle Susquehanna Subbasin include improperly treated wastewater, vehicle exhaust, coal-fired power plant emissions, industrial discharges, and illegal dumping (CBF 2005). Anthropogenic sources of pollution will likely be an ongoing issue for the Susquehanna River. However, SRBC, PDEP, and other environmental groups such as the CBF are working collaboratively in their efforts to conduct basin-wide monitoring and promote watershed protection and management, and water quality regulations will continue to be enforced by the PDEP through the NPDES permitting program.

Almost a century of intensive anthracite coal mining within the Wyoming Valley seriously impaired the Susquehanna River water quality and its ecological resources. The river was the recipient of the highly acidic, iron-rich drainage from numerous mining sites that operated in the Middle Susquehanna Subbasin from the late 1800s through the early 1970s. Anthracite mining reached its peak at about 1930 and ceased almost entirely in 1972, due to the evolving fossil fuel economy. However, the mines still leaked iron-contaminated acidic runoff to the river for many years following their abandonment. Prior to construction of SSES, during low-flow periods the Susquehanna River had a yellow cast due to the high iron content caused by the upstream mining effluents. In addition to high levels of total iron, mining effluents were also responsible for the high sulfate content and low pH and dissolved oxygen levels in the river. The impaired water quality of the river resulted in major fish kills (AEC 1973).

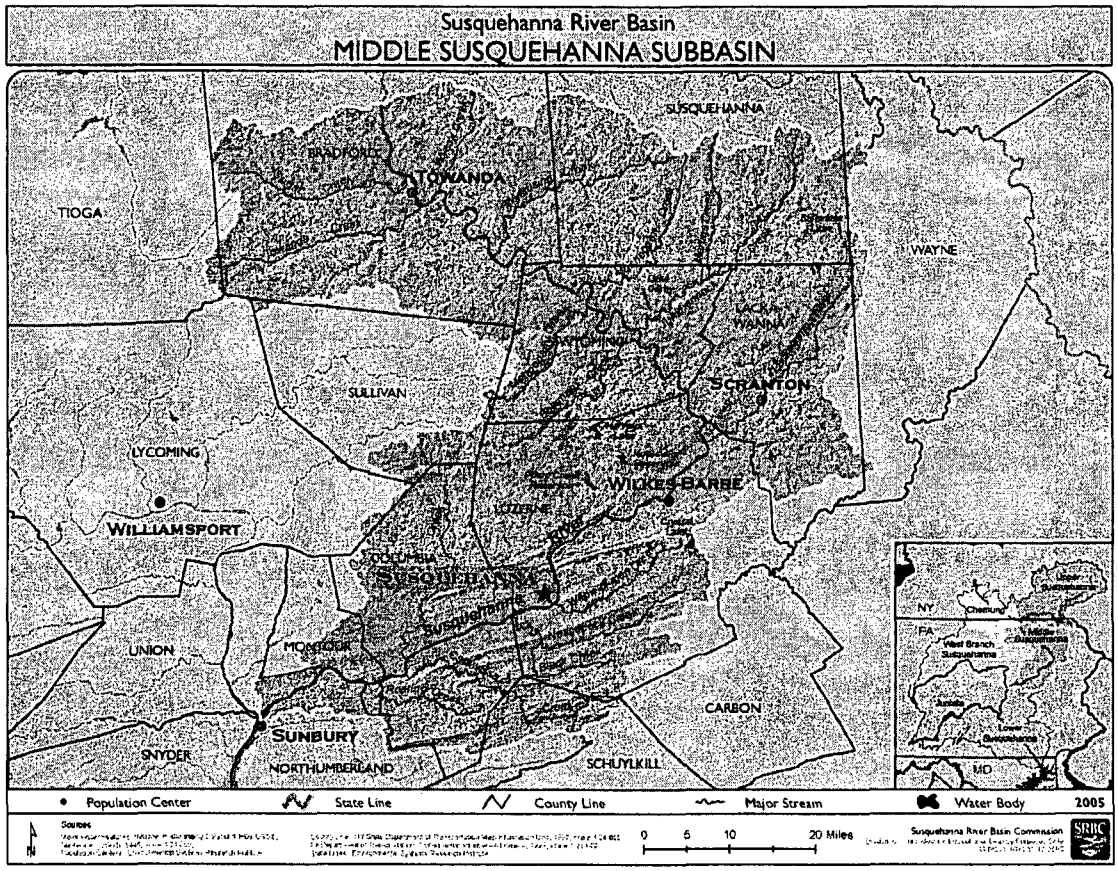

Figure 4-3. Middle Susquehanna Subbasin (Source: Adapted from SRBC 2007c)

Between 1972 and 1981, considerable improvement in the water quality of the Susquehanna River was noted. During this period, the volume of mining effluents being discharged to the river decreased. Dissolved solids, iron, and sulfate concentrations decreased, while pH and alkalinity of the river increased (NRC 1981). The water quality of the Susquehanna River has continued to improve, with the most significant change being a significant decrease in total iron levels, associated with the cessation of upriver mining (Ecology III 2007).

Municipal and industrial effluents to the Susquehanna River are, and will continue to be, regulated through NPDES permits issued by the PDEP Bureau of Water Supply and Wastewater Management. The PDEP periodically reviews and renews NPDES permits, thus it is reasonable to predict that the improving trends in Susquehanna River water quality will likely continue throughout the license renewal period.

Construction of hydroelectric dams on the river has also created significant impacts. As discussed in Section 2.2.5, the American shad is an anadromous species that was once of major sport and commercial importance within the Susquehanna River. Presently, American shad are rarely found in the upper reaches of the river because dams constructed in the last 100 years have blocked the species' natural upstream migration. Between 1904 and 1932, four hydroelectric dams were constructed on the Susquehanna River. Fish passage facilities on these early dams were primitive and failed to allow shad to pass. The 1928 construction of the 95-ft (29-m)-high Conowingo Dam, located just 10 mi (16 km) above the mouth of the Susquehanna River, effectively decimated the Susquehanna River shad migration, since authorities at the time deemed the dam too high to include fish passage (PFBC 2007).

Shad restoration attempts began in the mid-twentieth century with feasibility studies conducted by the Pennsylvania Fish Commission (now the Pennsylvania Fish and Boat Commission). From 1970 through 1980, the first Conowingo fish lift was built, and hatchery cultures of fry were stocked in the Susquehanna River and various tributaries. From 1985 through 1994, increasing numbers of fry were stocked, and over 125,000 adult shad were stocked above the Conowingo dam. Fry were stocked in the North Branch Susquehanna River in Pennsylvania and New York, the Chemung River in New York, the West Branch Susquehanna River, the Juniata River, the Susquehanna River near Montgomery Ferry, Conodoguinet Creek, the Conestoga River, Swatara Creek, and West Conewago Creek. During this period, the annual return of shad grew from 1500 to 60,000. From 1988 through 1997, a permanent fish passage facility was built at Conowingo Dam, multiple settlements with utilities that owned upstream dams were reached, and fish elevators were constructed at the Holtwood and Safe Harbor dams. In 1997, the shad return at Conowingo exceeded 100,000. In 1999 and 2000, a 500,000-shad fish ladder was completed at the Three Mile Island east channel dam, and smaller upriver dams along the Susquehanna River and major tributaries were reopened to natural shad migration through Binghamton, New York (PFBC 2007). The stocking program continues to be conducted annually in efforts to rebuild the American shad population in the Susquehanna River.

During the early shad restoration efforts, the FWS required SSES to monitor impingement rates of juvenile shad. Thus, as part of its annual environmental monitoring program, SSES routinely monitored its intake screens for aquatic organisms, paying particular attention to the impingement of shad. From 2001 to 2005, only one shad was collected from the intake screens. Because SSES uses a closed-cycle cooling water system, impingement at SSES has had a negligible impact upon shad restoration efforts.

Under EPU conditions, SSES will withdraw an average of about 60.9 mgd (230 million L/d) of water from the Susquehanna River for cooling tower evaporative losses and other plant needs, with a maximum daily water withdrawal estimate of 65.4 mgd (248 million L/d). This represents a 4.5 and 12.2 percent increase, respectively, in intake water withdrawn from the Susquehanna River from pre-EPU conditions (NRC 2007a). Some of this water would be returned to the river

as cooling tower blowdown, with the difference equaling the amount of consumptive water use by SSES. Consumptive water use due to evaporation and drift of cooling water through the SSES cooling towers is expected to increase from 38 mgd (144 million L/d) to 44 mgd (166 million L/d). Based on the Susquehanna River's annual mean flow rate, an average annual loss of 0.5 percent of river water at the SSES location would result. During low-flow conditions, which usually occur in late August, the average evaporative loss at SSES could approach 1 percent of the river flow (PPL 2006b).

Consumptive water use at SSES, and at all facilities withdrawing water from the Susquehanna River, is regulated by SRBC, an independent agency that manages water usage along the entire length of the Susquehanna River. Water use in the Middle Susquehanna Subbasin consists of 40.7 percent power generation, 37.6 percent municipal use, 15.2 percent industrial use, 4.1 percent agricultural use, and 2.4 percent domestic use (SRBC 2007b). To ensure the water resources of the Susquehanna River Basin continue to meet the needs of the basin population, SRBC coordinates with other State and Federal agencies and conducts extensive water resource monitoring, project review, water withdrawal registration, drought coordination, low-flow management (i.e., water storage), reservoir feasibility studies, and groundwater management (SRBC 2007d). In December 2006, PPL submitted an application to SRBC to eliminate the 40 mgd (150 million L/d) average monthly consumption limit and to approve a maximum daily river water withdrawal of 66 mgd (250 million L/d) (Fields 2007). SRBC has approved this increase (SRBC 2007a). SSES expects to consume an average of 44 mgd (167 million L/d) after the EPU (NRC 2007a), which represents less than 1 percent of the total average flow in the Susquehanna River in this area. Under regulation by SRBC, the operation of SSES for an additional 20 years beyond the original license term would not be expected to affect Susquehanna River surface water availability.

As noted above, PPL submitted to the NRC letters of intent to file a COL application for a third reactor at the SSES site. A third and possible fourth unit at the SSES would increase the amount of surface water withdrawn from the Susquehanna River, thus increasing consumptive water use and blowdown discharged to the river. Should one or two additional units be constructed, water demands would presumably be approximately double current consumption depending on unit size and cooling system characteristics. If the EPU water consumption rate is increased by 100 percent and compared to the average flow of the Susquehanna River, the consumption would be less than 2 percent of the river flow. SRBC would also regulate surface water withdrawals for the new reactors, setting consumptive water use limits and prescribing mitigative measures during low-flow conditions. Based on the independent review by NRC staff, the impacts of increased consumptive use would likely be SMALL.

The increase in water withdrawal from the Susquehanna River would likely increase rates of impingement and entrainment. Because the new units would also use closed-cycle cooling, the additional entrainment and impingement impacts would be minimal, and they would be

monitored and controlled in a manner similar to that for the current two units. Construction for the new units could also have temporary effects, including runoff, sedimentation, and dredging. The increased footprint of the new units could also lead to additional runoff throughout operations. A complete review of the impacts from construction and operation of the new units would be included in future NEPA documentation if PPL proceeds with its application.

The NRC staff has determined that the cumulative impacts on aquatic resources resulting from all past, present, and reasonably foreseeable future actions, including non-SSES actions, would be MODERATE to LARGE, due mostly to past actions including local anthracite mining and dam construction along the Susquehanna River. The NRC staff concludes, however, that the SMALL impacts of the SSES closed-cycle cooling system operations, including entrainment and impingement of fish and shellfish, heat shock, or any of the cooling system-related Category 1 issues, would not contribute to an overall decline in water quality or status of aquatic resources. Therefore, the NRC staff concludes that the potential contribution of SSES operations during the license renewal term on cumulative impacts to aquatic resources would be SMALL.

4.8.2 Cumulative Impacts on Terrestrial Resources

This section analyzes past, present, and future actions that could result in adverse cumulative impacts on terrestrial resources. For the purposes of this analysis, the geographic area considered includes Carbon, Columbia, Lehigh, Luzerne, Montour, Northampton, Northumberland, and Snyder Counties, which contain SSES and its associated transmission lines. Impacts that have occurred since station construction and that are likely to occur until the end of the license renewal term were considered, with some historical information provided to establish background.

At the time of station construction, terrestrial habitats on the site and along transmission lines were disturbed or destroyed. Continued operation and maintenance of the SSES site and transmission line ROWs maintain these areas in an altered condition. For some species, this impact has been offset by wildlife improvement programs.

In some areas, the construction of the transmission lines passed through forested areas, splitting them into smaller forested areas or fragments. This forest fragmentation effect converted areas of cool, shady interior forest to warm, open edge forest, with small trees, shrubs, and herbaceous vegetation within the ROW. This change favors plants that prefer warmer, drier, windier conditions, and animals that prefer a mix of herbs, shrubs, and trees (including Eastern cottontails [*Sylvilagus floridanus*], woodchucks [*Marmota monax*], mice [e.g., *Peromyscus* spp.], whitetail deer [*Odocoileus virginianus*], and various bird species), and disfavors species that prefer cooler, moister, calmer conditions found in the forest interior (AEC 1973). Allegheny wood-rats (*Neotoma magister*), wood thrush (*Hylocichla mustelina*), eastern wood-pewee, (*Contopus virens*), and scarlet tanager (*Piranga olivacea*) are on the

decline in Pennsylvania, and forest fragmentation has been identified as a potential cause (PDCNR 2007b). In fragmented woods, native birds and mammals, including blue jays (*Cyanocitta cristata*), raccoons (*Procyon lotor*), foxes, squirrels, and feral house cats (*Felis silvestris)*, can prey more easily on warblers and their nests (Fergus 2004). Additionally, brown-headed cowbird (*Molothrus ater*) nest parasitism is exacerbated by forest fragmentation, and many forest interior birds have declined as a result of this parasitism. Many woodland nesting birds have declined in the State, and wetlands and grasslands have also declined (Moyer 2003).

Additionally, fragmentation can form a barrier to movement for some animal species, particularly insects and small mammals, which may have difficulty crossing transmission line ROWs (Forman 2001). Some species do not like to approach forest edges, so the effects of even a small break in the forest can be greater on these species than would be expected. When populations of a species become fragmented, the resulting subpopulations may become vulnerable to extinction, as individuals may lose access to habitat and mates.

Invasive species consist of plants and animals that are introduced from other areas and can quickly outcompete native species. Many invasive species prefer edge habitats, and may encroach into areas that are periodically cleared faster than areas of unbroken forest. Some species are already present along the Susquehanna River, and have demonstrated an ability to replace native species. These invasive species include the tree-of-heaven (*Ailanthus altissima*), Oriental bittersweet (*Celastrus orbiculatus*), and garlic mustard (*Alliaria officinalis*), and they have encroached into woodland areas, while purple loosestrife (*Lythrum salicaria*), wild hops (*Humulus japonicus*), and Japanese knotweed (*Polygonum cuspidatum*) have colonized areas along the Susquehanna River, where they may outcompete native species and degrade the habitat of some animal species (Nature Conservancy 2001). PPL does not have a plan in place to prevent the spread of invasive species, and, in the transmission line ROWs, encourages some low-growth invasive species, such as autumn olive (*Elaeagnus umbellata*).

Maintenance of the transmission line ROWs are expected to continue regardless of the decision regarding license renewal. This maintenance will continue to favor invasive species. Open areas like transmission line ROWs have lower wind resistance than forests, potentially allowing wind-borne seeds to spread farther through transmission corridors than adjacent forests (Forman 2001). Construction and maintenance of the transmission lines have created potential pathways for the spread of these species. Potential preventative and mitigative measures would include periodically monitoring the site and transmission lines for these species, and removing them if they become established. This might be done while performing other vegetation removal activities, using mechanical or chemical methods. These species could drastically alter local ecosystems, without proper controls. Maintenance at the site and transmission lines would only contribute to these impacts if these species were present and allowed to spread along the corridors into new areas.

PPL Electric Utilities has proposed the creation of a new transmission line within the license renewal term (NRC 2007b). Although this transmission line is considered out of the scope of license renewal, it is included in this discussion on cumulative impacts. The construction of this transmission line would likely run northeast through Pennsylvania, possibly into New Jersey or New York. Any construction of a new transmission line and ROW would result in the loss of forest and other terrestrial habitats. This new transmission line could potentially alter more than 1000 ac (405 ha) of terrestrial habitats.

PPL has procedures in place to evaluate the environmental impacts of new projects such as new roads or parking lots. These procedures currently consist of a generic checklist form comprised of a list of potential environmental impacts that is reviewed by a biologist to determine whether these potential impacts occur on SSES. The definition of a potential impact is determined by PPL management. PPL considered all land in the protected area, some of which are forest and wetland habitat, to be previously disturbed. Any such disturbance would likely have potential cumulative impacts to terrestrial resources.

PPL has indicated its intention to apply for a COL for a third and possibly a fourth reactor unit, which would be located on previously disturbed land adjacent to the current units (PPL Generation 2007, NRC 2007b,). The construction of the new units would likely destroy forest and other habitats currently on the SSES site. The operation of the new units would result in an increase in water consumption from the Susquehanna River. Although new transmission lines may need to be added to SSES, PPL does not anticipate the need for additional ROWs with the addition of the new unit.

The largest contribution to the cumulative impact on terrestrial resources in the SSES area results from a wide variety of land developments and disturbances. Much of the area has been developed for commercial, industrial, and residential use, agricultural purposes, and resource extraction. This development has resulted in the loss or alteration of a large percentage of the terrestrial habitats in the area. Future developments, especially for residential and industrial purposes, will result in continued terrestrial habitat loss within the vicinity of the SSES site. In addition to direct loss of terrestrial habitats, future development will result in additional runoff from roads and impervious surfaces, and an increase in waste releases could have future impacts on adjacent terrestrial habitats.

There are numerous coal-powered plants within the vicinity of the SSES site. These and other fossil-fuel plants release carbon dioxide, mercury, nitrous oxides, and sulfur dioxide, among other air emissions. Nitrous oxides and sulfur dioxides can combine with water to form acid rain, which can lead to erosion and changes in soil pH levels. Mercury can be deposited on soils and surface water, which may then be taken up by plant or animal species, and poses the

risk of bioaccumulation. For these reasons, fossil-fuel power plants are likely to have current and future impacts to the terrestrial environment on the SSES site and surrounding area.

The NRC staff has determined that the cumulative impacts on terrestrial resources resulting from all past, present, and reasonably foreseeable future actions, including non-SSES actions, would be MODERATE to LARGE, due mostly to past and possible future land development and disturbance. The NRC staff notes, however, that continued operations during the license renewal term (the proposed action) would likely represent either no change or a SMALL incremental effect over the current level of cumulative impact.

4.8.3 Cumulative Human Health Impacts

The radiological dose limits for protection of the public and workers have been developed by the EPA and NRC to address the cumulative impact of acute and long-term exposure to radiation and radioactive material. These dose limits are codified in 40 CFR Part 190 and 10 CFR Part 20. For the purpose of this analysis, the area within a 50-mi (80-km) radius of the SSES site was included. The REMP conducted by PPL in the vicinity (approximately a 5 mi, or 8 km, radius) of the Susquehanna site measures radiation and radioactive materials from all sources, including the SSES; therefore, the monitoring program measures cumulative radiological impacts. There are no other nuclear power plants within a 50-mi (80-km) radius of SSES. However, the Safety Light Corporation (SLC), which is located in Columbia County, Pennsylvania, is within a 50-mi (80-km) radius of the SSES site. SLC is currently an operating facility manufacturing a self-illuminated exit sign, and holds a license with the NRC. The SLC site was added to the National Priority List on April 27, 2005, due to various radioactive isotopes and hazardous substances that have been found in the soil and groundwater at the site.

Monitoring results for the 5-year period from 2002 to 2006 were reviewed as part of the cumulative impacts assessment. Additionally, in Sections 2.2.7 and 4.3, the NRC staff concluded that impacts of radiation exposure to the public and workers (occupational) from operation of SSES during the renewal term are SMALL. The NRC and the Commonwealth of Pennsylvania would regulate any future actions in the vicinity of the Susquehanna site that could contribute to cumulative radiological impacts.

PPL has indicated that it has intentions of pursuing a COL for one or two reactor units on the SSES site. However, cumulative radiological doses from all uranium fuel cycle facilities, including the existing and any future reactors, within a 50-mi (80-km) radius of the SSES site have to be within the dose limits codified in 40 CFR Part 190 and 10 CFR Part 20.

Therefore, the NRC staff concludes that cumulative radiological impacts are SMALL.

The NRC staff determined that the electric-field-induced currents from the SSES transmission lines are well below the National Electrical Safety Code (NESC) recommendations for preventing electric shock from induced currents. Therefore, the SSES transmission lines do not detectably affect the overall potential for electric shock from induced currents within the analysis area. With respect to chronic effects of electromagnetic fields, although the NRC staff considers the GEIS finding of "not applicable" to be appropriate in regard to SSES, the SSES transmission lines are not likely to detectably contribute to the regional exposure to extremely low frequency-electromagnetic fields (ELF-EMFs). The SSES transmission lines pass through a sparsely populated, rural area with very few residences or businesses close enough to the lines to have detectable ELF-EMFs. Therefore, the NRC staff has determined that the cumulative impacts of the continued operation of the SSES transmission lines will be SMALL.

4.8.4 Cumulative Socioeconomic Impacts

As discussed in Section 4.4 of this draft SEIS, the continued operation of SSES during the license renewal term would have no impact on socioeconomic conditions in the region beyond those already being experienced. Since PPL has indicated that there would be no major plant refurbishment, overall expenditures and employment levels at SSES would remain relatively constant with no additional demand for housing, public utilities, and public services. In addition, since employment levels and the value of SSES would not change, there would be no population- and tax revenue-related land use impacts. There would also be no disproportionately high or adverse health or environmental impacts on minority and low-income populations in the region. Based on this and other information presented in the draft SEIS, there would be no cumulative socioeconomic impacts from the continued operation of the SSES during the license renewal term and no mitigation would be required.

Should PPL submit the application for a COL, receive approval by the NRC, and decide to construct one or two new nuclear power plant units at the SSES site, the cumulative short-term construction impacts of this action could be MODERATE to LARGE in the immediate vicinity of the SSES. These impacts would be caused by the short-term increased demand for rental housing and other commercial and public services by construction workers during the years of plant construction. During peak construction periods, there would be a noticeable increase in the number and volume of construction vehicles on roads in the immediate vicinity of the SSES site.

The cumulative long-term operations impacts of this action during the operation of the potential new power plants would be SMALL to MODERATE. These impacts would be caused by the increased demand for permanent housing and other commercial and public services, such as schools, police and fire, and public water and electric services by operations workers during the years of plant operations. During shift changes, there would be a noticeable increase in the number of commuter vehicles on roads in the immediate vicinity of the SSES site.

The specific impact of this action would depend on the actual design, characteristics, and construction practices that could be proposed by the applicant. Such details are not available at this time, but if such application is submitted to the NRC, the detailed socioeconomic impacts of this action at the SSES site would be analyzed and addressed in a separate NEPA document that would be prepared by the NRC.

Continued operation of SSES during the license renewal term has the potential to impact both known and unknown historic and archaeological resources. Impacts to known resources are likely to be well-managed by existing procedures, though impacts to unknown resources could result in a MODERATE impact. Cumulative impacts to historic and archaeological resources can result from the incremental loss of unique site types. For example, site 36-LU-49 (on the SSES property) dates to the Transitional period between the Archaic and Woodland periods (1500 B.C). The site is very rare for the SSES plant region and if altered could represent a significant cumulative impact. No major plant expansions or refurbishment activities are planned as part of license renewal.

As noted earlier, PPL Generation has indicated that it may pursue one or two new reactor units on the SSES site (NRC 2007b). This expansion has the potential to impact historic and archaeological resources in the immediate vicinity of the SSES plant. If PPL Generation files an application for any new reactor units, the appropriate environmental reviews would take place, including the Section 106 process of the National Historic Preservation Act of 1966, as amended. Any potential impacts to known historic and archaeological resources resulting from new construction would include consideration of unique site types. The appropriate mitigation for cumulative impacts to any known unique site types would likely be developed at that time.

Given that SSES plant property has the potential for extensive unknown resources – and in light of potential future actions onsite and past disturbance to the site – the NRC staff concludes that potential cumulative impacts on historic and archaeological resources could range from MODERATE to LARGE. Cumulative impacts could be partly mitigated through application of the mitigation measures discussed in Section 4.4.5.

4.8.5 Cumulative Impacts on Groundwater Use and Quality

Groundwater is used at SSES for potable domestic supply only, and withdrawals do not affect the long-term use of aquifers in the region. Average groundwater use from the wells at SSES is 65 gpm (260 L/min) with no measurable effects beyond the immediate vicinity of each well. The possible construction of one or two additional units would increase the need for domestic water supply somewhat, although economies of scale would likely limit the increase to less than 100 percent more than current demands. No significant groundwater contamination has been observed at the site, but future plans include an expansion of the SSES monitoring well

network. Independent review by NRC staff indicates the cumulative impacts on groundwater use and quality, when compared to or combined with those of other users in the region, are SMALL.

4.8.6 Cumulative Impacts on Air Quality

This section analyzes past, present, and future actions that could result in adverse cumulative impacts on air quality. For the purposes of this analysis, the geographic area considered is within a 50-mi radius of the plant. As discussed in Section 2.2.4, SSES is located within the Northeast Pennsylvania-Upper Delaware Valley Interstate Air Quality Control Region (AQCR) (Pennsylvania-New Jersey) designated by the EPA. Because of its limited potential to release criteria pollutants and hazardous air pollutants (HAPs), SSES has had minimal adverse impact on the attainment status of ambient air quality in the AQCR in which it is located.

The NRC is aware that PPL is planning to submit an application for a COL in 2008 and may ultimately pursue two additional units onsite. The plant's systems and footprint will depend upon the reactor design PPL ultimately chooses to pursue. Other plant systems (including cooling system selection) will also depend on the reactor design chosen. The plant will require river intake and outflow structures separate from the existing SSES facility and will have separate ancillary support systems such as diesel-fueled emergency generators.

Sources of criteria pollutant emissions associated with construction of the proposed facility would include exhaust emissions from construction equipment and from vehicles for earthmoving and material-handling activities and workforce traffic, as well as fugitive particulate emissions from various construction activities. PPL will be expected to outline necessary mitigation measures for minimizing the impact of construction activities on air quality in an environmental report at the time of COL application submittal.

The pollutant emissions of concern would be $PM_{2.5}$ (particulate matter with an average aerodynamic diameter of less than 2.5 micrometers), reactive organic gases, oxides of nitrogen, carbon monoxide, and sulfur dioxides from internal combustion engines of the construction vehicles and equipment, the material transport vehicles, and the private vehicles of the construction workforce. Fugitive particulate emissions can also be expected from material laydown areas and the construction site, due to ground disturbances such as grading, excavation, and construction vehicle travel on unpaved surfaces and from the concrete batching operation that could be operational onsite. Emissions of volatile organic compounds (VOCs) can also be expected from the onsite storage of vehicle and equipment fuels and from refueling activities.

Estimates of actual emissions cannot be made at this time. However, the Environmental Report contained in PPL's COL application will contain a construction plan and schedule, along with

quantitative projections of air quality impacts. All construction-related activities will be conducted in accordance with the Pennsylvania Department of Environmental Protection's Bureau of Air Quality (BAQ) requirements for visible and fugitive dust emissions as well as emission standards for stationary and mobile sources. Also, if open burning of cleared vegetation and construction debris is proposed, it would proceed under an appropriate State-issued permit. Because of the presence of nonattainment areas within the study area (a 50-mi [80-km] radius of SSES), PPL will be required to conduct a federal air conformity determination or full air conformity analysis. Additional controls may result from the conclusions of such analyses. It is reasonable to assume that with all necessary permits secured and appropriate mitigative actions identified and implemented, air quality impacts from new reactor construction would be minimal and of relatively short duration.

Once construction is completed, operation of one or two new nuclear units would result in increases of some criteria pollutant emissions at the site as a result of the coincident operation of ancillary support systems such as emergency generators. Resulting emissions would be of approximately the same nature and magnitude as the emissions from analogous support systems of the existing units at SSES. The plant is expected to continue to have negligible adverse impacts on near-field ambient air quality. Therefore, the NRC staff has determined that the cumulative impacts are SMALL.

4.8.7 Conclusions Regarding Cumulative Impacts

The NRC staff considered the potential impacts resulting from operation of SSES during the license renewal term and other past, present, and future actions in the vicinity of SSES. The NRC staff's determination is that the potential contribution to cumulative impacts resulting from SSES operation during the license renewal term would be SMALL for most areas of impact. If one or two additional units are built at the site, cumulative impacts on socioeconomics could be MODERATE to LARGE, as could cumulative impacts to historical and archaeological resources. In some resource areas – such as terrestrial resources, aquatic resources, and surface water – past human actions independent of SSES operations or constructing potential future units onsite have already created MODERATE to LARGE cumulative impacts.

4.9 Summary of Impacts of Operations During the Renewal Term

Neither PPL nor the NRC staff is aware of information that is both new and significant related to any of the applicable Category 1 issues associated with SSES operation during the renewal term. Consequently, the NRC staff concludes that the environmental impacts associated with these issues are bounded by the impacts described in the GEIS. For each of these issues, the

GEIS concluded that the impacts would be SMALL, and that additional plant-specific mitigation measures would not likely be sufficiently beneficial to warrant implementation.

Plant-specific environmental evaluations were conducted for 11 Category 2 issues applicable to SSES operation during the renewal term, as well as for environmental justice and chronic effects of electromagnetic fields. For 10 issues and environmental justice, the NRC staff concludes that the potential environmental impact of renewal term operations of SSES would be of SMALL significance in the context of the standards set forth in the GEIS. For historic and archaeological resources, the NRC staff's conclusion is that the impact resulting from license renewal would be MODERATE. In addition, the NRC staff determined that a consensus has not been reached by appropriate Federal health agencies regarding chronic adverse effects from electromagnetic fields.

Cumulative impacts of past, present, and reasonably foreseeable future actions were considered, regardless of what agency (Federal or non-Federal) or person undertakes such other actions. The NRC staff concluded that the impacts of continued operation of SSES during the license renewal period could contribute to SMALL to LARGE cumulative impacts. Constructing one or two additional units onsite would also contribute to these cumulative impacts. A complete review of impacts from construction and operation of the new units would be included in future NEPA documentation if PPL proceeds with its COL application.

4.10 References

10 CFR Part 20. *Code of Federal Regulations*, Title 10, *Energy*, Part 20, "Standards for Protection Against Radiation."

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

10 CFR Part 52. *Code of Federal Regulations*, Title 10, *Energy*, Part 52, "Early Site Permits; Standard Design Certifications; and Combined Licenses for Nuclear Power Plants."

10 CFR Part 72. *Code of Federal Regulations*, Title 10, *Energy*, Part 72, "Licensing Requirements for the Independent Storage of Spent Nuclear Fuel, High-Level Radioactive Waste, and Reactor-Related Greater than Class C Waste."

36 CFR Part 800. *Code of Federal Regulations*, Title 36, *Parks, Forests, and Public Property*, Part 800, "Protection of Historic Properties."

40 CFR Part 190. *Code of Federal Regulations*, Title 40, *Protection of Environment*, Part 190, "Environmental Radiation Standards for Nuclear Power Operations."

40 CFR Part 1508. *Code of Federal Regulations*, Title 40, *Protection of Environment*, Part 1508, "Terminology and Index."

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5.0 Environmental Impacts of Postulated Accidents

Environmental issues associated with postulated accidents are discussed in the *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (GEIS), NUREG-1437, Volumes 1 and 2 (NRC 1996, 1999).[(a)] The GEIS includes a determination of whether the analysis of the environmental issue could be applied to all plants and whether additional mitigation measures would be warranted. Issues are then assigned a Category 1 or a Category 2 designation. As set forth in the GEIS, Category 1 issues are those that meet all of the following criteria:

(1) The environmental impacts associated with the issue have been determined to apply either to all plants or, for some issues, to plants having a specific type of cooling system or other specified plant or site characteristics.

(2) A single significance level (i.e., SMALL, MODERATE, or LARGE) has been assigned to the impacts (except for collective offsite radiological impacts from the fuel cycle and from high-level waste and spent fuel disposal).

(3) Mitigation of adverse impacts associated with the issue has been considered in the analysis, and it has been determined that additional plant-specific mitigation measures are likely not to be sufficiently beneficial to warrant implementation.

For issues that meet the three Category 1 criteria, no additional plant-specific analysis is required unless new and significant information is identified.

Category 2 issues are those that do not meet one or more of the criteria for Category 1, and, therefore, additional plant-specific review of these issues is required.

This chapter describes the environmental impacts from postulated accidents that might occur during the license renewal term.

5.1 Postulated Plant Accidents

Two classes of accidents are evaluated in the GEIS. These are design-basis accidents and severe accidents, as discussed below.

(a) The GEIS was originally issued in 1996. Addendum 1 to the GEIS was issued in 1999. Hereafter, all references to the "GEIS" include the GEIS and Addendum 1.

5.1.1 Design-Basis Accidents

In order to receive U.S. Nuclear Regulatory Commission (NRC) approval to operate a nuclear power facility, an applicant for an initial operating license (OL) must submit a Safety Analysis Report (SAR) as part of its application. The SAR presents the design criteria and design information for the proposed reactor and comprehensive data on the proposed site. The SAR also discusses various hypothetical accident situations and the safety features that are provided to prevent and mitigate accidents. The NRC staff reviews the application to determine whether the plant design meets the Commission's regulations and requirements and includes, in part, the nuclear plant design and its anticipated response to an accident.

Design-basis accidents (DBAs) are those accidents that both the licensee and the NRC staff evaluate to ensure that the plant can withstand normal and abnormal transients, and a broad spectrum of postulated accidents, without undue hazard to the health and safety of the public. A number of these postulated accidents are not expected to occur during the life of the plant, but are evaluated to establish the design basis for the preventive and mitigative safety systems of the facility. The acceptance criteria for DBAs are described in Title 10, Part 50 and Part 100, of the *Code of Federal Regulations* (10 CFR Part 50 and 10 CFR Part 100).

The environmental impacts of DBAs are evaluated during the initial licensing process, and the ability of the plant to withstand these accidents is demonstrated to be acceptable before issuance of the OL. The results of these evaluations are found in license documentation such as the applicant's Final Safety Analysis Report (FSAR), the NRC staff's Safety Evaluation Report (SER), the Final Environmental Statement (FES), and Section 5.1 of this Supplemental Environmental Impact Statement (SEIS). A licensee is required to maintain the acceptable design and performance criteria throughout the life of the plant, including any extended-life operation. The consequences for these events are evaluated for the hypothetical maximally exposed individual; as such, changes in the plant environment will not affect these evaluations. Because of the requirements that continuous acceptability of the consequences and aging management programs be in effect for license renewal, the environmental impacts as calculated for DBAs should not differ significantly from initial licensing assessments over the life of the plant, including the license renewal period. Accordingly, the design of the plant relative to DBAs during the extended period is considered to remain acceptable, and the environmental impacts of those accidents were not examined further in the GEIS.

The Commission has determined that the environmental impacts of DBAs are of SMALL significance for all plants because the plants were designed to successfully withstand these accidents. Therefore, for the purposes of license renewal, DBAs are designated as a Category 1 issue in 10 CFR Part 51, Subpart A, Appendix B, Table B-1. The early resolution of the DBAs makes them a part of the current licensing basis of the plant; the current licensing basis of the plant is to be maintained by the licensee under its current license and, therefore,

under the provisions of 10 CFR 54.30, is not subject to review under license renewal. This issue, applicable to Susquehanna Steam Electric Station (SSES), is listed in Table 5-1.

Table 5-1. Category 1 Issue Applicable to Postulated Accidents During the Renewal Term

ISSUE–10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Sections
POSTULATED ACCIDENTS	
Design-basis accidents	5.3.2; 5.5.1

Based on information in the GEIS, the Commission found that

> The NRC staff has concluded that the environmental impacts of design-basis accidents are of small significance for all plants.

PPL Susquehanna, LLC (PPL) stated in its Environmental Report (ER) (PPL 2006) that it is not aware of any new and significant information associated with the issuance of renewed PPL OLs. The NRC staff has not identified any new and significant information during its independent review of the SSES ER, or the site audit, the scoping process, and evaluation of other available information. Therefore, the NRC staff concludes that there are no impacts related to DBAs beyond those discussed in the GEIS.

5.1.2 Severe Accidents

Severe nuclear accidents are those that are more severe than DBAs because they could result in substantial damage to the reactor core, regardless of offsite consequences. In the GEIS, the NRC staff assessed the impacts of severe accidents using the results of existing analyses and site-specific information to conservatively predict the environmental impacts of severe accidents for each plant during the renewal period.

Severe accidents initiated by external phenomena, such as tornadoes, floods, earthquakes, fires, and sabotage, traditionally have not been discussed in quantitative terms in FESs and were not specifically considered for the SSES site in the GEIS. However, in the GEIS, the NRC staff did evaluate existing impact assessments performed by the NRC and by the industry at 44 nuclear plants in the United States and concluded that the risk from beyond-design-basis earthquakes at existing nuclear power plants is SMALL. The GEIS for license renewal performed a discretionary analysis of terrorist acts in connection with license renewal, and concluded that the core damage and radiological release from such acts would be no worse than the damage and release expected from internally initiated events. In the GEIS, the Commission concludes that the risk from sabotage and beyond-design-basis earthquakes at

existing nuclear power plants is small and, additionally, that the risks from other external events are adequately addressed by a generic consideration of internally initiated severe accidents (GEIS, Vol. 1, pp. 5–18).

Based on information in the GEIS, the Commission found that

> The probability weighted consequences of atmospheric releases, fallout onto open bodies of water, releases to groundwater, and societal and economic impacts from severe accidents are small for all plants. However, alternatives to mitigate severe accidents must be considered for all plants that have not considered such alternatives.

Therefore, the Commission has designated mitigation of severe accidents as a Category 2 issue in 10 CFR Part 51, Subpart A, Appendix B, Table B-1. This issue, applicable to SSES, is listed in Table 5-2.

Table 5-2. Category 2 Issue Applicable to Postulated Accidents During the Renewal Term

ISSUE–10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Sections	10 CFR 51.53(c)(3)(ii) Subparagraph	SEIS Section
POSTULATED ACCIDENTS			
Severe accidents	5.3.3; 5.3.3.2; 5.3.3.3; 5.3.3.4; 5.3.3.5; 5.4; 5.5.2	L	5.2

The NRC staff has not identified any new and significant information with regard to the consequences from severe accidents during its independent review of the SSES ER (PPL 2006), or the site audit, the scoping process, and evaluation of other available information. Therefore, the NRC staff concludes that there are no impacts of severe accidents beyond those discussed in the GEIS. However, in accordance with 10 CFR 51.53(c)(3)(ii)(L), the NRC staff has reviewed severe accident mitigation alternatives (SAMAs) for SSES. The results of its review are discussed in Section 5.2.

5.2 Severe Accident Mitigation Alternatives

10 CFR 51.53(c)(3)(ii)(L) requires that license renewal applicants consider alternatives to mitigate severe accidents if the NRC staff has not previously evaluated SAMAs for an applicant's plant in an Environmental Impact Statement (EIS) or related supplement or in an environmental assessment. The purpose of this consideration is to ensure that plant changes (i.e., hardware, procedures, and training) with the potential for improving severe accident safety

performance are identified and evaluated. SAMAs have not been previously considered for SSES; therefore, the remainder of Chapter 5 addresses those alternatives.

5.2.1 Introduction

This section summarizes the SAMA evaluation for SSES conducted by PPL and the NRC staff's review of that evaluation. The NRC staff performed its review with contract assistance from Information Systems Laboratories, Inc. The NRC staff's review is available in full in Appendix G; the SAMA evaluation is available in full in PPL's ER (PPL 2006).

The SAMA evaluation for SSES was conducted using a four-step approach. In the first step, PPL quantified the level of risk associated with potential reactor accidents using the plant-specific probabilistic risk assessment (PRA) and other risk models.

In the second step, PPL examined the major risk contributors and identified possible ways (SAMAs) of reducing that risk. Common ways of reducing risk are changes to components, systems, procedures, and training. PPL initially identified 15 potential SAMAs for SSES. PPL then screened out four SAMAs from further consideration because they were determined to provide no measurable benefit or to have estimated costs that would exceed the dollar value associated with completely eliminating all severe accident risk at SSES. The remaining 11 SAMAs were subjected to further evaluation.

In the third step, PPL estimated the benefits and the costs associated with each of the remaining SAMAs. Estimates were made of how much each SAMA could reduce risk. Those estimates were developed in terms of dollars in accordance with NRC guidance for performing regulatory analyses (NRC 1997). The cost of implementing the proposed SAMAs was also estimated.

Finally, in the fourth step, the costs and benefits of each of the remaining SAMAs were compared to determine whether each SAMA was cost-beneficial, meaning that the benefits of the SAMA were greater than the cost (a positive cost-benefit). PPL found two SAMAs to be potentially cost-beneficial in the baseline analysis and three additional SAMAs to be potentially cost-beneficial when analysis uncertainties are considered (PPL 2006).

The potentially cost-beneficial SAMAs do not relate to adequately managing the effects of aging during the period of extended operation; therefore, they need not be implemented as part of license renewal pursuant to 10 CFR Part 54. PPL's SAMA analyses and the NRC's review are discussed in more detail below.

5.2.2 Estimate of Risk

PPL submitted an assessment of SAMAs for SSES as part of the ER (PPL 2006). This assessment was based on the most recent SSES PRA available at that time, a plant-specific offsite consequence analysis performed using the MELCOR Accident Consequence Code System 2 (MACCS2) computer program, and insights from the SSES Individual Plant Examination (IPE) (PPL 1991) and Individual Plant Examination of External Events (IPEEE) (PPL 1994).

The baseline core damage frequency (CDF) for the purpose of the SAMA evaluation is approximately 2.0×10^{-6} per year. This CDF is based on the risk assessment for internally initiated events. PPL did not include the contribution to risk from external events within the SSES risk estimates; however, it did account for the potential risk-reduction benefits associated with external events by increasing the estimated benefits for internal events by a factor of two. The breakdown of CDF by initiating event is provided in Table 5-3. The results shown are for Unit 1, but are also representative of those for Unit 2.

Table 5-3. SSES Core Damage Frequency

Initiating Event	CDF (Per Year)	Percent Contribution to CDF
Loss of offsite power	1.4×10^{-6}	72
Trip w/o MSIV[(a)] closure	1.8×10^{-7}	9
Interfacing system LOCA[(a)]	1.1×10^{-7}	6
Loss of DC power bus	8.8×10^{-8}	4
Small LOCA	4.9×10^{-8}	3
MSIV closure	4.4×10^{-8}	2
Manual shutdown	1.8×10^{-8}	1
Medium LOCA	1.6×10^{-8}	1
Internal flooding	1.5×10^{-8}	1
Excessive rupture	1.0×10^{-8}	1
Others	1.8×10^{-8}	1
Total CDF	**2.0×10^{-6}**	**100**

(a) MSIV = main steam isolation valve; LOCA = loss of coolant accident.

As shown in Table 5-3, events initiated by loss of offsite power (LOOP) are the dominant contributors to the CDF. Although not separately reported, station blackout (SBO) sequences contribute roughly 3.2×10^{-7} per year (17 percent of the total internal events CDF), while anticipated transient without scram (ATWS) sequences contribute 9.5×10^{-8} per year (about 5 percent of the total internal events CDF).

PPL estimated the dose to the population within 50 mi (80 km) of the SSES site to be approximately 0.019 person-Sieverts (person-Sv) (1.9 person-rem) per year. The breakdown of the total population dose by containment release mode is summarized in Table 5-4. Containment failures within the intermediate time frame (greater than 6 hours but less than 24 hours following accident initiation) dominate the population dose risk at SSES.

5.2.3 Potential Plant Improvements

Once the dominant contributors to plant risk were identified, PPL searched for ways to reduce that risk. In identifying and evaluating potential SAMAs, PPL considered insights from the plant-specific PRA and SAMA analyses performed for other operating plants that have submitted license renewal applications. PPL identified 15 potential risk-reducing improvements (SAMAs) to plant components, systems, procedures, and training.

Table 5-4. Breakdown of Population Dose by Containment Release Mode

Containment Release Mode	Population Dose (Person-rem[(a)] per Year)	Percent Contribution
Early containment failure	0.52	27
Intermediate containment failure	1.20	63
Late containment failure	0.18	9
Intact containment	Negligible	Negligible
Total	1.90	100

(a) One person-rem = 0.01 person-Sv.

The NRC staff has reviewed PPL's data and evaluation methods and concludes that the quality of the risk analyses is adequate to support an assessment of the risk reduction potential for candidate SAMAs. Accordingly, the NRC staff based its assessment of offsite risk on the CDFs and offsite doses reported by PPL.

PPL removed four SAMAs from further consideration because they were determined to provide no measurable benefit or to have estimated costs that would exceed the dollar value associated with completely eliminating all severe accident risk at SSES. A detailed cost-benefit analysis was performed for each of the 11 remaining SAMAs.

The NRC staff concludes that PPL used a systematic and comprehensive process for identifying potential plant improvements for SSES, and that the set of potential plant improvements identified by PPL is reasonably comprehensive and, therefore, acceptable.

5.2.4 Evaluation of Risk Reduction and Costs of Improvements

PPL evaluated the risk-reduction potential of the remaining 11 SAMAs. The SAMA evaluations were performed using realistic assumptions with some conservatism.

PPL estimated the costs of implementing the 11 candidate SAMAs through the application of engineering judgment and use of other licensees' estimates for similar improvements. The cost estimates conservatively did not include the cost of replacement power during extended outages required to implement the modifications, nor did they include contingency costs associated with unforeseen implementation obstacles.

The NRC staff reviewed PPL's bases for calculating the risk reduction for the various plant improvements and concludes that the rationale and assumptions for estimating risk reduction are reasonable and generally conservative (i.e., the estimated risk reduction is similar to or somewhat higher than what would actually be realized). Accordingly, the NRC staff based its estimates of averted risk for the various SAMAs on PPL's risk reduction estimates.

The NRC staff reviewed the bases for the applicant's cost estimates. For certain improvements, the NRC staff also compared the cost estimates to estimates developed elsewhere for similar improvements, including estimates developed as part of other licensees' analyses of SAMAs for operating reactors and advanced light-water reactors. The NRC staff found the cost estimates to be reasonable, and generally consistent with estimates provided in support of other plants' analyses.

The NRC staff concludes that the risk reduction and the cost estimates provided by PPL are sufficient and appropriate for use in the SAMA evaluation.

5.2.5 Cost-Benefit Comparison

The cost-benefit analysis performed by PPL was based primarily on NUREG/BR-0184 (NRC 1997) and was executed consistent with this guidance. NUREG/BR-0058 has recently been revised to reflect the NRC's revised policy on discount rates. Revision 4 of NUREG/BR-0058

states that two sets of estimates should be developed – one at three percent and one at seven percent (NRC 2004). PPL provided both sets of estimates (PPL 2006).

PPL identified two potentially cost-beneficial SAMAs in the baseline analysis contained in the ER (using a three percent discount rate). The potentially cost-beneficial SAMAs are:

- SAMA 2a – Install minimal hardware changes and modify procedures to provide a cross-tie capability between the 4 kilovolt (kV) alternating current (AC) emergency buses.

- SAMA 6 – Procure an additional portable 480 volt (V) AC station diesel generator to power battery chargers in scenarios where AC power is unavailable.

PPL performed additional analyses to evaluate the impact of parameter choices and uncertainties on the results of the SAMA assessment (PPL 2006). Three additional SAMA candidates were determined to be potentially cost-beneficial, if the benefits were increased by a factor of 2.1 to account for uncertainties:

- SAMA 2b – Improve the cross-tie capability between 4 kV AC emergency buses, i.e., between A or D emergency buses and B or C emergency buses (a more flexible cross-tie option than SAMA 2a).

- SAMA 3 – Modify procedures to stagger reactor pressure vessel (RPV) depressurization when fire protection system injection is the only available makeup source.

- SAMA 5 – Modify portable station diesel generator to automatically align to 125 V direct current (DC) battery chargers.

After reviewing PPL Susquehanna's SAMA analysis, the NRC staff concludes that the costs of all other SAMAs evaluated are greater than their associated benefits.

5.2.6 Conclusions

The NRC staff reviewed PPL's analysis and concluded that the methods used and the implementation of those methods were sound. The treatment of SAMA benefits and costs support the general conclusion that the SAMA evaluations performed by PPL are reasonable and sufficient for the license renewal submittal. Although the treatment of SAMAs for external events was somewhat limited by the unavailability of an external event PRA, the likelihood of there being cost-beneficial enhancements in this area was minimized by improvements that have been realized as a result of the IPEEE process, and increasing the estimated SAMA benefits for internal events by a factor of two to account for potential benefits in external events.

Based on its review of the SAMA analysis, the NRC staff concurs with PPL's identification of areas in which risk can be further reduced in a cost-beneficial manner through the implementation of all or a subset of potentially cost-beneficial SAMAs. Given the potential for cost-beneficial risk reduction, the staff considers that further evaluation of these SAMAs by PPL is warranted. However, none of the potentially cost-beneficial SAMAs relate to adequately managing the effects of aging during the period of extended operation. Therefore, they need not be implemented as part of the license renewal pursuant to 10 CFR Part 54.

5.3 References

10 CFR Part 50. *Code of Federal Regulations*, Title 10, *Energy*, Part 50, "Domestic Licensing of Production and Utilization Facilities."

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

10 CFR Part 54. *Code of Federal Regulations*, Title 10, *Energy*, Part 54, "Requirements for Renewal of Operating Licenses for Nuclear Power Plants."

10 CFR Part 73. *Code of Federal Regulations*, Title 10, *Energy*, Part 73, "Physical Protection of Plants and Materials."

10 CFR Part 100. *Code of Federal Regulations*, Title 10, *Energy*, Part 100, "Reactor Site Criteria."

Pennsylvania Power & Light Company (PPL). 1991. Letter from Harold W. Keiser, PPL, to C.L. Miller, NRC. Subject: "Susquehanna Steam Electric Station Submittal of the IPE Report." (December 13, 1991).

Pennsylvania Power & Light Company (PPL). 1994. Letter from Robert G. Byram, PPL, to C.L. Miller, NRC. Subject: "Susquehanna Steam Electric Station Submittal of the IPEEE Report." (June 27, 1994).

PPL Susquehanna, LLC (PPL). 2006. *Susquehanna Steam Electric Station Units 1 and 2 Application for License Renewal, Appendix E: Applicant's Environmental Report – Operating License Renewal Stage*. Allentown, Pennsylvania. (September 2006). ADAMS No. ML062630235.

U.S. Nuclear Regulatory Commission (NRC). 1996. *Generic Environmental Impact Statement for License Renewal of Nuclear Plants*. NUREG-1437, Vols. 1 and 2, Washington, D.C.

U.S. Nuclear Regulatory Commission (NRC). 1997. *Regulatory Analysis Technical Evaluation Handbook*. NUREG/BR-0184, Washington, D.C.

U.S. Nuclear Regulatory Commission (NRC). 1999. *Generic Environmental Impact Statement for License Renewal of Nuclear Plants, Main Report*, "Section 6.3 – Transportation, Table 9.1, Summary of Findings on NEPA Issues for License Renewal of Nuclear Power Plants, Final Report." NUREG-1437, Vol. 1, Addendum 1, Washington, D.C.

U.S. Nuclear Regulatory Commission (NRC). 2004. *Regulatory Analysis Guidelines of the U.S. Nuclear Regulatory Commission*. NUREG/BR-0058, Rev. 4, Washington, D.C.

6.0 Environmental Impacts of the Uranium Fuel Cycle and Solid Waste Management

Environmental issues associated with the uranium fuel cycle and solid waste management are discussed in the *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (GEIS), NUREG-1437, Volumes 1 and 2 (NRC 1996, 1999).[a] The GEIS includes a determination of whether the analysis of the environmental issue could be applied to all plants and whether additional mitigation measures would be warranted. Issues are then assigned a Category 1 or a Category 2 designation. As set forth in the GEIS, Category 1 issues are those that meet all of the following criteria:

(1) The environmental impacts associated with the issue have been determined to apply either to all plants or, for some issues, to plants having a specific type of cooling system or other specified plant or site characteristics.

(2) A single significance level (i.e., SMALL, MODERATE, or LARGE) has been assigned to the impacts (except for collective offsite radiological impacts from the fuel cycle and from high-level waste (HLW) and spent fuel disposal).

(3) Mitigation of adverse impacts associated with the issue has been considered in the analysis, and it has been determined that additional plant-specific mitigation measures are likely not to be sufficiently beneficial to warrant implementation.

For issues that meet the three Category 1 criteria, no additional plant-specific analysis is required unless new and significant information is identified.

Category 2 issues are those that do not meet one or more of the criteria for Category 1, and, therefore, additional plant-specific review of these issues is required.

This chapter addresses the issues that are related to the uranium fuel cycle and solid waste management during the license renewal term that are listed in Table B-1 of Title 10, Part 51, of the *Code of Federal Regulations* (10 CFR Part 51), Subpart A, Appendix B, and are applicable to the Susquehanna Steam Electric Station, Units 1 and 2 (SSES). The generic potential impacts of the radiological and nonradiological environmental impacts of the uranium fuel cycle and transportation of nuclear fuel and wastes are described in detail in the GEIS based, in part,

(a) The GEIS was originally issued in 1996. Addendum 1 to the GEIS was issued in 1999. Hereafter, all references to the "GEIS" include the GEIS and its Addendum 1.

on the generic impacts provided in 10 CFR 51.51(b), Table S-3, "Table of Uranium Fuel Cycle Environmental Data," and in 10 CFR 51.52(c), Table S-4, "Environmental Impact of Transportation of Fuel and Waste to and from One Light-Water-Cooled Nuclear Power Reactor." The U.S. Nuclear Regulatory Commission (NRC) staff also addresses the impacts from radon-222 and technetium-99 in the GEIS.

6.1 The Uranium Fuel Cycle

Category 1 issues in 10 CFR Part 51, Subpart A, Appendix B, Table B-1, that are applicable to SSES from the uranium fuel cycle and solid waste management are listed in Table 6-1. There are nine Category 1 issues related to the fuel cycle and waste management. There are no Category 2 issues.

Table 6-1. Category 1 Issues Applicable to the Uranium Fuel Cycle and Solid Waste Management During the Renewal Term

ISSUE–10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Section
URANIUM FUEL CYCLE AND WASTE MANAGEMENT	
Offsite radiological impacts (individual effects from other than the disposal of spent fuel and HLW)	6.1; 6.2.1; 6.2.2.1; 6.2.2.3; 6.2.3; 6.2.4; 6.6
Offsite radiological impacts (collective effects)	6.1; 6.2.2.1; 6.2.3; 6.2.4; 6.6
Offsite radiological impacts (spent fuel and HLW disposal)	6.1; 6.2.2.1; 6.2.3; 6.2.4; 6.6
Nonradiological impacts of the uranium fuel cycle	6.1; 6.2.2.6; 6.2.2.7; 6.2.2.8; 6.2.2.9; 6.2.3; 6.2.4; 6.6
Low-level waste storage and disposal	6.1; 6.2.2.2; 6.4.2; 6.4.3; 6.4.3.1; 6.4.3.2; 6.4.3.3; 6.4.4; 6.4.4.1; 6.4.4.2; 6.4.4.3; 6.4.4.4; 6.4.4.5; 6.4.4.5.1; 6.4.4.5.2; 6.4.4.5.3; 6.4.4.5.4; 6.4.4.6; 6.6
Mixed waste storage and disposal	6.4.5.1; 6.4.5.2; 6.4.5.3; 6.4.5.4; 6.4.5.5; 6.4.5.6; 6.4.5.6.1; 6.4.5.6.2; 6.4.5.6.3; 6.4.5.6.4; 6.6
Onsite spent fuel	6.1; 6.4.6; 6.4.6.1; 6.4.6.2; 6.4.6.3; 6.4.6.4; 6.4.6.5; 6.4.6.6; 6.4.6.7; 6.6
Nonradiological waste	6.1; 6.5; 6.5.1; 6.5.2; 6.5.3; 6.6
Transportation	6.1; 6.3.1; 6.3.2.3; 6.3.3; 6.3.4; 6.6, Addendum 1

PPL Susquehanna, LLC (PPL) stated in its Environmental Report (ER) (PPL 2006) that it is not aware of any new and significant information associated with issuance of the renewed SSES operating licenses (OLs). The NRC staff has not identified any new and significant information during its independent review of the SSES ER, or the site audit, the scoping process, and evaluation of other available information. Therefore, the NRC staff concludes that there are no impacts related to these issues beyond those discussed in the GEIS. For these issues, the NRC staff concluded in the GEIS that the impacts are SMALL except for the collective offsite radiological impacts from the fuel cycle and from HLW and spent fuel disposal, as discussed below, and that additional plant-specific mitigation measures are not likely to be sufficiently beneficial to be warranted.

A brief description of the NRC staff review and the GEIS conclusions, as codified in Table B-1, 10 CFR Part 51, for each of these issues follows:

- Offsite radiological impacts (individual effects from other than the disposal of spent fuel and HLW). Based on information in the GEIS, the Commission found that

  > Offsite impacts of the uranium fuel cycle have been considered by the Commission in Table S-3 10 CFR 51.51(b). Based on information in the GEIS, impacts on individuals from radioactive gaseous and liquid releases, including radon-222 and technetium-99, are small.

  The NRC staff has not identified any new and significant information during its independent review of the SSES ER, or the site audit, the scoping process, and evaluation of other available information. Therefore, the NRC staff concludes that there would be no offsite radiological impacts of the uranium fuel cycle during the renewal term beyond those discussed in the GEIS.

- Offsite radiological impacts (collective effects). Based on information in the GEIS, the Commission found that

  > The 100-year environmental dose commitment to the U.S. population from the fuel cycle, HLW and spent fuel disposal excepted, is calculated to be about 14,800 person-rem (148 person-sieverts), or 12 cancer fatalities, for each additional 20-year power reactor operating term. Much of this, especially the contribution of radon releases from mines and tailing piles, consists of tiny doses summed over large populations. This same dose calculation can theoretically be extended to include many tiny doses over additional thousands of years as well as doses outside the United States. The result of such a calculation would be thousands of cancer fatalities from the fuel cycle, but this result assumes that even tiny doses have some

> statistical adverse health effect that will not ever be mitigated (e.g., no cancer cure in the next thousand years), and that these doses projected over thousands of years are meaningful. However, these assumptions are questionable. In particular, science cannot rule out the possibility that there will be no cancer fatalities from these tiny doses. For perspective, the doses are very small fractions of regulatory limits and even smaller fractions of natural background exposure to the same populations.
>
> Nevertheless, despite all the uncertainty, some judgment as to the regulatory National Environmental Policy Act (NEPA) implications of these matters should be made and it makes no sense to repeat the same judgment in every case. Even taking the uncertainties into account, the Commission concludes that these impacts are acceptable in that these impacts would not be sufficiently large to require the NEPA conclusion, for any plant, that the option of extended operation under 10 CFR Part 54 should be eliminated. Accordingly, while the Commission has not assigned a single level of significance for the collective effects of the fuel cycle, this issue is considered Category 1.

The NRC staff has not identified any new and significant information during its independent review of the SSES ER, or the site audit, the scoping process, and evaluation of other available information. Therefore, the NRC staff concludes that there would be no offsite radiological impacts (collective effects) from the uranium fuel cycle during the renewal term beyond those discussed in the GEIS.

- Offsite radiological impacts (spent fuel and HLW disposal). Based on information in the GEIS, the Commission found that

> For the HLW and spent fuel disposal component of the fuel cycle, there are no current regulatory limits for offsite releases of radionuclides for the current candidate repository site. However, if we assume that limits are developed along the lines of the 1995 National Academy of Sciences (NAS) report, *Technical Bases for Yucca Mountain Standards* (NAS 1995), and that in accordance with the Commission's Waste Confidence Decision, 10 CFR 51.23, a repository can and likely will be developed at some site which will comply with such limits, peak doses to virtually all individuals will be 100 mrem (1 mSv) per year or less. However, while the Commission has reasonable confidence that these assumptions will prove correct, there is considerable uncertainty since the limits are yet to be developed, no repository application has been completed or reviewed, and uncertainty is inherent in the models used to evaluate possible pathways to the human

environment. The NAS report indicated that 100 mrem (1 mSv) per year should be considered as a starting point for limits for individual doses, but notes that some measure of consensus exists among national and international bodies that the limits should be a fraction of the 100 mrem (1 mSv) per year. The lifetime individual cancer risk from a 100 mrem (1 mSv) annual dose limit is about 3×10^{-3}.

Estimating cumulative doses to populations over thousands of years is more problematic. The likelihood and consequences of events that could seriously compromise the integrity of a deep geologic repository were evaluated by the U.S. Department of Energy in the *Final Environmental Impact Statement: Management of Commercially Generated Radioactive Waste*, October 1980 (DOE 1980). The evaluation estimated the 70-year whole-body dose commitment to the maximum individual and to the regional population resulting from several modes of breaching a reference repository in the year of closure, after 1000 years, after 100,000 years, and after 100,000,000 years. Subsequently, the NRC and other Federal agencies have expended considerable effort to develop models for the design and for the licensing of a HLW repository, especially for the candidate repository at Yucca Mountain. More meaningful estimates of doses to population may be possible in the future as more is understood about the performance of the proposed Yucca Mountain repository. Such estimates would involve very great uncertainty, especially with respect to cumulative population doses over thousands of years. The standard proposed by the NAS is a limit on maximum individual dose. The relationship of potential new regulatory requirements, based on the NAS report, and cumulative population impacts has not been determined, although the report articulates the view that protection of individuals will adequately protect the population for a repository at Yucca Mountain. However, the U.S. Environmental Protection Agency's (EPA's) generic repository standards in 40 CFR Part 191 generally provide an indication of the order of magnitude of cumulative risk to population that could result from the licensing of a Yucca Mountain repository, assuming the ultimate standards will be within the range of standards now under consideration. The standards in 40 CFR Part 191 protect the population by imposing "containment requirements" that limit the cumulative amount of radioactive material released over 10,000 years. Reporting performance standards that will be required by the EPA are expected to result in releases and associated health consequences in the range between 10 and 100 premature cancer deaths, with an upper limit of 1000 premature cancer deaths worldwide for a 100,000-metric ton (MTHM) repository.

> Nevertheless, despite all the uncertainty, some judgment as to the regulatory NEPA implications of these matters should be made and it makes no sense to repeat the same judgment in every case. Even taking the uncertainties into account, the Commission concludes that these impacts are acceptable in that these impacts would not be sufficiently large to require the NEPA conclusion, for any plant, that the option of extended operation under 10 CFR Part 54 should be eliminated. Accordingly, while the Commission has not assigned a single level of significance for the impacts of spent fuel and HLW disposal, this issue is considered Category 1.

On February 15, 2002, based on a recommendation by the Secretary of the U.S. Department of Energy, the President recommended the Yucca Mountain site for the development of a repository for the geologic disposal of spent nuclear fuel and high-level nuclear waste. The U.S. Congress approved this recommendation on July 9, 2002, in Joint Resolution 87, which designated Yucca Mountain as the repository for spent nuclear waste. On July 23, 2002, the President signed Joint Resolution 87 into law; Public Law 107-200, 116 *Statutes at Large* (Stat.) 735 (2002), designates Yucca Mountain as the repository for spent nuclear waste. This development does not represent new and significant information with respect to the offsite radiological impacts from license renewal related to disposal of spent nuclear fuel and high-level nuclear waste.

The EPA developed Yucca-Mountain-specific repository standards, which were subsequently adopted by the NRC in 10 CFR Part 63. In an opinion, issued July 9, 2004, the U.S. Court of Appeals for the District of Columbia Circuit (the Court) vacated the EPA's radiation protection standards for the candidate repository, which required compliance with certain dose limits over a 10,000-year period. The Court's decision also vacated the compliance period in NRC's licensing criteria for the candidate repository in 10 CFR Part 63. In response to the Court's decision, the EPA issued its proposed revised standards to 40 CFR Part 197 on August 22, 2005 (EPA 2005). In order to be consistent with the EPA's revised standards, the NRC proposed revisions to 10 CFR Part 63 on September 8, 2005 (NRC 2005).

Therefore, for the HLW and spent fuel disposal component of the fuel cycle, there is some uncertainty with respect to regulatory limits for offsite releases of radioactive nuclides for the current candidate repository site. However, prior to promulgation of the affected provisions of the Commission's regulations, the NRC staff assumed that limits would be developed along the lines of the 1995 NAS report, *Technical Bases for Yucca Mountain Standards*, and that in accordance with the Commission's Waste Confidence Decision, 10 CFR 51.23, a repository that would comply with such limits could and likely would be developed at some site.

Despite the current uncertainty with respect to these rules, some judgment as to the regulatory NEPA implications of offsite radiological impacts of spent fuel and HLW disposal should be made. The NRC staff concludes that these impacts are acceptable in that the impacts would not be sufficiently large to require the NEPA conclusion that the option of extended operation under 10 CFR Part 54 should be eliminated.

The NRC staff has not identified any new and significant information during its independent review of the SSES ER, or the site audit, the scoping process, and evaluation of other available information. Therefore, the NRC staff concludes that there would be no offsite radiological impacts related to spent fuel and HLW disposal during the renewal term beyond those discussed in the GEIS.

- Nonradiological impacts of the uranium fuel cycle. Based on information in the GEIS, the Commission found that

  > The nonradiological impacts of the uranium fuel cycle resulting from the renewal of an operating license for any plant are found to be small.

  The NRC staff has not identified any new and significant information during its independent review of the SSES ER, or the site audit, the scoping process, and evaluation of other available information. Therefore, the NRC staff concludes that there would be no nonradiological impacts of the uranium fuel cycle during the renewal term beyond those discussed in the GEIS.

- Low-level waste storage and disposal. Based on information in the GEIS, the Commission found that

  > The comprehensive regulatory controls that are in place and the low public doses being achieved at reactors ensure that the radiological impacts to the environment will remain small during the term of a renewed license. The maximum additional onsite land that may be required for low-level waste storage during the term of a renewed license and associated impacts will be small. Nonradiological impacts on air and water will be negligible. The radiological and nonradiological environmental impacts of long-term disposal of low-level waste from any individual plant at licensed sites are small. In addition, the Commission concludes that there is reasonable assurance that sufficient low-level waste disposal capacity will be made available when needed for facilities to be decommissioned consistent with NRC decommissioning requirements.

The NRC staff has not identified any new and significant information during its independent review of the SSES ER, or the site audit, the scoping process, and evaluation of other available information. Therefore, the NRC staff concludes that there would be no impacts of low-level waste storage and disposal associated with the renewal term beyond those discussed in the GEIS.

- Mixed waste storage and disposal. Based on information in the GEIS, the Commission found that

> The comprehensive regulatory controls and the facilities and procedures that are in place ensure proper handling and storage, as well as negligible doses and exposure to toxic materials for the public and the environment at all plants. License renewal will not increase the small, continuing risk to human health and the environment posed by mixed waste at all plants. The radiological and nonradiological environmental impacts of long-term disposal of mixed waste from any individual plant at licensed sites are small. In addition, the Commission concludes that there is reasonable assurance that sufficient mixed waste disposal capacity will be made available when needed for facilities to be decommissioned consistent with NRC decommissioning requirements.

The NRC staff has not identified any new and significant information during its independent review of the SSES ER, or the site audit, the scoping process, and evaluation of other available information. Therefore, the NRC staff concludes that there would be no impacts of mixed waste storage and disposal associated with the renewal term beyond those discussed in the GEIS.

- Onsite spent fuel. Based on information in the GEIS, the Commission found that

> The expected increase in the volume of spent fuel from an additional 20 years of operation can be safely accommodated onsite with small environmental effects through dry or pool storage at all plants if a permanent repository or monitored retrievable storage is not available.

The NRC staff has not identified any new and significant information during its independent review of the SSES ER, or the site audit, the scoping process, and evaluation of other available information. Therefore, the NRC staff concludes that there would be no impacts of onsite spent fuel associated with license renewal beyond those discussed in the GEIS.

- Nonradiological waste. Based on information in the GEIS, the Commission found that

  > No changes to generating systems are anticipated for license renewal. Facilities and procedures are in place to ensure continued proper handling and disposal at all plants.

  The NRC staff has not identified any new and significant information during its independent review of the SSES ER, or the site audit, the scoping process, and evaluation of other available information. Therefore, the NRC staff concludes that there would be no nonradiological waste impacts during the renewal term beyond those discussed in the GEIS.

- Transportation. Based on information contained in the GEIS, the Commission found that

  > The impacts of transporting spent fuel enriched up to 5 percent uranium-235 with average burnup for the peak rod to current levels approved by the NRC up to 62,000 MWd/MTU and the cumulative impacts of transporting HLW to a single repository, such as Yucca Mountain, Nevada, are found to be consistent with the impact values contained in 10 CFR 51.52(c), Summary Table S-4, "Environmental Impact of Transportation of Fuel and Waste to and from One Light-Water-Cooled Nuclear Power Reactor." If fuel enrichment or burnup conditions are not met, the applicant must submit an assessment of the implications for the environmental impact values reported in 10 CFR 51.52(c).

  SSES meets the fuel-enrichment and burnup conditions set forth in Addendum 1 to the GEIS. The NRC staff has not identified any new and significant information during its independent review of the SSES ER, or the site audit, the scoping process, and evaluation of other available information. Therefore, the NRC staff concludes that there would be no impacts of transportation associated with license renewal beyond those discussed in the GEIS.

There are no Category 2 issues for the uranium fuel cycle and solid waste management.

6.2 References

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

10 CFR Part 54. *Code of Federal Regulations*, Title 10, *Energy,* Part 54, "Requirements for Renewal of Operating Licenses for Nuclear Power Plants."

10 CFR Part 63. *Code of Federal Regulations*, Title 10, *Energy,* Part 63, "Disposal of High-Level Radioactive Wastes in a Geologic Repository at Yucca Mountain, Nevada."

40 CFR Part 191. *Code of Federal Regulations*, Title 40, *Protection of Environment*, Part 191, "Environmental Radiation Protection Standards for Management and Disposal of Spent Nuclear Fuel, High-Level and Transuranic Radioactive Waste."

40 CFR Part 197. *Code of Federal Regulations*, Title 40, *Protection of Environment*, Part 197, "Public Health and Environmental Radiation Protection Standards for Yucca Mountain, Nevada."

Joint Resolution Approving the Site at Yucca Mountain, Nevada, for the Development of a Repository for the Disposal of High-Level Radioactive Waste and Spent Nuclear Fuel, Pursuant to the Nuclear Waste Policy Act of 1982. 2002. Public Law 107-200. 116 Stat. 735.

National Academy of Sciences (NAS). 1995. *Technical Bases for Yucca Mountain Standards*. Washington, D.C.

National Environmental Policy Act (NEPA), as amended. 42 USC 4321, et seq.

PPL Susquehanna, LLC (PPL). 2006. *Susquehanna Steam Electric Station Units 1 and 2 Application for License Renewal, Appendix E: Applicant's Environmental Report – Operating License Renewal Stage*. Allentown, Pennsylvania. (September 2006). ADAMS No. ML062630235.

U.S. Department of Energy (DOE). 1980. *Final Environmental Impact Statement: Management of Commercially Generated Radioactive Waste*. DOE/EIS-0046F. Washington, D.C.

U.S. Environmental Protection Agency (EPA). 2005. "Public Health and Environmental Radiation Protection Standards for Yucca Mountain, Nevada." *Federal Register*, Vol. 70, No. 161, pp. 49014–49068. Washington, D.C. (August 22, 2005).

U.S. Nuclear Regulatory Commission (NRC). 1996. *Generic Environmental Impact Statement for License Renewal of Nuclear Plants*. NUREG-1437, Vols. 1 and 2, Washington, D.C.

U.S. Nuclear Regulatory Commission (NRC). 1999. *Generic Environmental Impact Statement for License Renewal of Nuclear Plants, Main Report*, "Section 6.3 – Transportation, Table 9.1, Summary of Findings on NEPA Issues for License Renewal of Nuclear Power Plants, Final Report." NUREG-1437, Vol. 1, Addendum 1, Washington, D.C.

U.S. Nuclear Regulatory Commission (NRC). 2005. "Implementation of a Dose Standard After 10,000 Years." *Federal Register,* Vol. 70, No. 173, pp. 53313–53320. Washington, D.C. (September 8, 2005).

7.0 Environmental Impacts of Decommissioning

Environmental impacts from the activities associated with the decommissioning of any reactor before or at the end of an initial or renewed license are evaluated in the *Generic Environmental Impact Statement for Decommissioning of Nuclear Facilities: Supplement 1, Regarding the Decommissioning of Nuclear Power Reactors*, NUREG-0586, Supplement 1 (NRC 2002). The U.S. Nuclear Regulatory Commission (NRC) staff's evaluation of the environmental impacts of decommissioning presented in NUREG-0586, Supplement 1, identifies a range of impacts for each environmental issue.

The incremental environmental impacts associated with decommissioning activities resulting from continued plant operation during the renewal term are discussed in the *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (GEIS), NUREG-1437, Volumes 1 and 2 (NRC 1996, 1999).[(a)] The GEIS includes a determination of whether the analysis of the environmental issue could be applied to all plants and whether additional mitigation measures would be warranted. Issues were then assigned a Category 1 or a Category 2 designation. As set forth in the GEIS, Category 1 issues are those that meet all of the following criteria:

(1) The environmental impacts associated with the issue have been determined to apply either to all plants or, for some issues, to plants having a specific type of cooling system or other specified plant or site characteristics.

(2) A single significance level (i.e., SMALL, MODERATE, or LARGE) has been assigned to the impacts (except for collective offsite radiological impacts from the fuel cycle and from high-level waste and spent fuel disposal).

(3) Mitigation of adverse impacts associated with the issue has been considered in the analysis, and it has been determined that additional plant-specific mitigation measures are likely not to be sufficiently beneficial to warrant implementation.

For issues that meet the three Category 1 criteria, no additional plant-specific analysis is required unless new and significant information is identified.

Category 2 issues are those that do not meet one or more of the criteria for Category 1, and, therefore, additional plant-specific review of these issues is required. There are no Category 2 issues related to decommissioning.

(a) The GEIS was originally issued in 1996. Addendum 1 to the GEIS was issued in 1999. Hereafter, all references to the "GEIS" include the GEIS and its Addendum 1.

7.1 Decommissioning

Category 1 issues in Table B-1 of Title 10, Part 51, of the *Code of Federal Regulations* (10 CFR Part 51), Subpart A, Appendix B, that are applicable to Susquehanna Steam Electric Station, Units 1 and 2 (SSES) decommissioning following the renewal term are listed in Table 7-1. PPL Susquehanna, LLC (PPL) stated in its Environmental Report (ER) (PPL 2006) that it is aware of no new and significant information regarding the environmental impacts of SSES license renewal. The NRC staff has not identified any new and significant information during its independent review of the SSES ER, or the site audit, the scoping process, and evaluation of other available information. Therefore, the NRC staff concludes that there are no impacts related to these issues beyond those discussed in the GEIS. For all of these issues, the NRC staff concluded in the GEIS that the impacts are SMALL, and additional plant-specific mitigation measures would not likely be sufficiently beneficial to be warranted.

Table 7-1. Category 1 Issues Applicable to the Decommissioning of SSES

ISSUE–10 CFR Part 51, Subpart A Appendix B, Table B-1	GEIS Section
DECOMMISSIONING	
Radiation doses	7.3.1; 7.4
Waste management	7.3.2; 7.4
Air quality	7.3.3; 7.4
Water quality	7.3.4; 7.4
Ecological resources	7.3.5; 7.4
Socioeconomic impacts	7.3.7; 7.4

Decommissioning would occur regardless if SSES is shut down at the end of its current operating license or at the end of the period of extended operation. There are no Category 2 issues related to decommissioning.

A brief description of the NRC staff's review and the GEIS conclusions, as codified in Table B-1, for each of the issues follows:

- Radiation doses. Based on information in the GEIS, the Commission found that

  > Doses to the public will be well below applicable regulatory standards regardless of which decommissioning method is used. Occupational doses

would increase no more than 1 person-rem caused by buildup of long-lived radionuclides during the license renewal term.

The NRC staff has not identified any new and significant information during its independent review of the SSES ER, or the site audit, the scoping process, and evaluation of other available information. Therefore, the NRC staff concludes that there would be no radiation dose impacts associated with decommissioning following the license renewal term beyond those discussed in the GEIS.

- Waste management. Based on information in the GEIS, the Commission found that

  Decommissioning at the end of a 20-year license renewal period would generate no more solid wastes than at the end of the current license term. No increase in the quantities of Class C or greater than Class C wastes would be expected.

  The NRC staff has not identified any new and significant information during its independent review of the SSES ER, or the site audit, the scoping process, and evaluation of other available information. Therefore, the NRC staff concludes that there would be no impacts from solid waste associated with decommissioning following the license renewal term beyond those discussed in the GEIS.

- Air quality. Based on information in the GEIS, the Commission found that

  Air quality impacts of decommissioning are expected to be negligible either at the end of the current operating term or at the end of the license renewal term.

  The NRC staff has not identified any new and significant information during its independent review of the SSES ER, or the site audit, the scoping process, and evaluation of other available information. Therefore, the NRC staff concludes that there would be no impacts on air quality associated with decommissioning following the license renewal term beyond those discussed in the GEIS.

- Water quality. Based on information in the GEIS, the Commission found that

  The potential for significant water quality impacts from erosion or spills is no greater whether decommissioning occurs after a 20-year license renewal period or after the original 40-year operation period, and measures are readily available to avoid such impacts.

The NRC staff has not identified any new and significant information during its independent review of the SSES ER, or the site audit, the scoping process, and evaluation of other available information. Therefore, the NRC staff concludes that there would be no impacts on water quality associated with decommissioning following the license renewal term beyond those discussed in the GEIS.

- Ecological resources. Based on information in the GEIS, the Commission found that

  > Decommissioning after either the initial operating period or after a 20-year license renewal period is not expected to have any direct ecological impacts.

  The NRC staff has not identified any new and significant information during its independent review of the SSES ER, or the site audit, the scoping process, and evaluation of other available information. Therefore, the NRC staff concludes that there would be no impacts on ecological resources associated with decommissioning following the license renewal term beyond those discussed in the GEIS.

- Socioeconomic impacts. Based on information in the GEIS, the Commission found that

  > Decommissioning would have some short-term socioeconomic impacts. The impacts would not be increased by delaying decommissioning until the end of a 20-year relicense period, but they might be decreased by population and economic growth.

  The NRC staff has not identified any new and significant information during its independent review of the SSES ER, or the site audit, the scoping process, and evaluation of other available information. Therefore, the NRC staff concludes that there would be no socioeconomic impacts associated with decommissioning following the license renewal term beyond those discussed in the GEIS.

7.2 References

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

PPL Susquehanna, LLC (PPL). 2006. *Susquehanna Steam Electric Station Units 1 and 2 Application for License Renewal, Appendix E: Applicant's Environmental Report – Operating License Renewal Stage*. Allentown, Pennsylvania. (September 2006). ADAMS No. ML062630235.

U.S. Nuclear Regulatory Commission (NRC). 1996. *Generic Environmental Impact Statement for License Renewal of Nuclear Plants.* NUREG-1437, Vols. 1 and 2, Washington, D.C.

U.S. Nuclear Regulatory Commission (NRC). 1999. *Generic Environmental Impact Statement for License Renewal of Nuclear Plants, Main Report,* "Section 6.3 – Transportation, Table 9.1, Summary of Findings on NEPA Issues for License Renewal of Nuclear Power Plants, Final Report." NUREG-1437, Vol. 1, Addendum 1, Washington, D.C.

U.S. Nuclear Regulatory Commission (NRC). 2002. *Generic Environmental Impact Statement for Decommissioning of Nuclear Facilities: Supplement 1, Regarding the Decommissioning of Nuclear Power Reactors.* NUREG-0586, Supplement 1, Washington, D.C.

8.0 Environmental Impacts of Alternatives

This chapter examines the potential environmental impacts associated with alternatives to issuing renewed operating licenses (OLs) for Susquehanna Steam Electric Station, Units 1 and 2 (SSES). The U.S. Nuclear Regulatory Commission (NRC) staff considers the following alternatives: (1) denying the issuance of renewed OLs (i.e., the no-action alternative); (2) implementing electric generating sources other than SSES; (3) purchasing electric power from other sources to replace power generated by SSES; and (4) implementing a combination of generation and conservation measures.

The NRC staff evaluated environmental impacts across 12 categories – land use, ecology, surface water use and quality, groundwater use and quality, air quality, waste, human health, socioeconomics, transportation, aesthetics, historic and archaeological resources, and environmental justice – using the NRC's three-level standard of significance: SMALL, MODERATE, or LARGE. The NRC developed these standards by using Council on Environmental Quality guidelines. The NRC staff outlined these standards in the footnotes to Table B-1 of Title 10, Part 51, of the *Code of Federal Regulations* (10 CFR Part 51), Subpart A, Appendix B:

SMALL – Environmental effects are not detectable or are so minor that they will neither destabilize nor noticeably alter any important attribute of the resource.

MODERATE – Environmental effects are sufficient to alter noticeably, but not to destabilize important attributes of the resource.

LARGE – Environmental effects are clearly noticeable and are sufficient to destabilize important attributes of the resource.

The impact categories evaluated in this chapter are the same categories used in the *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (GEIS), NUREG-1437, Volumes 1 and 2 (NRC 1996, 1999),[a] with the additional impact category of environmental justice and transportation.

(a) The GEIS was originally issued in 1996. Addendum 1 to the GEIS was issued in 1999. Hereafter, all references to the "GEIS" include the GEIS and its Addendum 1.

8.1 No-Action Alternative

NRC regulations implementing the National Environmental Policy Act (NEPA), 10 CFR Part 51, Subpart A, Appendix A(4), specify that the no-action alternative be discussed in an NRC Environmental Impact Statement (EIS). For license renewal, the no-action alternative refers to a scenario in which the NRC would not issue the renewed SSES OLs, and PPL Susquehanna, LLC (PPL) would then cease plant operations in accordance with 10 CFR 50.82. If, after performing safety and environmental reviews of the SSES license renewal application, the NRC were to act to issue renewed SSES OLs, then PPL may choose to continue operating SSES throughout the renewal term. If this were to occur, then shutdown of the unit and decommissioning activities would be postponed for up to an additional 20 years. The NRC staff expects that the impacts of decommissioning after 60 years of operation would not differ significantly from those that would occur after 40 years of operation.

The NRC staff addressed the environmental impacts of decommissioning in several documents, including the *Final Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities*, NUREG-0586, Supplement 1 (NRC 2002); Chapter 7 of the GEIS; and Chapter 7 of this draft Supplemental Environmental Impact Statement (SEIS). These analyses either directly address or bound the environmental impacts of decommissioning whenever PPL ceases operating SSES.

These documents do not, however, address environmental impacts that occur after plant shutdown and before the actual decommissioning process begins. The environmental impacts from plant shutdown are discussed for each category, and are summarized in Table 8-1.

- **Land Use**

  Onsite land use would not be affected by the plant shutdown. Plant structures and other facilities would remain in place until decommissioning. Transmission lines at SSES would remain in service after the plant stops operating. PPL noted in the Environmental Report (ER), however, that plant shutdown and construction of a new power plant at an alternative site other than SSES would, however, cause offsite land use impacts. PPL would need to construct 50 mi (80 km) of new transmission line to remedy a "load pocket" created by an SSES shutdown (PPL 2006). Maintenance of existing transmission lines would continue as before. The amount of land used for transmission lines may noticeably increase if PPL constructs the new transmission line in an undisturbed area. Impacts on land use from plant shutdown would range from SMALL, if new transmission lines follow existing routes, to MODERATE, if they require new rights-of-way (ROWs).

Table 8-1. Summary of Environmental Impacts of Shutdown under the No-Action Alternative

Impact Category	Impact	Comment
Land use	SMALL to MODERATE	Impact is expected to be SMALL to MODERATE because plant shutdown would require the construction of an additional 50 mi (80 km) of transmission lines to address a load pocket. Onsite land use would not change prior to decommissioning.
Ecology	SMALL to MODERATE	Impact is expected to be SMALL to MODERATE. Though aquatic impacts would generally be smaller than during operation, terrestrial impacts would increase due to construction and maintenance of new transmission lines and associated ROWs.
Water use and quality – surface water	SMALL	Impact is expected to be SMALL because surface water intake and discharges would decrease.
Water use and quality – groundwater	SMALL	Impact is expected to be SMALL because groundwater use would decrease.
Air quality	SMALL	Impact is expected to be SMALL because emissions related to plant operation and worker transportation would decrease.
Waste	SMALL	Impact is expected to be SMALL because generation of high-level waste would stop and generation of low-level and mixed waste would decrease.
Human health	SMALL	Impact is expected to be SMALL because radiological doses to workers and members of the public, which are within regulatory limits, would decrease. The likelihood of accidents also would decrease.
Socioeconomics	MODERATE to LARGE	Impact is expected to be MODERATE to LARGE because of loss of employment and tax revenues.
Transportation	SMALL	Impact is expected to be SMALL because the loss of employment would reduce traffic.
Aesthetics	SMALL	Impact is expected to SMALL because plant structures would remain in place.
Historic and archaeological resources	MODERATE	Impact is expected to be MODERATE. While plant shutdown would decrease onsite land disturbance, impacts from the new transmission line would depend on location and presence of resources and could be significant.
Environmental justice	MODERATE to LARGE	Impact is expected to be MODERATE to LARGE because of the loss of jobs and tax revenue; decline in social services may occur.

- **Ecology**

  Ecology would be minimally affected by plant shutdown, although the need to construct additional transmission lines could have a noticeable effect. In Chapter 4 of this draft SEIS, the NRC staff concluded that the terrestrial and aquatic ecological impacts of continued plant operation would be SMALL. As indicated in Land Use, above, maintenance of the ROWs – the primary terrestrial ecology impact – would continue as before, although PPL would need to construct roughly 50 mi (80 km) of new transmission lines to address a potential load pocket that would be created by plant shutdown. If the plant were to cease operating, impacts to aquatic ecology would decrease, as the plant would withdraw and discharge less water than during operations. Shutdown would reduce the already SMALL impacts to aquatic ecology, although transmission line construction would increase impacts to terrestrial ecology. Overall, the likely increase in terrestrial impacts would be greater than the likely decrease in aquatic impacts, given the greater number of sensitive terrestrial species. As such, the NRC staff concludes that ecological impacts from shutdown of the plant would be SMALL to MODERATE. Some portion of this impact could be mitigated by constructing new transmission lines in existing ROWs to as large an extent possible.

- **Water Use and Quality – Surface Water**

  Surface-water use and quality impacts would decrease following reactor shutdown, as the plant would withdraw less water from the Susquehanna River for cooling-tower makeup, and would discharge less water to the Susquehanna River from blowdown and domestic and service-water usage. In Chapter 4 of this draft SEIS, the NRC staff concluded that impacts of continued plant operation on surface-water use and quality would be SMALL. Since operational impacts were already SMALL, the NRC staff concludes that a decrease in impact levels from plant shutdown means that impacts would remain SMALL.

- **Water Use and Quality – Groundwater**

  In the event of plant shutdown, impacts to groundwater use and quality would decrease. The plant currently relies on groundwater for domestic uses, as well as some industrial uses. After shutdown, wells would need to be properly closed as the plant stops using groundwater. Since the plant would require less groundwater after shutdown than it does during operations – and as the NRC staff determined that continued operations would have a SMALL impact on surface-water use and quality – the NRC staff concludes that groundwater use and quality impacts from shutdown of the plant would be SMALL.

- **Air Quality**

  Air quality impacts would decrease following plant shutdown. When the plant stops operating, there would be a reduction in emissions from activities related to plant operation, such as use of diesel generators and worker transportation. In Chapter 4, the NRC staff concluded that the impact of continued plant operation on air quality would be SMALL. Therefore, the NRC staff concludes that the impact on air quality from shutdown of the plant would be SMALL.

- **Waste**

  The plant would generate smaller volumes of nonradioactive and radioactive waste following shutdown. The NRC staff characterized the impacts of waste generated by continued plant operation as SMALL in Chapter 6 and also characterized impacts of low-level and mixed waste from plant operation as SMALL. When the plant stops operating, the plant would stop generating high-level waste and generation of low-level and mixed waste associated with plant operation and maintenance would decrease. As the NRC staff determined that operational waste impacts were SMALL, reduced impacts during shutdown would also be SMALL.

- **Human Health**

  Human health impacts would be smaller following plant shutdown. The plant – which is currently operating within regulatory limits – would emit less gaseous and liquid radioactive material to the environment. In addition, following shutdown, the variety of potential accidents at the plant (radiological or industrial) would be reduced to a limited set associated with shutdown events and fuel handling and storage. In Chapter 4 of this draft SEIS, the NRC staff concluded that the impacts of continued plant operation on human health would be SMALL. In Chapter 5, the NRC staff concluded that the impacts of accidents during operation were SMALL. Therefore, as radioactive emissions to the environment decrease, and as the likelihood and variety of accidents decrease following shutdown, the NRC staff concludes that the impacts to human health following plant shutdown would be SMALL.

- **Socioeconomics**

  Plant shutdown would have a noticeable negative impact on socioeconomic conditions in the region around SSES. Plant shutdown would eliminate up to 1227 jobs and would reduce tax revenue in the region. These losses could be partially offset by decommissioning activities, or by construction and operation of a new power plant on or near the current SSES site. The socioeconomic impacts of plant shutdown would range

from MODERATE to LARGE. See Appendix J of NUREG-0586, Supplement 1 (NRC 2002), for additional discussion of the potential socioeconomic impacts of plant decommissioning.

- **Transportation**

  Traffic volumes on the roads in the vicinity of SSES would be reduced after plant shutdown. Most of the reduction in traffic volume would be associated with the loss of jobs. There would also be a reduction in shipment of material to and from the plant prior to decommissioning. Transportation impacts would be SMALL as a result of plant shutdown. Transportation impacts would increase if a new reactor or alternative energy facility were constructed on the SSES site or in the immediate vicinity.

- **Aesthetics**

  Plant structures and other facilities would likely remain in place until decommissioning, although plumes from the plant's cooling towers would likely disappear entirely. Noise caused by plant operation would cease. A new transmission line would introduce aesthetic impacts in offsite areas. The NRC staff concludes that the aesthetic impacts of plant closure would be SMALL.

- **Historic and Archaeological Resources**

  Plant shutdown would likely have no noticeable impacts on historic and archaeological resources. Prior to decommissioning, it is unlikely that plant staff would begin site deconstruction or remediation; existing transmission lines would remain energized. As such, plant staff would continue to maintain the transmission line ROWs. Should PPL construct a new transmission line to address the load pocket created by plant shutdown, PPL would need to survey any lands disturbed by construction and land clearing. In Chapter 4, the NRC staff concluded that the impacts of continued plant operation on historic and archaeological resources would be MODERATE. Although land-disturbing activities may decrease at the archaeologically rich SSES site, construction and land clearing for 50 mi (80 km) of transmission line would introduce potential new effects dependent on location and presence of resources. Given the potential for resources in the area, the NRC staff concludes that the impacts on historic and archaeological resources from plant shutdown would also be MODERATE.

- **Environmental Justice**

  Plant shutdown could disproportionately impact minority and low-income populations because of the loss of jobs and employment opportunities in the region. Impacts from plant shutdown on minority and low-income populations could range from MODERATE to LARGE, and could be compounded if the loss of tax revenue from the SSES plant causes a reduction in social services. Some impacts could be offset if new power generating facilities are built at or near the SSES site. See Appendix J of NUREG-0586, Supplement 1 (NRC 2002), for additional discussion of these impacts.

Since NRC assumes that a need exists for power from plants seeking license renewal, the NRC staff assumes that other forms of power supply or demand reduction (i.e., conservation) would meet this need if the NRC selects the no-action alternative. In addition, if the NRC decides to issue renewed licenses for SSES Units 1 and 2, utility- and State-level planners may nevertheless elect to pursue other forms of electrical generation or load reduction. As such, the NRC staff discusses the impacts of alternatives that meet system needs in Section 8.2. The alternatives considered in Section 8.2 are distinct alternatives to license renewal, although their environmental impacts may also be considered potential consequences of the no-action alternative.

8.2 Alternative Energy Sources

This section discusses the environmental impacts associated with alternative sources of electric power to replace the power generated by SSES, as well as conservation. The order of presentation does not imply which alternative energy source would most likely replace the power generated by SSES, or would have the least environmental impacts.

The NRC staff considers the following single-source generation alternatives in detail:

- Coal-fired generation at the SSES site and at an alternate site (Section 8.2.1)
- Natural gas-fired generation at the SSES site and at an alternate site (Section 8.2.2), and
- New nuclear power generation at the SSES site and at an alternate site (Section 8.2.3).

The alternative of purchasing power from other sources to replace power generated at SSES is discussed in Section 8.2.4. Other power-generation and conservation alternatives the NRC staff considered but found not to be reasonable replacements for SSES are discussed in Section 8.2.5. Section 8.2.6 discusses the environmental impacts of a combination of generation and conservation alternatives.

Each year the Energy Information Administration (EIA), a branch of the U.S. Department of Energy (DOE), issues its updated Annual Energy Outlook, which is a forecasting document that analyzes trends and issues in energy production, supply, and consumption in order to project future energy developments. The comprehensiveness and policy neutrality of the Annual Energy Outlook is unique among forecasting documents. In the *Annual Energy Outlook 2007 with Projections to 2030*, the EIA projects a continued nationwide increase in energy consumption and generating capacity (EIA 2007). Early in this period – through 2010 – the EIA projects that gas-fired combined-cycle or combustion turbine technology will account for most generating capacity additions. As natural gas prices increase, coal-fired generation begins to account for the largest share of capacity additions (EIA 2007). The EIA projects that coal will account for most – 54 percent – of new capacity through 2030 and that advanced coal technologies – such as coal-fueled integrated gasification combined-cycle (IGCC) generation – will continue to decline in cost relative to improved natural-gas-fired combined-cycle technologies (EIA 2007). The EIA also projects that U.S. generators will increase total nuclear and renewable generation capacity throughout the forecast term, due partly to tax credits and other incentives. As a proportion of installed capacity, however, nuclear generation will decrease slightly through 2030, while renewable generation remains relatively constant. The EIA indicates that changes in electricity generation costs – which are highly dependent on emission control costs – will drive utilities' choices in generating technologies (EIA 2007).

The EIA asserts that oil-fired plants will account for virtually no new generation capacity in the United States through 2030, projecting a 0.6 percent annual decrease in electric sector oil consumption because of higher fuel costs and lower efficiencies (EIA 2007). Given EIA's analysis, the NRC staff will not consider an oil-fired alternative for SSES.

SSES will have a combined net rating of approximately 2600 megawatts electric (MW(e)), if the NRC grants PPL the extended power uprate for the units. For the purposes of this draft SEIS, 2600 MW is the amount of capacity an alternative would need to provide. PPL staff indicated that alternatives providing 2400 MW(e) would adequately approximate the amount of capacity provided by an uprated SSES, and would allow the alternatives analysis to make use of commercially-available gas-fired units (PPL 2006). The NRC staff believes this approximation would provide a reasonable analysis, but notes that this assumption may understate the environmental impacts of replacing the 2600 MW(e) from Susquehanna Units 1 and 2.

PPL staff proposed several possible alternatives, all of which could be constructed at the current SSES site (PPL 2006). Given the availability of water and transmission lines at SSES, the NRC staff evaluated impacts for each alternative energy source at the existing SSES site, as well as impacts for each alternative at an alternate site. NRC staff assumed that an alternative site would allow access to adequate cooling water, but would not yet have transmission or other infrastructure.

8.2.1 Coal-Fired Generation

The NRC staff evaluated a coal-fired alternative at the SSES site and an alternate site, which may or may not have been previously developed. Regardless of plant location, the NRC staff believes that a new coal-fired alternative large enough to replace the capacity of SSES would likely make use of the higher efficiencies available from operating at supercritical steam conditions.[a]

PPL assumed a heat rate[b] of 10,200 Btu/kWh for a coal-fired alternative that would consist of four units having a net capacity of 600 MW(e) (2553 MW(e) gross output assuming 6 percent internal consumption (PPL 2006)). The NRC staff notes that PPL's heat rate is higher than the heat rate the NRC would expect from a new supercritical coal-fired alternative. The NRC staff has reevaluated PPL's analysis assuming a heat rate of 8844 Btu/kWh, the value reported by EIA as the 2005 heat rate for new, scrubbed coal plants in *Assumptions to the Annual Energy Outlook 2006 With Projections to 2030* (EIA 2006b). This would reduce by approximately 13.3 percent the level of emissions and wastes that a new coal-fired alternative would produce.

In analyzing a coal-fired alternative, the NRC staff reviewed the information in the SSES ER (PPL 2006) and compared it to environmental impact information in the GEIS, as well as to reference information available from EIA, the U.S. Environmental Protection Agency (EPA), and electric industry sources. Although the operating license renewal period is only 20 years, the NRC staff considers the impact of operating the coal-fired alternative for 40 years as a reasonable projection of the alternative's operating life.

The coal-fired alternative, with a gross electric output of 2553 MW(e), would consume approximately 6.50 million metric tons (MT) (7.16 million tons) per year of pulverized bituminous coal with an ash content of approximately 14.9 percent and a higher heating value of 11,741 Btu/lb, which are average for coal consumed in Pennsylvania (DOE 2006c). As in PPL's analysis (PPL 2006), the NRC staff assumed a capacity factor[c] of 0.85 for the coal-fired alternative. The coal-fired alternative would produce approximately 969,000 MT (1.07 million

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(a) Supercritical coal-fired plants have steam cycles that operate at higher pressures (>3207 psi) than subcritical plants. They can be significantly more efficient. Even higher efficiencies are possible with ultra-supercritical coal plants or by using integrated gasification combined-cycle (IGCC) technologies. Currently, the United States has no ultra-supercritical plants and one relatively small IGCC facility.

(b) Heat rate is a measure of generating station thermal efficiency. In English units, it is generally expressed in British thermal units (Btu) per net kilowatt hour (kWh). It is computed by dividing the total Btu content of the fuel burned for electric generation by the resulting kWh generation.

(c) The capacity factor is the ratio of electricity generated, for the period of time considered, to the energy that could have been generated at continuous full-power operation during the same period.

tons) of ash in a year. After combustion, PPL assumes that 90 percent of the ash, or 872,000 MT (961,000 tons), would be collected and marketed for beneficial reuse. Since the coal-fired alternative's operators would likely control sulfur dioxide (SO_2) emissions using lime-based scrubbers, the coal-fired alternative would generate approximately 621,000 MT (684,000 tons) of scrubber sludge (disposed of at the plant site according to PPL), based on annual lime usage of approximately 210,000 MT (231,000 tons).[a]

The NRC staff assumes that a coal-fired alternative located at either the SSES site or an alternate site would use a closed-cycle cooling system, as SSES currently does. Locating a plant at an alternate site would require construction of 50 mi (80 km) of new transmission line to remedy the load pocket created by an SSES shutdown (PPL 2006). PPL did not analyze an alternate site for a coal-fired alternative in its ER.

At the SSES site, coal and lime would likely be delivered by rail. The coal-fired alternative would likely require nearly two unit trains per day of coal, given that one unit train contains 100 cars with 91 MT (100 tons) each, 9070 MT (10,000 tons) of coal total per train. The existing rail spur would need to be improved to allow for these deliveries. On any given day, up to four train trips may occur on the rail spur as trains come and go. At an alternate site, crews would need to construct a rail spur to receive deliveries. Following combustion, ash for beneficial reuse would likely leave the site by train, as well. Occasional deliveries of lime would also occur by rail. The environmental impacts of the coal-fired alternative are discussed in the following sections and are summarized in Table 8-2. Impacts at an alternate site would vary with characteristics of the site selected.

- **Land Use**

  A new coal-fired power plant located at the SSES site would use existing facilities and infrastructure to the extent practicable, thereby limiting the amount of new construction that would be required. A new coal-fired power plant may be able to use the existing cooling towers, switchyard, offices, and transmission lines, as well as the rail spur. Much of the land that would be used has been previously disturbed. Improvements to the existing rail line may be required in order to support coal and lime deliveries, although impact from this upgrade would be short-lived.

  The coal-fired alternative would require approximately 1050 ac (425 ha; 690 ac – 280 ha - for powerblock and coal storage and 360 ac – 145 ha – for waste management) for industrial use, based on PPL estimates. Additional land adjacent to the SSES site may be required.

(a) The NRC staff notes that some portion of the scrubber sludge could potentially be recycled rather than landfilled.

Table 8-2. Summary of Environmental Impacts of Coal-Fired Generation at the SSES Site and an Alternate Greenfield Site Using Closed-Cycle Cooling

Impact Category	Susquehanna Site		Alternate Site	
	Impact	Comments	Impact	Comments
Land use	MODERATE	Uses existing facilities to the extent practical to reduce land requirements for power plant, waste disposal, and rail spur; additional offsite land use impacts for coal and limestone mining.	MODERATE to LARGE	Uses more land for plant, offices, parking, transmission lines, and rail spur; additional offsite land use impacts for coal and limestone mining, as well as a transmission line to eliminate a potential load pocket at SSES.
Ecology	MODERATE	Uses mostly previously disturbed but currently unused areas at current SSES site, plus existing rail and transmission corridors; may result in habitat loss and fragmentation in coal-mining areas. Reduced water requirement may benefit aquatic ecology.	SMALL to LARGE	Impact depends on location and ecology of the site, surface water body used for intake and discharge, and transmission line and rail routes; potential habitat loss and fragmentation; reduced productivity and biological diversity.
Water use and quality – surface water	SMALL	The coal-fired alternative would use the existing cooling tower system, although runoff from coal and waste piles could affect water quality, if not properly managed.	SMALL to MODERATE	With closed-cycle cooling, the impact would likely be SMALL, although it could be MODERATE depending on characteristics of the surface water body.
Water use and quality – groundwater	SMALL	Groundwater use, as at the current SSES, would likely be limited to domestic and some industrial purposes.	SMALL to MODERATE	Impact would depend on the volume of water withdrawn and the characteristics of the aquifers, although groundwater would likely not be used for cooling.
Air quality	MODERATE	Luzerne, Columbia, and several nearby counties are nonattainment areas for ozone. The coal-fired alternative would emit:	MODERATE	Potentially same impacts as the Susquehanna site, although pollution-control standards may vary.

Table 8-2. (contd)

Impact Category	Susquehanna Site		Alternate Site	
	Impact	Comments	Impact	Comments
Air quality (contd)		Sulfur oxides • 13,200 tons/yr Nitrogen oxides • 1790 tons/yr Particulates • 534 tons/yr of total suspended particulates • 123 tons/yr of PM_{10} Carbon monoxide • 1790 tons/yr It would also emit small amounts of mercury, other hazardous air pollutants, some naturally occurring radioactive materials, and unregulated CO_2.		
Waste	MODERATE	Total waste mass would be approximately 791,000 tons/yr of ash and scrubber sludge requiring approximately 360 ac (146 ha) for disposal during the 40-year life of the plant. Ninety percent of ash is recycled. Construction impacts would be SMALL, with land-clearing waste disposed onsite.	MODERATE	Same impacts as SSES site; waste disposal constraints may vary.
Human health	SMALL	Impacts are uncertain, but considered SMALL, given that plant must comply with health-based emission standards and offset its emissions of ozone-producing NO_x.	SMALL	Likely similar impacts as at the SSES site.

Table 8-2. (contd)

Impact Category	Susquehanna Site		Alternate Site	
	Impact	Comments	Impact	Comments
Socioeconomics	SMALL to MODERATE	Construction impacts would be MODERATE. Up to 2500 workers during the peak period of the 5-year construction period, followed by reduction from current SSES Units 1 and 2 workforce of 1227 to 640. Tax base would generally be preserved in Luzerne County. Impacts during operation would be SMALL.	SMALL to LARGE	Construction impacts would depend on location, but could be LARGE if plant is located in a rural area. Luzerne and surrounding counties would lose tax revenue and employment. Impacts at a site near to an urban area may be SMALL to MODERATE. Impacts during operation would be SMALL.
Transportation	SMALL to MODERATE	Transportation impacts during construction would be MODERATE, and traffic impacts during operation would be SMALL. For rail transportation of coal and lime, the impact likely would be MODERATE, depending on routing of coal train.	SMALL to MODERATE	Transportation impacts would be MODERATE primarily during construction. Impacts during operation would be SMALL to MODERATE. For rail transportation of coal and lime, the impact is likely to be MODERATE, depending on routing of coal trains.
Aesthetics	SMALL to MODERATE	Visual aesthetic impact would be SMALL, given existing structures and screening from topography and vegetation. Noise impacts from plant operations would be SMALL to MODERATE.	SMALL to LARGE	The greatest impacts would be from the construction of new transmission lines, plant stacks, and rail lines. Overall, impacts would depend on site characteristics. Noise impacts could be noticeable, depending on proximity to residences and businesses.

Table 8-2. (contd)

Impact Category	Susquehanna Site		Alternate Site	
	Impact	Comments	Impact	Comments
Historic and archeological resources	MODERATE	Some construction would affect previously developed but non-industrial parts of the SSES site; the site's extensive resources increase sensitivity and the potential for impacts.	SMALL to MODERATE	Cultural resource studies would be required so that construction would avoid highly sensitive areas.
Environmental justice	SMALL	Impacts on minority and low-income populations would be similar to those experienced by the population as a whole, which are SMALL. Some additional impacts on rental housing may occur during construction.	SMALL to MODERATE	Impacts would vary depending on population distribution and makeup at the site. Impacts of lost employment and tax base at SSES increase impact levels.

Improvements to the rail spur would affect land onsite, but this disturbance would be limited to the land along the current rail spur. Construction impacts would be short-lived and would likely result in little additional land use impact.

The coal-fired alternative would require approximately 360 ac (146 ha) of land area over the 40-year plant life[(a)] for waste disposal. The impact of a coal-fired alternative on land use, because of the amount of land required to support a coal-fired alternative at the existing SSES site, would likely be MODERATE.

The coal-fired alternative at an alternate site could impact up to 1700 ac (688 ha) for a 1000 MW(e) generating station. This land would support plant structures and associated infrastructure. A 2400 MW(e) plant could require up to 4080 ac (1651 ha) of land. This amount of land would include the plant site, transmission line ROWs, and a rail spur. In addition, 50 mi (80 km) of transmission line ROW would need to be cleared and maintained to eliminate the load pocket area near SSES. These impacts could range from MODERATE to LARGE, depending on the location of the plant. Some of this impact could be mitigated by building in existing ROWs whenever possible.

Coal mining introduces offsite land use impacts in addition to land use impacts from the construction and operation of new power plants. Land disturbance from coal mining

(a) Only half of the land area needed for waste disposal is directly attributable to the alternative of renewing the Susquehanna Units 1 and 2 operating licenses for 20 years.

would likely occur mostly in Pennsylvania (EIA 2006c). Approximately 22,000 ac (8903 ha) could be affected for mining coal and waste disposal to support a 1000 MW(e) coal plant during its operational life (NRC 1996). A total of approximately 56,200 ac (22,744 ha) of land would be required to support a new coal-fired power plant. Partially offsetting this offsite land use would be the elimination of the need for uranium mining to supply fuel for Units 1 and 2. Approximately 1000 ac (405 ha) would be used for mining and processing uranium. For SSES, roughly 2500 ac (1016 ha) of uranium mining area would no longer be needed.

- **Ecology**

Locating a coal-fired power plant at the SSES site would alter site ecology, although it would primarily affect terrestrial resources. Constructing the coal-fired alternative onsite would require converting roughly 1050 ac (425 ha) of land to industrial use (plant, coal storage, ash, and scrubber sludge disposal). However, some of this land would have been previously disturbed. Coal mining operations would also affect terrestrial ecology in offsite coal mining areas, although some of this land is likely already disturbed by mining operations.

Aquatic impacts would likely be similar to the impacts of the existing SSES, as the onsite option may make use of the existing plant's cooling, intake, and outflow structures. The greater thermal efficiency of the coal-fired alternative versus the proposed action means that the coal-fired alternative would consume less water for cooling and blowdown than SSES. In aggregate, this difference would not significantly affect the overall impact level for this option. Impacts to ecology from a coal-fired alternative at the existing site would likely be MODERATE.

Siting a coal-fired power plant at an alternate site would incur rather larger ecological impacts. In addition to onsite impacts, crews would need to disturb land to construct transmission lines and a rail spur, which would require continued maintenance even as transmission lines leading from the SSES site remain in service. The new plant's cooling system would need a source of water for the plant cooling system (likely cooling towers), as well as a discharge point for plant cooling tower blowdown. Decreases in withdrawal from and discharge to the Susquehanna River may partially offset some aquatic impacts at an alternate site. Constructing a new transmission line to remedy the load pocket created when generation at SSES ceases would create additional impacts from ROW clearing and maintenance, as well as construction activities. These impacts would be similar to the impacts of constructing new transmission lines to serve the new plant, but would be at a different location.

Overall impacts for a coal-fired alternative at an alternate site would likely be SMALL to LARGE, and may include habitat loss and fragmentation, as well as reduced productivity and biological diversity, depending on previous levels of disturbance and proximity to existing infrastructure.

- **Water Use and Quality**

Surface Water. PPL staff asserts that the coal-fired alternative at the Susquehanna site could use the existing cooling water system, which would minimize incremental water quality impacts from construction of a new cooling system. Given the coal-fired alternative's greater thermal efficiency, it is likely that it would use less water than the existing Units 1 and 2. Surface-water impacts thus are expected to remain SMALL. The Susquehanna River Basin Commission (SRBC) would continue to regulate consumptive water use.

Like the current plant's discharge, the coal-fired alternative's liquid effluent would continue to consist mostly of cooling tower blowdown, with the discharge having a higher temperature and increased concentration of dissolved solids relative to the receiving body of water and intermittent low concentrations of biocides, although the amount discharged would be smaller than the current discharge. A new NPDES permit would be required to address any new pollutants introduced from emission controls or other aspects of operation. The smaller workforce associated with a coal-fired power plant would also create less sewage, which after treatment is currently discharged to the Susquehanna River. Process waste water could also be discharged.

A coal-fired power plant located at an alternative site would likely rely on surface water for cooling and use a closed-cycle cooling system with cooling towers. For alternate sites, the impact on the surface water would depend on the volume of water needed for makeup water, the plant's discharge volume, and the characteristics of the receiving body of water. Withdrawal of water may be under the control of a commission, depending on the water body in question, while discharges to any surface body of water would be regulated by the State of Pennsylvania Division of Environmental Protection (PDEP). Surface water impacts would likely be SMALL to MODERATE at an alternate site.

Groundwater. The current plant uses groundwater for a variety of domestic and industrial purposes. It does not use groundwater for plant cooling. The coal-fired alternative may continue to use the existing wells for domestic purposes, and may or may not require groundwater for industrial applications (like pump seal maintenance). Because the coal-fired alternative would have many fewer employees than the existing SSES, it is likely that it would use less groundwater than the current plant. Disposal of

coal wastes, however, may have a greater impact on groundwater resources, especially if onsite disposal results in any contaminants reaching groundwater. Applicable waste disposal regulations would help to mitigate this impact. Additionally, since currently used aquifers are shallow and run toward the Susquehanna River, impacts from coal waste are unlikely to impair groundwater resources for other potential users. Impacts to groundwater from the coal-fired alternative at the SSES site would likely be SMALL.

At an alternate site, impacts would depend on whether the plant would use groundwater for any purposes, as well as the characteristics of local aquifers. Regardless of location, the NRC staff finds it highly unlikely that a coal-fired power plant would rely on groundwater for plant cooling, and believes that groundwater and waste-management regulations would result in SMALL to MODERATE impacts at an alternate site.

- **Air Quality**

The air quality impacts of a coal-fired power plant are considerably greater than those of the current SSES due to emissions of sulfur oxides (SO_x, typically expressed as SO_2), nitrogen oxides (NO_x), particulates, carbon monoxide (CO), hazardous air pollutants such as mercury, and naturally occurring radioactive materials.

Currently, Luzerne County and the neighboring counties of Lackawanna, Wyoming, Monroe, and Carbon are nonattainment areas for the 8-hour ozone standard under the Clean Air Act (CAA). These counties are either in attainment or unclassified for other criteria pollutants.

A new coal-fired power plant located in Luzerne County or other parts of the Scranton-Wilkes-Barre area would likely need a nonattainment area permit and a Title V operating permit under the CAA. The plant would need to comply with the new source performance standards for such plants set forth in 40 CFR Part 60, Subpart da. The standards establish limits for particulate matter and opacity (40 CFR 60.42da), SO_2 (40 CFR 60.43da), NO_x (40 CFR 60.44da), and mercury (40 CFR 60.45da).

The EPA has various regulatory requirements for visibility protection in 40 CFR Part 51, Subpart P, including a specific requirement for review of any new major stationary source in an area designated as attainment or unclassified under the CAA.

Section 169A of the CAA (Title 42, Section 7491, of the *United States Code*, 42 USC 7491) establishes a national goal of preventing future and remedying existing impairment of visibility in mandatory Class I Federal areas (identified in 40 CFR 81.400, et seq.) when impairment results from man-made air pollution. The EPA's haze rule specifies that for each mandatory Class I Federal area located within a State, the State

must establish goals that provide for reasonable progress towards achieving natural visibility conditions. The reasonable progress goals must provide for an improvement in visibility for the most-impaired days over the period of the implementation plan and ensure no degradation in visibility for the least-impaired days over the same period (40 CFR 51.308(d)(1)). If the coal-fired alternative were located close to a mandatory Class I area, additional air pollution control requirements could be imposed. Pennsylvania, however, contains no Class I areas.

Impacts for particular pollutants would be as follows:

Sulfur oxides emissions. PPL's ER (PPL 2006) proposes that the coal-fired alternative would use lime-based scrubbers to remove sulfur oxides. Its total SO_2 emissions would be approximately 13,200 tons/yr (11,983 MT/yr), based on EPA emissions factors (EPA 1998a).

A new coal-fired power plant would be subject to the requirements in Title IV of the CAA. Title IV was enacted to reduce emissions of SO_2 and NO_x, the two principal precursors of acid rain, by restricting emissions of these pollutants from power plants. Title IV caps aggregate annual power plant SO_2 emissions and imposes controls on SO_2 emissions through a system of marketable allowances. The EPA issues one allowance for each ton of SO_2 that a unit is allowed to emit. New units do not receive allowances, but are required to have allowances to cover their SO_2 emissions. Owners of new units must therefore either acquire allowances, purchase from owners of other power plants, or reduce SO_2 emissions at other power plants they own. Allowances can be banked for use in future years. Thus, the coal-fired alternative would not add to net regional SO_2 emissions, although it might do so locally.

Regardless, SO_2 emissions at the site would be greater for the coal-fired alternative than the operating license renewal alternative.

Nitrogen oxides emissions. Title IV of the CAA establishes technology-based emission limitations for NO_x emissions. A new coal-fired power plant would be subject to the new source performance standards for such plants at 40 CFR 60.44a(d)(1). This regulation, issued on September 16, 1998 (EPA 1998a), limits the discharge of any gases that contain nitrogen oxides (expressed as nitrogen dioxide) in excess of 300 nanograms per joule (ng/J) of gross energy output (0.70 lb/million Btu), based on a 30-day rolling average.

PPL projects that the coal-fired alternative would use low-NO_x burners with overfire air and selective catalytic reduction (SCR). Given these control technologies, the NRC staff estimates that the total annual NO_x emissions for the coal-fired alternative would be

approximately 1790 tons/yr (1625 MT/yr), or less than 5 percent of the new source performance standard emission rate. As SSES is located in an ozone nonattainment area, and as NO_x is an ozone precursor, the plant operator would need to purchase emission allowances to offset this amount of emissions. This level of NO_x emissions would be greater, however, than the operating license renewal alternative.

In addition, the total amount of NO_x that could be emitted by Pennsylvania in the year 2007 ozone season (May 1 to September 30) was set at 40 CFR 51.121(e). The total permitted amount is 257,928 tons (234,152 MT). The coal-fired alternative would need to offset its emissions through credit purchases or from a set-aside pool so that future statewide allowable limits would not be violated.

Particulate emissions. Based on EPA emissions factors (1998b), the NRC staff estimates that the total annual stack emissions would include approximately 534,000 tons (484,776 MT) of filterable total suspended particulates and approximately 123,000 tons (111,584 MT) of particulate matter (PM) having an aerodynamic diameter less than or equal to 10 μm (PM_{10}) (40 CFR 50.6a).[(a)] Fabric filters or electrostatic precipitators would be used for control, resulting in a total emission of 534 tons/yr (485 MT/yr) and 123 tons/yr (112 MT/yr), respectively. Coal-handling equipment would also introduce fugitive particulate emissions. Particulate emissions would be greater under the coal-fired alternative than under the operating license renewal alternative.

During the construction of the coal-fired alternative, onsite activities at any location would generate fugitive dust. In addition, vehicles and motorized equipment would create exhaust emissions during the construction process. These impacts, however, would be intermittent and short-lived. In addition, to minimize dust generation, construction crews would use applicable dust-control measures.

Carbon monoxide emissions. The NRC staff estimates that the total CO emissions from the coal-fired alternative would be approximately 1790 tons/yr (1625 MT/yr) based on EPA emissions factors (EPA 1998b). This level of emissions is greater than that of the operating license renewal alternative.

Hazardous air pollutants including mercury. In December 2000, the EPA issued regulatory findings on emissions of hazardous air pollutants from electric utility steam-generating units (EPA 2000a). The EPA determined that coal- and oil-fired electric utility steam-generating units are significant emitters of hazardous air pollutants. Coal-fired power plants were found by the EPA to emit arsenic, beryllium, cadmium, chromium, dioxins, hydrogen chloride, hydrogen fluoride, lead, manganese, and mercury

(a) See also 40 CFR 50.7a for $PM_{2.5}$ standards.

(EPA 2000a). The EPA concluded that mercury is the hazardous air pollutant of greatest concern. The EPA found that (1) there is a link between coal combustion and mercury emissions; (2) electric utility steam-generating units are the largest domestic source of mercury emissions; and (3) certain segments of the U.S. population (e.g., the developing fetus and subsistence fish-eating populations) are believed to be at potential risk of adverse health effects due to mercury exposures resulting from consumption of contaminated fish (EPA 2000a). Accordingly, on March 15, 2005, the EPA issued the Clean Air Mercury Rule to permanently cap and reduce mercury emissions from coal-fired power plants (EPA 2007).

Uranium and thorium. Coal contains uranium and thorium, among other naturally occurring radioactive elements. One researcher indicated that uranium concentrations are generally in the range of 1 to 10 parts per million (ppm) and thorium concentrations are generally about 2.5 times this level (Gabbard 1993). The U.S. Geological Survey (USGS) indicates that Western and Illinois Basin coals contain uranium and thorium at roughly equal concentrations, mostly between 1 and 4 ppm, but also indicates that some coals may contain concentrations as high as 20 ppm of both elements (USGS 1997). Gabbard indicates that a 1000 MW(e) coal-fired plant could release roughly 4.7 MT (5.2 tons) of uranium and 11.6 MT (12.8 tons) of thorium to the atmosphere (Gabbard 1993). USGS and Gabbard indicate that almost all of the uranium, thorium, and most decay products remain in solid coal wastes, especially in the fine glass spheres that constitute much of coal's fly ash. Modern emission controls, such as those included for this coal-fired alternative, allow for recovery of greater than 99 percent of these solid wastes (EPA 1998b), thus retaining most of coal's radioactive elements in solid form rather than releasing them to the atmosphere. Even after concentration in coal waste, the level of radioactive elements remains relatively low – typically 10 to 100 ppm – and consistent with levels found in naturally occurring granitic rocks, shales, and phosphate rocks (USGS 1997).

Carbon dioxide. The coal-fired alternative would also have unregulated carbon dioxide (CO_2) emissions that could contribute to climate change. Based on EIA emission factors for bituminous coal combustion, this coal-fired alternative would result in 17.3 million tons (15.6 million MT) (EIA 2007b). The level of CO_2 emissions from the coal-fired alternative would be greater than that for the operating license renewal alternative.

Summary. The NRC staff analysis indicates that emissions from a coal-fired alternative would be substantial. The GEIS notes that potential effects of these emissions include global warming from unregulated CO_2 emissions and acid rain from SO_x and NO_x emissions as potential impacts. Adverse human health effects such as cancer and emphysema have also been associated with the products of coal combustion. The appropriate characterization of air impacts from the coal-fired alternative would be

MODERATE, since extensive emissions controls would be necessary to meet air quality standards. These controls mean impacts would be clearly noticeable, but would not destabilize air quality.

Siting the coal-fired alternative at a site other than Susquehanna would not significantly change air quality impacts, although it could result in installing more or less stringent pollution-control equipment to meet applicable local requirements. Therefore, the impacts would be MODERATE.

- **Waste**

Coal combustion generates waste in the form of ash, and equipment for controlling air pollution generates additional ash and scrubber sludge.[a] A coal-fired power plant having a gross capacity of 2553 MW(e) would generate approximately 1.59 million MT (1.75 million tons) of this waste annually for 40 years. Of this waste, approximately 872,000 MT (961,000 tons; 90 percent of the ash content) would be recycled for beneficial reuse, according to PPL, leaving a total of approximately 718,000 MT (791,000 tons) that would be landfilled onsite, accounting for approximately 360 ac (146 ha) of land area over the 40-year plant life. Waste impacts to groundwater and surface water could extend beyond the operating life of the plant if leachate and runoff from the waste storage area occurs. If this does occur, given the hydrologic characteristics of the site, this contamination may also spread to the Susquehanna River. Disposal of the waste could noticeably affect land use and groundwater quality, but with appropriate management and monitoring, it would not destabilize any resources. After closure of the waste site and revegetation, the land could be available for other uses.

In May 2000, the EPA issued a "Notice of Regulatory Determination on Wastes from the Combustion of Fossil Fuels" (EPA 2000b). In it, the EPA indicated that it would issue regulations for disposal of coal combustion waste under Subtitle D of the Resource Conservation and Recovery Act. The EPA has not yet issued these regulations.

In summary, the appropriate characterization of impacts from waste generated from burning coal is MODERATE; the impacts would be clearly noticeable, but would not destabilize any important resource.

Crews would generate debris during construction activities. These would likely be disposed onsite, when possible. Overall, this amount of waste is small compared to

(a) Radionuclides (e.g., uranium and thorium) are present in coal fly ash exist at levels equivalent to those in naturally occurring granitic, phosphate, and shale rocks (USGS 1997).

operational waste generated, and many construction wastes can be recycled. As such, construction-stage waste impacts would be SMALL.

Siting the facility at a site other than SSES would not alter waste generation, although other sites might have more constraints on disposal locations. If the coal-fired alternative was sited on a previously developed location, then there may be fewer constraints. Independent of site location, the impacts would be MODERATE.

- **Human Health**

Coal-fired power power plants introduce worker risks from coal and limestone mining, from coal and lime transportation, and from disposal of coal combustion waste. In addition, there are public risks from inhalation of stack emissions. Emission impacts can be widespread and health risks difficult to quantify. The coal-fired alternative also introduces the risk of coal-pile fires and attendant inhalation risks.

In the GEIS, the NRC staff stated that there could be human health impacts (cancer and emphysema) from inhalation of toxins and particulates, but it did not identify the significance of these impacts.

Regulatory agencies, including the EPA and State agencies, set air emission standards and requirements based on human health impacts. These agencies also impose site-specific emission limits as needed to protect human health. Though SSES is located in a nonattainment area, emission contents and trading or offset mechanisms would prevent further degradation. Human health impacts would be SMALL. Impacts at an alternate site would also likely be SMALL.

- **Socioeconomics**

PPL projected a maximum construction workforce of 1600 (PPL 2006), though the GEIS projects a peak workforce of 1200 to 2500 per 1000 MW(e). Given a 2553 MW(e) plant, the NRC staff projects a workforce of 2500 would be required to construct the new power plant. These workers would be in addition to the 1227 currently working at SSES. It is likely that many of these workers would commute from the Scranton-Wilkes-Barre area. During construction, the surrounding communities would experience increased demand for rental housing and public services, although this would be moderated by the proximity of the site to the Scranton-Wilkes-Barre area. After construction, local communities may be affected by the loss of the construction jobs and associated loss of business. Construction of the coal-fired alternative would take approximately 5 years. Construction impacts would be MODERATE. Impacts at an alternate site would likely be MODERATE to LARGE. In the GEIS, the NRC staff stated that socioeconomic impacts

at a rural site would be larger than at an urban site, because more of the construction workforce would need to move closer to the construction site.

PPL estimated an operational workforce of 197 (PPL 2006), which would be smaller than the plant's current operating workforce, while the GEIS estimated approximately 640 workers. Either number is a significant reduction from the 1227 employees currently employed at SSES. This would result in SMALL impacts. Operations impacts at an alternate site would be SMALL to MODERATE, depending on the characteristics of communities near the site.

- **Transportation**

During 5 years of construction, up to 2500 workers would be commuting to the site alongside the 1227 workers at SSES. The addition of these workers would increase traffic volumes on existing roads in the vicinity of SSES. These impacts would likely be MODERATE. Impacts at an alternate site could also be MODERATE.

Transportation impacts during plant operations would likely be SMALL. The maximum number of plant operating personnel would be approximately 640, which is smaller than the current SSES workforce. At an alternate site, these impacts would also likely be SMALL, although they could rise to MODERATE if the site has poor access to highways.

The impacts of the transport of coal and lime via rail to the SSES site would be MODERATE. Approximately 716 trains per year would be needed to deliver coal for the coal-fired alternative, and a smaller number of trips to deliver lime. The NRC staff expects a total of at least 28 train trips per week, or nearly 4 trips per day on the spur leading to the plant. For each train delivery of coal there would be a train leaving the site. Impacts at an alternate site would vary based on rail congestion in the area and would also be MODERATE.

- **Aesthetics**

Visual impacts of a coal-fired alternative at SSES would be consistent with the industrial nature of the site, and would be partially screened by surrounding topography and forested areas. Impacts from new structures would be less than the impacts of existing cooling towers. If sited at SSES, the four power plant units would be up to 200 ft (61 m) tall and may be visible offsite in daylight hours. The four exhaust stacks would be up to 600 ft (183 m) high. The current SSES cooling towers are 540 ft (165 m) tall. The units and associated stacks would also be visible offsite at night because of lighting. The visual impacts of the coal-fired alternative could be reduced by landscaping and using

exterior building colors that blend in with the environment. Visual impact at night could be mitigated by the appropriate use of shielding.

Plant operations may be audible offsite, and intermittent noise from coal-handling equipment, solid-waste disposal, and rail delivery of coal and lime would be greater than currently experienced at SSES. Based on this information, aesthetic impacts would likely be SMALL to MODERATE.

At an alternate site, the coal-fired alternative's buildings, exhaust stacks, cooling towers, and cooling tower condensate plumes would introduce new aesthetic impacts that may or may not be screened by surrounding topography and vegetation. There could also be a significant aesthetic impact associated with construction of new transmission lines. Noise and light from plant operations, as well as lighting on plant structures, may be detectable offsite. Noise impacts from a rail spur, if required, would be similar to the impacts at the existing SSES site. Aesthetic impacts could be mitigated if the plant were located in an industrial area adjacent to other power plants. Overall, the aesthetic impacts associated with locating the coal-fired alternative at an alternate site can be categorized as SMALL to LARGE, depending on site location.

- **Historic and Archaeological Resources**

Before constructing a coal-fired alternative at the SSES site or an alternate site, a cultural resource inventory would need to be performed for any property that has not been previously surveyed. Other lands, if any, that are acquired to support the coal-fired alternative would also need to be surveyed for cultural resources, identification and recording of existing historic and archaeological resources, and possible mitigation of adverse effects from ground-disturbing actions. Studies would be needed for all areas of potential disturbance at the proposed plant site and along associated corridors where new construction would occur (e.g., roads, transmission corridors, rail lines, or other ROWs).

The archaeological richness of the SSES site, coupled with existing procedures for mitigating impacts, means impacts would be MODERATE for the existing site and would likely be SMALL to MODERATE at an alternate site. Impacts may vary based on whether the site has been previously developed or disturbed.

- **Environmental Justice**

Constructing a coal-fired alternative may result in increased rental housing demand and prices during the 5-year construction period. Housing demands would be somewhat mitigated by the site's proximity to the Scranton-Wilkes-Barre area, since many

construction workers would commute. Increased coal consumption may increase employment in other relatively low-income regions in Pennsylvania. Environmental justice impacts for a coal-fired alternative at the SSES site would likely be SMALL.

Constructing a coal-fired alternative at an alternate site would result in the loss of tax revenue and social services, as well as jobs at the SSES site. Depending on the alternate site's proximity to low-income and minority populations, constructing the plant at an alternate site may result in disproportionate impacts to minority or low-income populations. Overall, the environmental justice impact of constructing a coal-fired alternative at an alternate site could be SMALL to MODERATE.

8.2.2 Natural Gas-Fired Generation

The environmental impacts of a natural gas-fired alternative located at both the SSES site and at an alternate site are presented in this section. The NRC staff assumed that a replacement natural gas-fired plant would use combined-cycle technology, as it provides significant efficiency advantages over combustion turbines or gas-fired boilers. While combined-cycle plants often supply intermediate duty cycles, they are capable of supporting baseload needs.

Since the existing SSES uses closed-cycling cooling, and since new facilities are required to use measures to reduce impingement and entrainment of fish and shellfish, the NRC staff assumed that a gas-fired alternative would use a closed-cycle cooling system. For a natural gas-fired alternative onsite, the NRC staff assumed that the new plant would make use of the existing cooling system, including cooling towers, intakes, and discharges.

A new natural gas-fired plant on the SSES site would likely also make use of existing transmission lines, switchyards, and support buildings or infrastructure, like parking lots. The plant would require approximately 2 mi (3 km) of new gas pipeline to connect to an existing 24-in. (61-cm) pipeline north of the plant. Additional upgrades to the pipeline network – including a compressor station – may be necessary to support a gas-fired alternative at any site.

For comparison purposes, the NRC staff evaluated a new gas-fired combined-cycle alternative producing a net capacity of 2400 MW(e). Given that 4 percent of energy produced will meet onsite loads, the gross output for this alternative is roughly 2500 MW(e). In preparing this analysis, the NRC staff used published performance data for a new, commercially available 400 MW(e) combined-cycle unit and assumes that six such units would be necessary to provide sufficient capacity for an alternative to SSES. Each unit's heat rate would be 5690 Btu/kWh.

The NRC staff evaluated impacts for the gas-fired alternative and compared it to environmental impact information in the GEIS, emissions data developed by EPA (2000c), and performance data available from industry and other sources. The NRC staff believes that the gas-fired

alternative would have a lifespan similar to the 20-year renewal period, although with refurbishment, the gas-fired alternative may be capable of operating for a longer period of time.

The overall environmental impacts of the natural gas-fired alternative are discussed in the following sections and summarized in Table 8-3. Impacts at an alternate site will be influenced by site characteristics, and will tend to be greater if the site has not been previously disturbed.

- **Land Use**

  A new gas-fired power plant located at the SSES site would use existing facilities and infrastructure to the extent practicable, limiting the amount of new construction that would be required. A new gas-fired plant may be able to use existing cooling towers, switchyard, offices, and transmission lines, as well as the rail spur. Much of the land that would be used has been previously disturbed. The GEIS assumed that 110 ac (45 ha) would be needed to construct and generate a 1000 MW(e) gas-fired plant. A gas-fired alternative equal to SSES could require up to 275 ac (111 ha). PPL assumed that only 90 ac (36 ha) would be necessary for a gas-fired plant onsite (PPL 2006). Since a gas-fired alternative at SSES would take advantage of existing structures, the NRC staff believes that 90 ac (36 ha) is an acceptable estimate. An additional 12 ac (5 ha) may be needed for a gas pipeline. Additional land may be required if a new compressor station or other improvements to local gas transmission are necessary.

  Between 90 ac (36 ha) and 275 ac (111 ha) would be needed for the plant and associated infrastructure at an alternate site (PPL 2006; NRC 1996). Additional acres could be disturbed for gas pipelines and electric transmission lines.

  Land use impacts from a natural gas-fired power plant at the SSES site would be SMALL to MODERATE. Given a lack of existing infrastructure at an alternate site, including the need to construct 50 mi (80 km) of transmission lines to eliminate the load pocket area near SSES, impacts at an alternate site may be SMALL to LARGE. Some portion of this impact could be mitigated by constructing new transmission lines in existing ROWs to as great an extent possible.

  In addition to onsite land requirements, land would be required offsite for natural gas wells and collection stations. The GEIS estimates that 3600 ac (1457 ha) would be required for wells, collection stations, and pipelines to bring the gas to a 1000 MW(e) generating facility. If this land requirement was scaled directly with generating capacity, an alternative to SSES could require 8990 ac (3638 ha) (through actual requirements could very significantly). Most of this land requirement would occur in areas where gas extraction already occurs. The NRC staff notes that some of this natural gas may arrive in the United States as liquefied natural gas (LNG), and may not be adequately reflected

Table 8-3. Summary of Environmental Impacts of Natural Gas-Fired Generation at the SSES Site and an Alternate Site Using Closed-Cycle Cooling

Impact Category	SSES Site		Alternate Site	
	Impact	Comments	Impact	Comments
Land use	SMALL to MODERATE	This alternative would require approximately 90 ac (36 ha) for new plant structures, and would use the existing cooling system, switchyard, transmission lines, and parking lots. A new gas pipeline may affect 12 ac (5 ha).	SMALL to LARGE	Up to 275 ac (111 ha) for power- block, offices, roads, and parking areas disturbed. Transmission lines and gas pipeline would require additional land.
Ecology	SMALL	The new plant would be able to use previously disturbed areas at current SSES site, with relatively little land disturbed for pipeline. Aquatic ecology actually benefits from the gas-fired alternative, as the combined-cycle plant rejects significantly less heat to the environment than the existing SSES, thus requiring less water.	SMALL to LARGE	Impact depends on location and ecology of the site, surface water body used for intake and discharge, and transmission and pipeline routes; potential habitat loss and fragmentation; reduced productivity and biological diversity.
Water use and quality – surface water	SMALL	Use of a closed-cycle cooling system with natural gas-fired combined-cycle units would result in a significant reduction in water use due to lower levels of heat rejection.	SMALL to MODERATE	Impact depends on volume of water withdrawal and discharge and characteristics of surface water body.
Water use and quality – groundwater	SMALL	Existing groundwater wells may remain in service, although domestic loads would be smaller with a greatly reduced worker population. Some industrial uses for water may also cease.	SMALL to MODERATE	Impact depends on volume of water withdrawal and aquifer characteristics, although, unless used for cooling makeup, the volume withdrawn is likely to be relatively small.

Table 8-3. (contd)

Impact Category	SSES Site		Alternate Site	
	Impact	Comments	Impact	Comments
Air quality	SMALL to MODERATE	Likely emissions: Sulfur oxides • 180 tons/yr Nitrogen oxides • 527 tons/yr Carbon monoxide • 120 tons/yr PM_{10} particulates • 100 tons/yr Some hazardous air pollutants; scrubbing could reduce some of the pollutants markedly; construction-stage impacts are SMALL.	SMALL to MODERATE	Likely the same emissions as at SSES site, although local regulations may vary.
Waste	SMALL	Small amount of ash produced.	SMALL	Same waste produced as at the SSES site.
Human health	SMALL	The plant would meet applicable, health-based requirements.	SMALL	Impacts likely to be similar to a plant at the SSES site.
Socioeconomics	SMALL to MODERATE	Construction impacts would be MODERATE. Up to 1200 to 1600 additional workers during the peak of the 3-year construction period, followed by reduction from current SSES workforce of 1227 to 375; tax base preserved. Impacts during operation would be SMALL.	SMALL to MODERATE	During construction, impacts would be SMALL to MODERATE, depending on location. Up to 1200 to 1600 additional workers would be onsite during the peak of the 3-year construction period. Luzerne County would lose jobs and tax base. Impacts during operation would be SMALL.
Transportation	SMALL to MODERATE	Impacts during construction would be SMALL to MODERATE. Impacts during operation would be SMALL.	SMALL to MODERATE	Transportation impacts would be SMALL to MODERATE, primarily during construction.

Table 8-3. (contd)

Impact Category	SSES Site		Alternate Site	
	Impact	Comments	Impact	Comments
Aesthetics	SMALL	Power plant structures would be smaller than existing SSES structures, and most would not be visible offsite. Noise would be limited.	SMALL to MODERATE	New transmission lines and cooling towers would cause the greatest impact. If used, natural draft cooling towers would have a greater impact than mechanical draft structures.
Historic and archeological resources	MODERATE	Construction would occur on previously developed parts of the SSES site; cultural resource inventory would minimize impacts on undeveloped lands, although the richness of site makes impacts possible.	SMALL to MODERATE	Cultural resource studies would be required so that construction would avoid highly sensitive areas.
Environmental justice	SMALL	Impacts on minority and low-income populations would be similar to those experienced by the general population, which are SMALL. Some additional impacts on rental housing may occur during construction, though these would not be noticeable.	SMALL to MODERATE	Impacts would vary depending on population distribution and make-up at the site. Impacts of lost employment and tax base at SSES increase impact levels.

in the GEIS estimates. Partially offsetting these offsite land requirements would be the elimination of the need for uranium fuel for Units 1 and 2. In the GEIS, the NRC staff estimated that approximately 1000 ac (405 ha) would not be needed for mining and processing uranium during the operating life of a 1000 MW(e) nuclear power plant. For SSES, roughly 2510 ac (1016 ha) of uranium mining area would no longer be needed.

- **Ecology**

Ecology impacts from siting a gas-fired alternative at the SSES site are likely to be minor. Terrestrial ecology would be minimally affected by the 90 ac (36 ha) disturbed in constructing the units. Given the nature of the site, much or all of this land may have been previously disturbed, and given the plant's small footprint, construction would be

able to avoid ecologically sensitive areas. Construction activities onsite would take place over the course of 3 years. No new transmission lines or switchyards would be necessary, and the existing cooling system would remain in use. The 2 mi (3 km) of pipeline necessary to bring natural gas to the site would likely run along existing road corridors, and any additional gas infrastructure would also be installed along these corridors, thus minimizing impacts. Transmission line ROW maintenance would likely continue as before.

As the onsite gas-fired alternative would continue to use the existing cooling system, impacts to aquatic ecology would also be minimal. Most noticeably, the gas-fired alternative exhausts much less waste heat per unit of electrical output than the existing SSES. A gas-fired alternative would require less than half as much water as the existing plant due to its much higher thermal efficiency.

Ecological impacts at an alternate site would depend on the nature of the land converted for the plant (up to 275 ac [111 ha]) and the possible need for new gas infrastructure and/or transmission lines, including a 50-mi (80-km) transmission line to eliminate the load pocket created by the SSES shutdown. Construction of the transmission line and construction and/or upgrading of the gas pipeline to serve the plant would be expected to have temporary ecological impacts, although these could be large if the plant site is far from existing gas and transmission lines. Ecological impacts to the plant site and utility easements could include impacts on threatened or endangered species, wildlife habitat loss and reduced productivity, habitat fragmentation, and a local reduction in biological diversity.

At an alternate site, the cooling makeup water intake and discharge could have aquatic resource impacts. These impacts are likely to be smaller at urban or previously industrial sites, owing to generally closer access to pipelines and transmission lines than at undeveloped sites. Overall, the ecological impacts are considered SMALL at the SSES site and could range from SMALL to LARGE at a different location.

- **Water Use and Quality**

Surface Water. A gas-fired alternative located at the SSES site would use less than half as much water as the existing SSES. The plant would withdraw less cooling water, discharge less blowdown water, and would consume (evaporate) less water than the existing SSES facility (as well as less than the coal or new nuclear alternatives). Like the current plant's discharge, the gas-fired alternative's liquid effluent would continue to consist mostly of cooling tower blowdown, with the discharge having a higher temperature and increased concentration of dissolved solids relative to the receiving body of water and intermittent low concentrations of biocides, although the amount

discharged would be smaller than the current discharge. The smaller workforce associated with a gas-fired power plant would also create less sewage, which after treatment is currently discharged to the Susquehanna River. Process waste water could also be discharged. All discharges would be regulated through a National Pollutant Discharge Elimination System (NPDES) permit, which would be administered by PDEP.

Some erosion and sedimentation could occur during construction of a gas-fired alternative (NRC 1996), but applicable construction-site regulations and implementation of best management practices would help to reduce these short-lived impacts. The NRC staff characterized water-quality impacts from sedimentation during construction as SMALL in the GEIS.

A natural gas-fired plant at an alternate site would likely also use a closed-cycle cooling system with cooling towers. The NRC staff assumes that surface water would be used for cooling makeup water and possibly as a source for sanitary and service water. Cooling tower blowdown, service water, and treated sanitary water would all be discharged to surface water. Intake and discharge would involve essentially the same quantities of water as would be necessary for an alternative located at the SSES site. The impact on the surface water would depend on the characteristics of the body of water. Intake from and discharge to any surface body of water would be regulated by the PDEP if located within Pennsylvania.

Impacts to surface-water quality and usage from a gas-fired alternative at the SSES site would be SMALL, while impacts at an alternate site may be slightly larger, depending on the characteristics of the water bodies the plant uses. At an alternate site, impacts may be SMALL to MODERATE.

Groundwater. SSES currently uses groundwater for domestic purposes and some industrial processes, although not for cooling water makeup. It is likely that groundwater usage would decrease with a gas-fired alternative, given the sharp reduction in number of workers onsite and reduced plant size. Some reduction may occur in the amount of water removed for industrial processes. Impacts on groundwater, then, for a gas-fired alternative at the SSES site would be SMALL.

Groundwater impacts at an alternate site may vary widely, depending on whether the plant uses groundwater for any purposes, although it is unlikely that a plant could use groundwater for cooling makeup. Assuming groundwater would only be used for domestic and maintenance purposes, groundwater impacts at an alternate site would be SMALL to MODERATE, depending on withdrawal amounts and aquifer characteristics.

- **Air Quality**

A gas-fired alternative would release a variety of air emissions. Like the coal-fired alternative, a gas-fired plant would emit criteria air pollutants, but generally in smaller quantities (except NO_x, which requires additional controls to reduce emissions).

Currently, Luzerne County and the neighboring counties of Lackawanna, Wyoming, Monroe, and Carbon are nonattainment areas for 8-hr ozone under the CAA. These counties are either in attainment or unclassified for other criteria pollutants.

A new gas-fired generating plant located in Luzerne County or other parts of the Scranton-Wilkes-Barre area would need a nonattainment area permit and a Title IV operating permit under the CAA. The plant would need to comply with the new source performance standards for such plants set forth in 40 CFR Part 60, Subpart Da. The standards establish limits for particulate matter and opacity (40 CFR 60.42(a)), SO_2 (40 CFR 60.43(a)), and NO_x (40 CFR 60.44(a)).

The EPA has various regulatory requirements for visibility protection in 40 CFR Part 51, Subpart P, including a specific requirement for review of any new major stationary source in an area designated as attainment or unclassified under the CAA.

Section 169A of the CAA (42 USC 7491) establishes a national goal of preventing future and remedying existing impairment of visibility in mandatory Class I Federal areas when impairment results from man-made air pollution. EPA's haze rule specifies that for each mandatory Class I Federal area located within a State, the State must establish goals that provide for reasonable progress towards achieving natural visibility conditions. The reasonable progress goals must provide for an improvement in visibility for the most-impaired days over the period of the implementation plan and ensure no degradation in visibility for the least-impaired days over the same period (40 CFR 51.308(d)(1)). If a gas-fired alternative were located close to a mandatory Class I area, additional air pollution control requirements could be imposed. Pennsylvania, however, contains no Class I areas.

Impacts for particular pollutants are as follows:

Sulfur oxides. Based on EPA emissions factors (EPA 2000c), the gas-fired alternative would produce approximately 180 tons/yr of sulfur oxides, expressed as SO_2. A new gas-fired power plant would be subject to the requirements in Title IV of the CAA. Title IV was enacted to reduce emissions of SO_2 and NO_x, the two principal precursors of acid rain, by restricting emissions of these pollutants from power plants. Title IV caps aggregate annual power plant SO_2 emissions and imposes controls on SO_2 emissions

through a system of marketable allowances. EPA issues one allowance for each ton of SO_2 that a unit is allowed to emit. New units do not receive allowances, but are required to have allowances to cover their SO_2 emissions. Owners of new units must therefore acquire allowances from owners of other power plants by purchase or reduce SO_2 emissions at other power plants they own. Allowances can be banked for use in future years. Thus, a new gas-fired power plant would not add to net regional SO_2 emissions, although it might do so locally.

While SO_2 emissions from the gas-fired alternative would be less than from the coal-fired alternative, they would be greater than for the operating license renewal alternative.

Nitrogen oxides. Based on EPA emissions factors (EPA 2000c), the gas-fired alternative would produce approximately 527 tons/yr (478 MT/yr) of NO_x. This level of NO_x emissions relies on dry low NO_x and selective catalytic reduction (SCR) to reduce initial NO_x emissions by more than 90 percent. As SSES is located in an ozone nonattainment area, the plant operator would need to purchase emissions allowances to offset this amount of emissions. While this level of NO_x emissions would be less than the coal-fired alternative, it would be greater than the operating license renewal alternative.

In addition to nonattainment considerations, the total amount of NO_x that can be emitted by all Pennsylvania sources in the year 2007 ozone season (May 1 to September 30) was capped according to 40 CFR 51.121(e) at 257,928 tons (233,988 MT). If a new gas-fired power plant would cause Pennsylvania to exceed the level of NO_x emissions established in caps in future years, the plant operators would need to offset its emissions through credit purchases or by borrowing from a set-aside pool of NO_x credits.

Title IV of the CAA establishes technology-based emission limitations for NO_x emissions. A new gas-fired power plant would be subject to standards published in 40 CFR 60.44a(1). This regulation, issued on September 16, 1998 (EPA 1998a), limits the discharge of any gases that contain nitrogen oxides (expressed as nitrogen dioxide) in excess of 86 ng/J of gross energy input (0.20 lb per million Btu), based on a 30-day rolling average. A gas-fired generator would be legally permitted to discharge approximately 10,600 tons (9623 MT) per year of NO_x, although the alternative considered here would emit only 527 tons (478 MT) per year.

Carbon monoxide. Based on EPA emissions factors (EPA 2000c), the gas-fired alternative would emit approximately 120 tons/yr (109 MT/yr) of CO. CO emissions from the gas-fired alternative are lower than those from the coal-fired alternative, but more than those emitted by the license renewal alternative.

PM_{10} particulates. Based on EPA emissions factors (EPA 2000c), the gas-fired alternative would produce approximately 100 tons/yr (91 MT/yr) of PM. All PM emissions generated by the gas-fired alternative would be PM_{10} emissions. Some of these may also classify as $PM_{2.5}$ emissions, which consist of particulates having an aerodynamic diameter less than or equal to 2.5 µm. PM emissions from the gas-fired alternative are lower than those from the coal-fired alternative, but more than those emitted by the license renewal alternative.

Carbon dioxide. A natural gas-fired plant would also have unregulated carbon dioxide emissions of 6.2 million tons/yr (5.6 million MT/yr) that could contribute to climate change (based on EIA emission factors (EPA 2007b). These impacts, however, are significantly smaller than the effects of the coal-fired alternative, and significantly greater than the effects of license renewal or a new nuclear power plant.

Hazardous air pollutants. In December 2000, the EPA issued regulatory findings on emissions of hazardous air pollutants from electric utility steam-generating units (EPA 2000b). Natural gas-fired power plants were found by the EPA to emit arsenic, formaldehyde, and nickel (EPA 2000b). Unlike for coal and oil-fired plants, the EPA did not determine that emissions of hazardous air pollutants from natural gas-fired power plants should be regulated under Section 112 of the CAA.

Construction-stage impacts. Construction activities would result in temporary fugitive dust, although construction crews would employ dust-control practices to limit this impact. Exhaust emissions would also come from vehicles and motorized equipment used during the construction process, although these emissions are likely to be intermittent in nature and would occur over a limited period of time. As such, construction stage air quality impacts would be SMALL.

Summary. The overall air-quality impact for a new natural gas-fired plant sited at SSES or at an alternate site is considered SMALL to MODERATE, depending on the control technology employed during the operating stage and the degree to which a gas-fired alternative affects ozone levels in nearby nonattainment areas.

- **Waste**

The primary waste component from the gas-fired alternative would be spent catalysts from SCR NO_x removal. Any ash generated from firing natural gas would be emitted by the gas-fired alternative as particulate matter. In the GEIS, the NRC staff concluded that waste generation from gas-fired technology would be minimal. Waste generation would be minor compared to the other alternatives considered.

During construction of the gas-fired alternative, crews would generate waste from land clearing and other construction activities. Most waste from land clearing could be disposed of onsite. Building on a previously developed site, like the SSES site or a site formerly used for industrial purposes, would minimize land-clearing waste. Many other wastes generated by the construction project, including metal scrap, have significant recycling value and would likely find markets for beneficial reuse.

Overall, the waste impacts would be SMALL for a natural gas-fired plant sited at SSES or at an alternate site.

- **Human Health**

Human health effects of gas-fired generation are generally low, although in Table 8-2 of the GEIS, the NRC staff identified cancer and emphysema as potential health risks from gas-fired plants. These risks are likely attributable to NO_x emissions that contribute to ozone formation, which in turn contribute to health risks. Emission controls on this gas-fired alternative maintain NO_x emissions well below air quality standards established for the purposes of protecting human health, and emissions-trading or offset requirements mean that overall NO_x in the region would not increase. Health risks to workers may also result from handling spent catalysts that may contain heavy metals. Overall, the impacts on human health of the natural gas-fired alternative sited at SSES or at an alternate site are likely to be SMALL.

- **Socioeconomics**

The NRC staff concluded in the GEIS that socioeconomic impacts from constructing and operating a natural gas-fired plant would not be very noticeable and that the small operational workforce would have the lowest socioeconomic impacts of any nonrenewable technology. Compared to the coal-fired and nuclear alternatives, the smaller size of the construction workforce, the shorter construction time frame, and the smaller size of the operations workforce would mitigate socioeconomic impacts.

PPL indicated that 1600 workers would be necessary to construct this alternative (PPL 2006). The NRC believes 1600 workers is a reasonable estimate. It is likely that many of these workers would commute from the Scranton-Wilkes-Barre area. During construction, the surrounding communities would experience increased demand for rental housing and public services, although this is moderated by the proximity of the site to urban areas. After construction, the communities may be impacted by the loss of the construction jobs and associated loss of business. Construction of the gas-fired alternative would take approximately 3 years.

Following construction, a gas-fired alternative at SSES would introduce a replacement tax base for Luzerne County, and it would also provide up to 375 jobs, based on estimates in the GEIS.

At an alternate site, 375 additional workers would be unlikely to have a major socioeconomic effect. Construction-stage impacts at an alternate site may have significant impacts, depending on whether it is located near an urban area. Alternate sites in rural areas may experience greater socioeconomic impacts during construction, including housing and social service demands, if 1200 to 1600 workers need to relocate to the area and then leave after 3 years. Tax revenue generated by a gas-fired plant would help to offset some of these negative impacts. Locating at an alternate site would impact the population around SSES, as tax revenue and jobs would be lost.

Socioeconomic impacts associated with construction and operation of a natural gas-fired power plant would be SMALL to MODERATE for siting at the SSES site, and would likely be SMALL to MODERATE if constructed at an alternate site.

- **Transportation**

Transportation impacts associated with construction and operations would depend on the population density and transportation infrastructure in the vicinity of the site. At the SSES plant site, 1200 to 1600 construction workers may be commuting alongside 1227 plant workers. Although the area has relatively good access to highways, local roadways may experience noticeable congestion during peak commuting times.

At an alternate site, transportation impacts could vary, depending on the proximity of the site to urban areas, transportation infrastructure, and the degree of existing transportation demands.

The overall transportation impacts at the SSES site would likely be SMALL to MODERATE and SMALL to MODERATE at an alternate site.

- **Aesthetics**

The six gas-fired units would be approximately 100 ft (30 m) tall, while each of the six exhaust stacks would be at least 175 ft (53 m) tall and perhaps taller to account for local topography, and some may require aircraft warning lights. On the SSES site, local topography and onsite forestation would largely screen these structures. Associated infrastructure would generally be smaller and less noticeable than that associated with the existing SSES plant. The current cooling towers would remain in service and –

along with their plumes and the six exhaust stacks – would be the only structures visible offsite during day or night.

Noise from the plant may be detectable offsite, but it is unlikely that this would be any greater than the existing plant noise.

On an alternate site, impacts may be more noticeable. In addition to the plant buildings, an alternate site would require new transmission lines and a new cooling system. Aesthetic impacts may be mitigated by siting in an area formerly developed for industrial purposes, or where local vegetation or topography provides screening for the plant.

On both sites, plant operating noise would be limited to industrial processes and communications. Unlike the other alternatives considered here, pipelines deliver fuel so no handling or other transportation equipment is necessary. Noise from pipelines may be audible offsite near compressors.

On the existing SSES site, aesthetic impacts of the gas-fired alternative would be SMALL, while impacts at an alternate site would likely be SMALL to MODERATE.

- **Historic and Archaeological Resources**

Before constructing a gas-fired alternative at the SSES site or an alternate site, a cultural resource inventory or survey would need to be performed for any property that has not been previously surveyed. Other lands, if any, that are acquired to support the gas-fired plant would also need to be surveyed for cultural resources, identification and recording of existing historic and archaeological resources, and possible mitigation of adverse effects from ground-disturbing actions. Studies would be needed for all areas of potential disturbance at the proposed plant site and along associated corridors where new construction would occur (e.g., roads, transmission corridors, rail lines, or other ROWs).

The existing site is particularly rich in cultural resources. Impacts would likely be MODERATE for the SSES site, even though much of it has been previously disturbed, and SMALL to MODERATE at an alternate site. Impacts may vary based on whether the alternate site has been previously developed and whether significant historic properties are present.

- **Environmental Justice**

Constructing a gas-fired alternative may result in increased rental housing demand and prices during the 3-year construction period. Housing demands during construction

would be mitigated by the site's proximity to the Scranton-Wilkes-Barre area. Environmental justice impacts for a gas-fired alternative at the SSES site would likely be SMALL.

Constructing a gas-fired alternative at an alternate site would result in the loss of tax revenue and social services, as well as jobs at the SSES site. Depending on the alternate site's proximity to low-income and minority populations, constructing the plant at an alternate site may result in disproportionate impacts to minority and low-income populations. Impacts to local populations would depend heavily on the populations' characteristics. Overall, the environmental justice impact of constructing a gas-fired alternative at an alternate site would likely be SMALL to MODERATE, primarily for impacts to minority and low-income populations near the current SSES site.

8.2.3 Nuclear Power Generation

Since 1997, the NRC has certified four new standard designs for nuclear power plants under 10 CFR Part 52, Subpart B. These designs are the 1300 MW(e) U.S. Advanced Boiling Water Reactor (10 CFR Part 52, Appendix A), the 1300 MW(e) System 80+ Design (10 CFR Part 52, Appendix B), the 600 MW(e) AP600 Design (10 CFR Part 52, Appendix C), and the 1100 MW(e) AP1000 Design (10 CFR Part 52, Appendix D). One additional design is awaiting certification, and five others are undergoing pre-application reviews. All of the plants currently certified or awaiting certification are light-water reactors; several of the designs in pre-certification review are not, including the Pebble Bed Modular Reactor and the Advanced Candu Reactor, ACR-700 (NRC 2007a). The NRC received several combined operating license (COL) applications in 2007, and has approved several early site permits (ESPs) The NRC expects additional COL applications in 2008, including a COL application by PPL Electric Utilities for undeveloped land at the SSES site. Given industry interest, the NRC staff considered a nuclear alternative to the current SSES. The NRC staff assumed that the new nuclear plant would have a 40-year lifetime, although license renewal could allow operation beyond the initial license.

The NRC staff summarized environmental data associated with the uranium fuel cycle in Table S-3 of 10 CFR 51.51. The data are representative of the impacts associated with a replacement nuclear power plant at SSES or an alternate site. The impacts in Table S-3 are from a 1000 MW(e) unit and would need to be adjusted to reflect impacts of a 2400 MW(e) plant. The environmental impacts associated with transporting fuel and waste to and from a power reactor are summarized in Table S-4 of 10 CFR 51.52. The summary of NRC's findings on NEPA issues for license renewal of nuclear power plants in Table B-1 of 10 CFR Part 51, Subpart A, Appendix B, is also relevant to the operation of a replacement nuclear power plant, although not for evaluation of the environmental impacts.

NRC staff discusses overall impacts of the new nuclear alternative in the following sections, excepting those issues already addressed. The impacts are summarized in Table 8-4. The extent of impacts at an alternate site depend on location and characteristics. Analyses in this section are not based on plans by PPL Electric Utilities for an additional unit or units on property at SSES. If and when PPL Electric Utilities submits a COL application, the NRC staff will review plant- and site-specific information and develop a detailed EIS based on information contained in its COL and collected or evaluated by the NRC staff at that time.

- **Land Use**

  The new nuclear alternative would use existing facilities and infrastructure at the SSES site to the extent practicable, limiting new construction. Specifically, the NRC staff assumed that a replacement nuclear plant would use the existing cooling system, switchyard, offices, parking lots, and transmission lines. Much of the land that would be used has been previously disturbed.

  The GEIS indicates that new light-water reactors could require 500 to 1000 ac (202 to 405 ha) per reference 1000 MW(e) unit. If impacts scaled directly with plant size, a 2400 MW(e) (with 3 percent internal power consumption; 2474 MW(e), gross) new nuclear plant would require approximately 1220 to 2450 ac (494 to 991 ha). Given that this new plant would use many existing structures, it is possible that a new nuclear alternative could fit on the existing SSES site. A new plant would trigger no net change in land needed for uranium mining because uranium mined for the new nuclear plant would offset fuel mined for the existing SSES.

  The amount of land affected at an alternate site would be similar to siting at SSES, except that some land may not have been previously disturbed or used for industrial purposes. In addition, land would be needed for new transmission lines, including a 50-mi (80-km) transmission line to remedy the load pocket created by SSES shutdown. Anywhere from hundreds to thousands of acres may be necessary for all ROWs. It may also be necessary to construct a rail spur to transport equipment during construction, as well as during refueling and major maintenance activities. The need to construct transmission and rail capacity would vary with site characteristics.

  The land use impact of a replacement nuclear generating plant at the existing SSES site is best characterized as MODERATE. This impact would be greater than that of the operating license renewal alternative, as well as greater than the onsite impacts of the gas-fired alternative. It would be similar to onsite land-use impacts of a coal-fired alternative. The offsite land-use impacts from the nuclear fuel cycle, however, are smaller than those for the gas-fired and coal-fired alternatives.

Table 8-4. Summary of Environmental Impacts of New Nuclear Power Generation at the SSES Site and an Alternate Greenfield Site Using Closed-Cycle Cooling

Impact Category	SSES Site		Alternate Site	
	Impact	Comments	Impact	Comments
Land use	MODERATE	Plant uses existing facilities to the extent practicable to reduce land requirements.	MODERATE to LARGE	The plant requires a similar amount of land at an alternate site, plus additional land for transmission lines and a rail spur.
Ecology	SMALL to MODERATE	The plant uses existing structures and undeveloped but previously disturbed areas. Aquatic ecology impacts are likely to be similar to those of the existing plant.	SMALL to LARGE	Impact depends on location and ecology of the site, surface water body used for intake and discharge, and transmission line routes; this could potentially cause habitat loss and fragmentation, reduced productivity, and lost biological diversity.
Water use and quality – surface water	SMALL	Uses existing cooling tower system for cooling tower makeup and discharges blowdown to the Susquehanna River.	SMALL to MODERATE	Impact will depend on the volume of water withdrawn and discharged and the characteristics of the surface water body. Surface water would likely be used for cooling.
Water use and quality – groundwater	SMALL	The plant would use the existing cooling tower system and may make use of existing groundwater systems for domestic and industrial purposes. Groundwater usage would likely be similar to that of the existing plant, with increased demand during construction.	SMALL to MODERATE	Impact will depend on the volume of water withdrawn, as well as characteristics of the aquifer, although the plant would likely not use groundwater for cooling.

Table 8-4. (contd)

Impact Category	SSES Site		Alternate Site	
	Impact	Comments	Impact	Comments
Air quality	SMALL	Construction vehicles and equipment would generate fugitive emissions and emissions during construction; diesel generators would create a small amount of emissions during operation.	SMALL	Similar impacts to those at the SSES site.
Waste	SMALL	Waste impacts for an operating nuclear power plant are set out in 10 CFR Part 51, Appendix B, Table B-1. Nonradioactive and mixed-waste generation would be similar to that at the existing plant. Debris would be generated and removed during construction, although overall impacts would be similar to the current plant.	SMALL	Similar impacts to those at the SSES site.
Human health	SMALL	Human health impacts for an operating nuclear power plant are SMALL as set out in 10 CFR Part 51, Appendix B, Table B-1.	SMALL	Human health impacts for an operating nuclear power plant are SMALL as set out in 10 CFR Part 51, Appendix B, Table B-1.
Socioeconomics	SMALL to MODERATE	Construction impacts would be MODERATE. Up to 2500 workers during peak period of the 6-year construction period. Operating workforce would be similar to SSES Units 1 and 2; tax base preserved in Luzerne County, but may change in surrounding counties if workers do not transfer from one plant to another. Impacts during operation would be SMALL.	SMALL to LARGE	Construction impacts depend on location. Impacts at a rural location could be LARGE. Impacts at a site near an urban area could be SMALL to MODERATE. Luzerne County would experience loss of tax base, while Luzerne and Columbia Counties would lose employment.

Table 8-4. (contd)

Impact Category	SSES Site		Alternate Site	
	Impact	Comments	Impact	Comments
Transportation	MODERATE	Transportation impacts during construction would be MODERATE. Transportation impacts of commuting plant personnel would be SMALL.	MODERATE	Transportation impacts would be MODERATE, primarily due to construction. Transportation impacts from operations would be SMALL to MODERATE.
Aesthetics	SMALL to MODERATE	Impact is essentially the same as the existing plant.	SMALL to LARGE	Greatest impacts result from new cooling towers and transmission lines. Overall impacts would depend on site characteristics. Noise could be detectable offsite.
Historic and archeological resources	MODERATE	Construction would affect additional onsite land. The site's extensive resources increase sensitivity and potential for impacts.	SMALL to MODERATE	Lands would need to be surveyed so construction would likely avoid highly sensitive areas. Transmission lines increase potential impacts.
Environmental justice	SMALL	Impacts on minority and low-income populations would be similar to those experienced by the general population. Some impacts on housing may occur during construction, although most personnel are expected to travel from nearby urban areas.	SMALL to MODERATE	Impacts will vary depending on population distribution and makeup at the site. Impacts of lost employment and tax base at SSES increase impact levels.

Impacts at an alternate site would be MODERATE to LARGE, depending particularly on transmission line routing and rail spur siting.

- **Ecology**

Locating a replacement nuclear power plant at the SSES site would alter ecological resources because of land needed for plant structures. Since much of this land would

have been either previously disturbed or used by existing plant structures, the plant's construction would actually create little new impact. The nuclear alternative would also make use of the existing plant's transmission system.

From an aquatic perspective, a new nuclear plant would be essentially identical to the current SSES in terms of water withdrawal and discharge. Given that the new plant would continue to use the existing cooling system, no major changes would likely occur. Provided plant construction workers use adequate erosion control onsite, aquatic ecology impacts would be minor.

At an alternate site, there would be construction impacts and new incremental operational impacts. On an alternate site, the plant would require 1220 to 2450 ac (494 to 991 ha) for the plant buildings and support infrastructure, as well as hundreds to thousands of acres for all transmission line ROWs and a rail spur. Impacts could include wildlife habitat loss, reduced productivity, habitat fragmentation, and a local reduction in biological diversity, depending on the degree to which the site was previously disturbed, as well as the extent to which transmission lines and a rail spur cross sensitive habitats. Use of cooling makeup water from a nearby surface water body could have adverse aquatic resource impacts, although the plant would mitigate these impacts by using closed-cycle cooling.

Overall, the ecological impacts at SSES would likely be SMALL to MODERATE, and at an alternate site would be SMALL to LARGE, depending on previous land disturbance and proximity to existing infrastructure.

- **Surface Water Use and Quality**

The NRC staff assumes that the replacement nuclear plant alternative at the SSES site would use the existing cooling system, which would minimize water-use and quality impacts. Surface-water impacts are expected to be SMALL, and similar to the impacts from continued operation of the existing plant. The NRC staff assumes that the nuclear alternative sited on the SSES property would continue to use groundwater for domestic, sanitary, and some service applications.

At an alternate site, a new nuclear plant would likely rely on closed-cycle cooling with cooling towers, whether natural or mechanical draft. For alternate sites, the impact on the surface water would depend on the volume of water needed for make-up water, the discharge volume, and the characteristics of the receiving body of water. Intake from and discharge to any surface body of water in Pennsylvania would be regulated by the PDEP. A nuclear plant at an alternate site may or may not use surface water for domestic, sanitary, or service water.

Water use for the nuclear alternative would be greater than for the gas- or coal-fired alternatives, owing the lower thermal efficiencies from the nuclear alternative.

Surface-water use and quality impacts for a nuclear alternative at the SSES site would likely be SMALL, while the impacts at an alternate site would likely be SMALL to MODERATE.

- **Groundwater Use and Quality**

If located at the SSES site, a new nuclear power plant would likely continue to rely on groundwater for domestic, sanitary, and maintenance water. For purposes of this analysis, the NRC staff assumes that water consumption would be similar to that for the current SSES plant. Groundwater demand on the SSES site could increase during construction, when construction workers are onsite in addition to SSES staff.

Use of groundwater for a nuclear power plant sited at an alternate site is also a possibility. Any groundwater withdrawal would require a permit from the local permitting authority. If sited in Pennsylvania, PDEP would regulate groundwater withdrawal and usage. Given the amount of water a new nuclear alternative would require for cooling, the NRC staff believes that a new nuclear alternative would not rely on groundwater for plant cooling.

Overall, groundwater impacts at the current site are expected to be SMALL, and at an alternate site may be SMALL to MODERATE, provided groundwater is not used for cooling purposes.

- **Air Quality**

The nuclear alternative would have very limited effects on air quality, and would emit far less air pollution than either the coal- or gas-fired alternatives. During operation, a nuclear alternative at either SSES or an alternate site would emit essentially no air pollution except that associated with testing and usage of diesel generators. These generators run for several hours to several days per year. Operating emission impacts would be similar to those of the existing SSES, which the NRC staff found to be SMALL in Chapter 4. For information on emissions from the nuclear fuel cycle, see Table S-3 in 10 CFR 51.51.[a]

(a) Table 5-3 quantifies emissions of gases released during the fuel cycle, with the exception of unregulated CO_2. Using Table 5-3 and EIA conversion factors, a new nuclear alternative's fuel cycle would emit roughly 650,000 tons (590,000 MT) of CO_2 (EIA 2007b). EIA indicates that nuclear power plants emit no CO_2 from operations, though diesel generators add small amounts.

Construction of a new nuclear plant sited at SSES or at an alternate site would result in fugitive emissions during the construction process. Exhaust emissions would also come from vehicles and motorized equipment used during the construction process. These impacts would be relatively short-lived and intermittent.

Overall, emissions and associated impacts would be SMALL.

- **Waste**

The waste impacts associated with operation of a nuclear power plant are set out in Table B-1 of 10 CFR Part 51, Subpart A, Appendix B. Construction-related debris would be generated during construction activities and removed to an appropriate disposal site. Overall, waste impacts would be SMALL at either SSES or an alternate site, and similar to those of the currently operating SSES plants.

- **Human Health**

In 10 CFR Part 51, Subpart A, Appendix B, Table B-1, the NRC established human health impacts for operating nuclear power reactors. Overall, the Commission determined that human health impacts would be SMALL. This determination would apply at the SSES site or at an alternate site.

- **Socioeconomics**

The construction period and the peak workforce associated with construction of a new nuclear power plant are currently unquantified (NRC 1996). For this analysis, the NRC staff assumed a construction period of 6 years and a peak workforce similar to that of a coal-fired alternative, or roughly 2500 workers. The NRC staff assumed that construction would take place while the existing nuclear units continue operation and would be completed by the time SSES permanently ceases operations.

At the SSES site, it is likely that many of these workers would commute from the Scranton-Wilkes-Barre area. During construction, the surrounding communities would experience increased demands for rental housing and public services, although this would be moderated by the proximity of the site to the Scranton-Wilkes-Barre area. After construction, local communities may be affected by the loss of the construction jobs and associated loss of business. During construction, impacts would be MODERATE.

Construction impacts at an alternate site would vary based on characteristics of the local population. In the GEIS, the NRC staff stated that socioeconomic impacts at an

alternate rural site would be larger than at an alternate urban site, because more of the peak construction workforce would need to move to the area to work. Construction impacts at a rural site could be LARGE, while impacts at a site near an urban area would be SMALL to MODERATE.

The replacement nuclear units would likely have an operating workforce comparable to the 1227 workers currently working at SSES. The replacement nuclear units would provide new tax revenue to offset losses from decommissioning SSES. Impacts from operations would be SMALL.

Operating impacts at an alternate site would be SMALL, though the loss of jobs and tax base would affect the area near SSES.

- **Transportation**

During the construction period, up to 2500 workers would be commuting to the SSES site alongside the 1227 workers at SSES. The addition of these workers, machinery, and material would increase traffic volumes on existing roads. Such impacts would be MODERATE. Transportation impacts related to commuting of plant operating personnel would be similar to current impacts associated with operation of Units 1 and 2 and are considered SMALL.

Transportation-related impacts from commuting construction workers at an alternate site would be MODERATE although they could vary somewhat across sites. Effects of commuting plant workers during operations would be SMALL to MODERATE.

- **Aesthetics**

The containment buildings for a replacement nuclear power plant sited at SSES as well as other associated buildings would be consistent with existing structures and partially screened by surrounding terrain and forestation. Some new structures could be visible offsite. The existing cooling towers would remain visible for many miles during daylight hours. Visual impacts could be mitigated by landscaping and selecting a color for buildings that is consistent with the environment. Visual impact at night could be mitigated by reduced use of lighting and appropriate use of shielding. No exhaust stacks would be needed.

Noise impacts from a new nuclear plant would be similar to those from the existing SSES. Mitigation measures, such as reduced use of outside loudspeakers, can be employed to reduce noise levels. Overall impacts are SMALL to MODERATE for a new nuclear plant at the SSES site.

At an alternate site, the NRC staff expects aesthetic impact from the buildings, cooling towers, and the plume associated with the cooling towers. There could also be a significant aesthetic impact from construction of new transmission lines. Noise and light from the plant could be detectable offsite, depending on site size and characteristics. The impact of noise and light would be mitigated if the plant is located in an industrial area. Overall, the aesthetic impacts associated with locating at an alternative site can be categorized as SMALL to LARGE, depending on site location. The greatest contributors to this input level are the cooling towers and transmission lines.

- **Historic and Archaeological Resources**

  At both SSES and an alternate site, a cultural resource inventory would likely be needed for any onsite property that has not been previously surveyed. Other lands, if any, that are acquired to support the new nuclear plant would also likely need to be surveyed for field cultural resources, identification and recording of existing historic and archaeological resources, and possible mitigation of adverse effects from subsequent ground-disturbing actions.

  The studies would likely be needed for all areas of potential disturbance at the proposed plant site and along associated corridors where new construction would occur (e.g., roads, transmission corridors, rail lines, or other ROWs). Because the SSES site contains extensive resources, impacts would be MODERATE at the existing site and SMALL to MODERATE at an alternate site.

- **Environmental Justice**

  Constructing a new nuclear alternative may result in increased rental housing demand and prices during the 6-year construction period. Housing demands would be mitigated by workers' commuting to the site from the Scranton-Wilkes-Barre area. Environmental justice impacts for a nuclear alternative at the SSES site would likely be SMALL.

  Constructing a nuclear alternative at an alternate site would result in the loss of tax revenue and social services, as well as jobs at the SSES site. Depending on the alternate site's proximity to low-income and minority populations, constructing the plant at an alternate site may result in disproportionate impacts to minority and low-income populations near the alternate site. Overall, the environmental justice impact of constructing a new nuclear alternative at an alternate site could be SMALL to MODERATE.

8.2.4 Purchased Electrical Power

PPL participates in the PJM Interconnection. This restructured energy supply system allows for the sale of energy across seven States and the District of Columbia (PPL 2006). Across the PJM, coal is the predominant fuel used for generation, accounting for 53.5 percent in 2003, followed by nuclear (32.9 percent), natural gas (8.4 percent), hydroelectric (2.1 percent), oil (2.0 percent), and renewables (1.1 percent) (PPL 2006). Many of PJM's gas-fired units are actually able to burn fuel oil, as well, although gas utilization is much higher due to lower costs and emissions. In the ER, PPL asserted that purchased power would be a reasonable alternative to license renewal, and that sufficient capacity would likely exist in the future (PPL 2006).

In the area around the plant, purchased power could likely be used to meet demand for electricity, although it is also possible that the loss of SSES could produce a load pocket that would require 50 mi of additional transmission line to mitigate (PPL 2006).

Impacts would likely be similar to those of the above options located at alternate sites. If PPL's power purchases cause currently existing capacity to operate at higher capacity factors, however, rather than triggering new construction, then construction stage impacts would be eliminated. It is likely, then, that purchased power would come from older, less efficient plants, plants with once-through cooling, or plants without modern emissions controls. As such, impacts are difficult to quantify, although they are likely similar to those of other alternatives considered in Sections 8.2.1 through 8.2.3 in this draft SEIS, as well as in the GEIS.

Given the location of SSES, it is unlikely that PPL would be able to purchase power from Canada or Mexico to replace the plant's capacity, regardless of whether either country has sufficient existing export capacity.

Since purchased power may come from a variety of generating resources, including coal, natural gas, nuclear, hydroelectric, and perhaps oil-fired installations (where impacts in previous NRC documents, including the SEIS and the GEIS, were determined to be similar to or larger than those of natural-gas fired generation), NRC staff evaluation indicates that impacts from the purchased power alternative would be greater than the impacts of license renewal.

8.2.5 Other Alternatives

In this section, the NRC staff discusses energy alternatives that it has determined are not individually sufficient to serve as alternatives to issuing the renewed SSES OL.

8.2.5.1 Oil-Fired Generation

EIA projects that oil-fired plants will account for very little of the new generation capacity in the United States during the 2007 to 2030 time period, and overall oil consumption for electricity generation will decrease because of higher fuel costs and lower efficiencies (EIA 2007).

PPL has several oil-fired units and dual-fuel units capable of burning both oil and natural gas. The variable costs of oil-fired generation tend to be greater than those of the nuclear or coal-fired options, and oil-fired generation tends to have greater environmental impacts than natural-gas-fired generation. In addition, future increases in oil prices are expected to make oil-fired generation increasingly more expensive. The high cost of oil has prompted a steady decline in its use for electricity generation. As such, the NRC staff has not considered oil-fired generation as an alternative to SSES license renewal.

8.2.5.2 Wind Power

Wind power, by itself, is not suitable for large baseload capacity. As discussed in Section 8.3.1 of the GEIS, wind has a high degree of intermittency, and low average annual capacity factors (up to 30 to 40 percent). Wind power, in conjunction with energy storage mechanisms or another readily dispatchable power source, like hydropower, might serve as a means of providing baseload power. Current energy storage technologies are too expensive for wind power to serve as a large baseload generator, and Pennsylvania lacks sufficient hydropower resources to pair with wind capacity to replace SSES (INEEL 1997).

The State of Pennsylvania is mostly a wind power Class 1 region, although some areas, particularly along ridgelines, may provide wind Classes ranging from 4 to 6. Wind turbines are economical in wind power Classes 4 through 7, which have average wind speeds of 12.5 to 21.1 miles per hour (mph) (20 to 34 kmph) (DOE 2007b). The SSES site is in a wind power Class 1 to 2 area, making a wind-energy facility at SSES economically infeasible, given the current state of wind energy generation technology.

As for wind power at another site, PPL noted that the PJM region has a technical wind potential of 6658 MW(e), and also noted that actual wind resource is likely to fall in the 665 to 1995 MW(e) range. With a capacity factor of 30 to 40 percent, this is not adequate to replace SSES's current capacity (PPL 2006), and the NRC staff has not evaluated wind power as an alternative to SSES license renewal.

8.2.5.3 Solar Power

Solar technologies use the sun's energy to produce electricity. Currently, the SSES site receives approximately 4 to 4.5 kWh per square meter per day (approximately 0.4 kWh of solar

radiation per square foot per day), as does much of the State of Pennsylvania (NREL 2007). Since flat-plate photovoltaics tend to be roughly 25 percent efficient, a solar-powered alternative would require at least 12,600 to14,200 ac (5099 to 5746 ha) to provide an amount of electricity equivalent to that generated by gas- and coal-fired alternatives (NRC 1996). Space between parcels and associated infrastructure would increase this land requirement. This amount of land, while large, is consistent with the land required for coal and natural gas fuel cycles. In the GEIS, the NRC staff noted that by its nature, solar power is intermittent, and the efficiency of collectors varies greatly with weather conditions. A solar powered alternative, in addition, would require energy storage or a backup power supply to provide electric power at night. Given challenges in meeting baseload requirements, the NRC has not evaluated solar power as an alternative to license renewal of SSES.

8.2.5.4 Hydropower

According to researchers at Idaho National Energy and Environmental Laboratory, Pennsylvania has an estimated 2217 MW of technically available, undeveloped hydroelectric resources at 104 sites throughout the State (INEEL 1997). This amount occurs primarily – 84 percent – in small installations generating 10 MW or less. The NRC staff notes that the total available hydropower potential is smaller than the capacity considered for the other alternatives to license renewal and all sites may not be available for development. The NRC staff has not considered hydropower as an alternative to license renewal.

8.2.5.5 Geothermal Energy

Geothermal energy has an average capacity factor of 90 percent and can be used for baseload power where available. However, geothermal electric generation is limited by the geographical availability of geothermal resources (NRC 1996). As illustrated by Figure 8.4 in the GEIS, there is no feasible eastern location for geothermal capacity to serve as an alternative to SSES Units 1 and 2. The NRC staff has concluded that geothermal energy is not a reasonable alternative to renewal of the Susquehanna Units 1 and 2 operating licenses.

8.2.5.6 Wood Waste

In 1999, DOE researchers estimated that Pennsylvania has biomass fuel resources consisting of urban, mill, agricultural, and forest residues, as well as speculative potential for energy crops. Excluding potential energy crops, DOE researchers projected that Pennsylvania had 5,090,000 tons (4,617,570 MT) of plant-based biomass available at $50 per ton delivered (Walsh et al. 2000; costs are in 1995 dollars). The Bioenergy Feedstock Development Program at Oak Ridge National Laboratory estimated that each air-dry pound of wood residue produces approximately 6400 Btu of heat (ORNL 2007). Assuming a 33 percent conversion efficiency, using all biomass available in Pennsylvania at $50 per ton – the maximum price the researchers

considered – would generate roughly 6.3 terawatt hours (TWh) of electricity. This is about one third of the power produced by SSES operating at 85 percent capacity for one year.

In addition, Walsh et al. (2000) note that these estimates of biomass capacity contain substantial uncertainty, and that potential availability does not mean biomass will actually be available at the prices indicated or that resources will be usably free of contamination. Some of these plant wastes already have reuse value, and would likely be more costly to deliver. Others, such as forest residues, may prove unsafe and unsustainable to harvest on a regular basis.

Due to insufficient supplies of potential fuel, the NRC staff has not considered a wood-fired alternative to SSES license renewal.

8.2.5.7 Municipal Solid Waste

Municipal solid waste combustors incinerate waste to produce steam, hot water, or electricity. Combustors use 3 types of technologies: mass burn, modular, and refuse-derived fuel. Mass burning is currently used most in the U.S., and involves no (or little) sorting, shredding, or separation; consequently, toxic or hazardous components present in the waste stream are combusted and toxic constituents are exhausted to the air or become part of the resulting solid wastes. Currently there are approximately 89 waste-to-energy plants operating in the United States. These plants generate approximately 2700 MW(e), or an average of approximately 30 MW(e) per plant (Integrated Waste Services Association 2007). Approximately 80 average-sized plants would be necessary to provide the same level of output as the other alternatives to SSES license renewal.

Estimates in the GEIS suggest that the overall level of construction impact from a waste-fired plant should be approximately the same as that for a coal-fired power plant. Additionally, waste-fired plants have the same or greater operational impacts than coal-fired technologies (including impacts on the aquatic environment, air, and waste disposal). The initial capital costs for municipal solid-waste plants are greater than for comparable steam-turbine technology at coal-fired facilities or at wood-waste facilities, due to the need for specialized waste separation and handling equipment (NRC 1996).

The decision to burn municipal waste to generate energy is usually driven by the need for an alternative to landfills rather than energy considerations. The use of landfills as a waste disposal option is likely to increase in the near term; with energy prices increasing, however, it is possible that municipal waste combustion facilities may become attractive again.

Regulatory structures that once supported municipal solid waste incineration no longer exist. For example, the Tax Reform Act of 1986 made capital-intensive projects such as municipal

waste combustion facilities more expensive relative to less capital-intensive waste disposal alternatives such as landfills. Also, the 1994 Supreme Court decision *C&A Carbone, Inc. v. Town of Clarkstown* struck down local flow control ordinances that required waste to be delivered to specific municipal waste combustion facilities rather than landfills that may have had lower fees. In addition, increasingly stringent environmental regulations have increased the capital cost necessary to construct and maintain municipal waste combustion facilities (EIA 2001).

Given the small average installed size of municipal solid waste plants and the unfavorable regulatory environment, the NRC staff has not considered municipal solid waste combustion to be a feasible alternative to SSES license renewal.

8.2.5.8 Other Biomass-Derived Fuels

In addition to wood and municipal solid-waste fuels, there are other concepts for biomass-fired electric generators, including direct burning of energy crops, conversation to liquid biofuels, and biomass gasification. In the GEIS, the NRC staff indicated that none of these technologies had progressed to the point of being competitive on a large scale or of being reliable enough to replace a baseload plant such as SSES Units 1 and 2. After reevaluating current technologies, the NRC staff believes other biomass-fired alternatives are still unable to reliably replace SSES' capacity. For this reason, the NRC staff has not considered other biomass-derived fuels to be feasible alternatives to renewal of the SSES Units 1 and 2 operating licenses.

8.2.5.9 Fuel Cells

Fuel cells oxidize fuels without combustion and its environmental side effects. Power is produced electrochemically by passing a hydrogen-rich fuel over an anode and air (or oxygen) over a cathode and separating the two by an electrolyte. The only by-products (depending on fuel characteristics) are heat, water, and carbon dioxide. Hydrogen fuel can come from a variety of hydrocarbon resources by subjecting them to steam under pressure. Natural gas is typically used as the source of hydrogen.

At the present time, fuel cells are not economically or technologically competitive with other alternatives for baseload electricity generation. EIA projects that by 2008 fuel cells may cost $4374 per installed kW (EIA 2006b), roughly three-and-a-half times the construction cost of new coal-fired capacity and more than seven times the cost of new, advanced gas-fired combined-cycle capacity. In addition, fuel cell units are likely to be small in size (EIA's reference plant is 10 MW). While it may be possible to use a distributed array of fuel cells to provide an alternative to SSES, it would be extremely costly to do so. As such, the NRC staff has not considered fuel cells as an alternative to SSES license renewal.

8.2.5.10 Delayed Retirement

PPL will retire two 140 MW(e) coal-fired units at its Martin's Creek location in September of 2007, as well as two small (2 and 3 MW(e)) diesel generators in the same month (PPL 2006). For reasons of insufficient capacity, delayed retirement of other PPL generating units would not be a feasible alternative to renewal of the SSES Units 1 and 2 operating licenses.

8.2.5.11 Utility-Sponsored Conservation

Prior to passage of Pennsylvania's Advanced Energy Portfolio Standard, the State of Pennsylvania commissioned studies to establish the potential amounts of energy and efficiency resources throughout the State. This study identified over 16,000 gigawatt hours (GWh) of energy efficiency potential available within 20 years of the study (Pletka 2004), or by 2024. This roughly matches the expiration of SSES Unit 2's OL. Units 1 and 2, however, produce approximately 19,000 GWh when operating at 85 percent, and the other alternatives considered in this section would produce roughly 18,000 GWh over the same 1-year period. While Pennsylvania's potential to reduce energy consumption versus a business-as-usual projection is substantial, it is not individually sufficient to replace the capacity of SSES.

8.2.6 Combination of Alternatives

The NRC staff considered a wide variety of alternatives to issuing renewed operating licenses for SSES, several of which the NRC staff determined to be individually capable of replacing SSES' capacity, and many of which the NRC staff determined to be incapable of replacing SSES' capacity or so expensive as to be unreasonable options. Since the decision of whether to operate the plant is up to energy planners outside NRC, any of a wide range of combination alternatives could be chosen by the relevant decisionmakers to replace capacity currently at SSES.

In this section, the NRC staff considers a combination of options that could serve as an alternative to issuing renewed OLs for SSES.

In performing this analysis, the NRC staff considered that locating a generating station at the SSES site serves an important grid reliability function, and the NRC staff also recognized that maintaining existing capacity generally creates smaller impacts than building new capacity. As such, this combination alternative considers that one SSES unit would remain in service, while the other shuts down. This option would preserve half of the generating capacity at the SSES site, and may prevent the "load pocket" phenomenon described in the SSES ER (PPL 2006). In addition, it would preserve many jobs at the SSES site, as one unit and the shared infrastructure would remain in operation. Also, decommissioning of the shutdown unit would likely be postponed until the remaining unit shuts down.

Several feasible options exist for replacing the capacity from the retired unit at the SSES site, possibly including conservation, as well as small amounts of wood-fired generation or wind power. Another option would be to site replacement gas-fired combined-cycle capacity to replace one unit at the existing site. From an environmental perspective, the NRC staff believes that relying on conservation to replace the retired unit's capacity would result in the smallest impact to the environment, as the GEIS notes that most conservation impacts are SMALL or negligible. The NRC staff recognizes that significant uncertainty exists surrounding the actual conservation potential, although the NRC staff also recognizes that estimates for conservation potential reported in Pletka (2004) were used by Pennsylvania in developing the State's Advanced Energy Portfolio Standard. Approximately 60 percent of reported conservation potential would be necessary to replace one SSES unit.

The overall impacts of this alternative would be predominantly SMALL, with some noticeable (MODERATE) effects.

Effects to land use would be SMALL, as existing site and ROW maintenance would continue unchanged, and no new construction would occur to replace the retired unit's capacity.

Ecological impacts would also be SMALL. The single-unit plant needs about half as much water as two units, ROW maintenance continues, domestic water consumption and discharge decline, and no new construction occurs. The ecological impacts of this combination alternative would thus be smaller than renewing both licenses, and smaller than coal-fired, gas-fired, and new nuclear alternatives. No additional transmission lines are necessary.

Water-use and -quality impacts would be SMALL. Surface water intake and discharge would be less than the existing two units, and likely smaller than coal-fired or new nuclear alternatives. Water consumption may be similar to that of a gas-fired alternative. Groundwater use would also be less than required for both units. Air quality impacts would be SMALL.

Renewing one license would result in less radioactive and mixed-waste generation, as well as less nonradioactive waste, than the proposed action. Conservation activities may increase nonradioactive waste generation, but with nearly 20 years to implement conservation, waste generation could be minimized by replacing items as they reach the end of their lives. In total, waste impacts would be SMALL.

Human health effects of this combination alternative would be substantially similar to the health impacts of renewing both licenses, although the GEIS notes that conservation approaches can affect indoor air quality. The GEIS indicates, however, that these effects can likely be effectively mitigated. Thus health impacts would also be SMALL.

Impacts to aesthetics would not be noticeable, and would thus be SMALL. Impacts to historic and archeological resources, however, would likely be similar to continued operation of both units. This alternative would have MODEREATE impacts on cultural resources.

This combination alternative results in noticeable impacts, however, for socioeconomics and environmental justice. If nearly half of SSES staff and tax revenues are eliminated, the surrounding communities would likely experience SMALL to MODERATE impacts. Transportation impacts would remain SMALL, however, as fewer plant staff commute to SSES. This combination alternative would also create SMALL to MODERATE environmental justice impacts, as lost tax base and employment could affect the low-income populations in the local areas.

8.3 Summary of Alternatives Considered

The environmental impacts of the proposed action (issuing renewed SSES Units 1 and 2 operating licenses) would be SMALL for most impact categories except for historic and archaeological resources, and the Category I issues of collective offsite radiological impacts from the fuel cycle and from high level waste (HLW) and spent fuel disposal. The NRC staff did not assign a single significance level to collective offsite radiological impacts from the fuel cycle and from HLW and spent fuel disposal, but the Commission determined them to be Category 1 issues nonetheless.

In addition to the proposed action, the NRC staff considered several alternative actions in depth, including the no-action alternative (discussed in Section 8.1), coal-fired generation (Section 8.2.1), natural gas-fired combined-cycle generation (Section 8.2.2), new nuclear generation (Section 8.2.3), purchased electrical power (Section 8.2.4), and a combination of alternatives (discussed in Section 8.2.6). The NRC staff selected these alternatives after reviewing a broad array of technologies, many of which the NRC staff determined would be unable to meet the needs currently served by SSES. The NRC staff briefly discussed these alternatives in Section 8.2.5.

The NRC staff notes that all of the alternatives to license renewal capable of meeting the needs currently served by SSES Units 1 and 2 entail potentially greater impacts than the proposed action of license renewal for the SSES Units 1 and 2. Since the no-action alternative would necessitate the implementation of one or a combination of alternatives, all of which have greater impacts than the proposed action, the NRC staff also concludes that the no-action alternative would have greater environmental impacts than the proposed license renewal action. As such, issuing renewed operating licenses for SSES Units 1 and 2 is the environmentally preferred alternative.

8.4 References

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10 CFR Part 52. *Code of Federal Regulations*, Title 10, *Energy,* Part 52, "Early Site Permits; Standard Design Certifications; and Combined Licenses for Nuclear Power Plants."

40 CFR Part 50. *Code of Federal Regulations*, Title 40, *Protection of Environment*, Part 50, "National Primary and Secondary Ambient Air Quality Standards."

40 CFR Part 51. *Code of Federal Regulations*, Title 40, *Protection of Environment*, Part 51, "Requirements for Preparation, Adoption, and Submittal of Implementation Plans."

40 CFR Part 60. *Code of Federal Regulations*, Title 40, *Protection of Environment*, Part 60, "Standards of Performance for New Stationary Sources."

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9.0 Summary and Conclusions

By letter dated September 13, 2006, PPL Susquehanna, LLC (PPL) submitted an application to the U.S. Nuclear Regulatory Commission (NRC) to issue renewed operating licenses (OLs) for Susquehanna Steam Electric Station, Units 1 and 2 (SSES) for an additional 20-year period (PPL 2006a). If the OLs are renewed, State regulatory agencies and PPL will ultimately decide whether the plant will continue to operate based on factors such as the need for power or other matters within the State's jurisdiction or the purview of the owners. If the OLs are not renewed, then the plants must be shut down at or before the expiration of the current OLs, which expire on July 17, 2022, for Unit 1, and March 23, 2024, for Unit 2.

Section 102 of the National Environmental Policy Act (NEPA) directs that an Environmental Impact Statement (EIS) is required for major Federal actions that significantly affect the quality of the human environment. The NRC has implemented Section 102 of NEPA in Title 10, Part 51, of the *Code of Federal Regulations* (10 CFR Part 51). Part 51 identifies licensing and regulatory actions that require an EIS. In 10 CFR 51.20(b)(2), the Commission requires preparation of an EIS or a supplement to an EIS for renewal of a reactor OL; 10 CFR 51.95(c) states that the EIS prepared at the OL renewal stage will be a supplement to the *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (GEIS), NUREG-1437, Volumes 1 and 2 (NRC 1996, 1999).[a]

Upon acceptance of the PPL application, the NRC began the environmental review process described in 10 CFR Part 51 by publishing a Notice of Intent to prepare an EIS and conduct scoping (NRC 2006) on November 2, 2006. The NRC staff visited the SSES site in May 2007 and held public scoping meetings on November 15, 2006, in Berwick, Pennsylvania. The NRC staff reviewed the PPL Environmental Report (ER) (PPL 2006b) and compared it to the GEIS, consulted with other agencies, and conducted an independent review of the issues following the guidance set forth in NUREG-1555, Supplement 1: *Standard Review Plans for Environmental Reviews for Nuclear Power Plants, Supplement 1: Operating License Renewal* (NRC 2000). The NRC staff also considered the public comments received during the scoping process for preparation of this draft Supplemental Environmental Impact Statement (SEIS) for SSES. The public comments received during the scoping process that were considered to be within the scope of the environmental review are provided in Appendix A, Part 1, of this draft SEIS.

(a) The GEIS was originally issued in 1996. Addendum 1 to the GEIS was issued in 1999. Hereafter, all references to the "GEIS" include the GEIS and its Addendum 1.

The NRC staff will hold two public meetings in Berwick, Pennsylvania, in late May 2008, to describe the preliminary results of the NRC environmental review and to answer questions to provide members of the public with information to assist them in formulating their comments on this draft SEIS. When the comment period ends, the NRC staff will consider and address all of the comments received. These comments will be addressed in Appendix A, Part 2, of the final SEIS.

This draft SEIS includes the NRC staff's preliminary analysis that considers and weighs the environmental effects of the proposed action, including cumulative impacts; the environmental impacts of alternatives to the proposed action; and mitigation measures available for reducing or avoiding adverse effects. This draft SEIS also includes the NRC staff's preliminary recommendation regarding the proposed action.

The NRC has adopted the following statement of purpose and need for license renewal from the GEIS:

> The purpose and need for the proposed action (issuing a renewed operating license) is to provide an option that allows for power generation capability beyond the term of a current nuclear power plant operating license to meet future system generating needs, as such needs may be determined by State, utility, and, where authorized, Federal (other than NRC) decisionmakers.

The evaluation criterion for the NRC staff's environmental review, as defined in 10 CFR 51.95(c)(4) and the GEIS, is to determine

> ... whether or not the adverse environmental impacts of license renewal are so great that preserving the option of license renewal for energy-planning decisionmakers would be unreasonable.

Both the statement of purpose and need and the evaluation criterion implicitly acknowledge that there are factors, in addition to license renewal, that will ultimately determine whether an existing nuclear power plant continues to operate beyond the period of the current OL.

NRC regulations (10 CFR 51.95(c)(2)) contain the following statement regarding the content of SEISs prepared at the license renewal stage:

> The supplemental environmental impact statement for license renewal is not required to include discussion of need for power or the economic costs and economic benefits of the proposed action or of alternatives to the proposed action except insofar as such benefits and costs are either essential for a determination regarding the inclusion of an alternative in the range of alternatives considered or relevant to mitigation. In addition, the supplemental

environmental impact statement prepared at the license renewal stage need not discuss other issues not related to the environmental effects of the proposed action and the alternatives, or any aspect of the storage of spent fuel for the facility within the scope of the generic determination in § 51.23(a) and in accordance with § 51.23(b).[(a)]

The GEIS contains the results of a systematic evaluation of the consequences of renewing an OL and operating a nuclear power plant for an additional 20 years. It evaluates 92 environmental issues using the NRC's three-level standard of significance – SMALL, MODERATE, or LARGE – developed using the Council on Environmental Quality guidelines. The following definitions of the three significance levels are set forth in the footnotes to Table B-1 of 10 CFR Part 51, Subpart A, Appendix B:

SMALL – Environmental effects are not detectable or are so minor that they will neither destabilize nor noticeably alter any important attribute of the resource.

MODERATE – Environmental effects are sufficient to alter noticeably, but not to destabilize, important attributes of the resource.

LARGE – Environmental effects are clearly noticeable and are sufficient to destabilize important attributes of the resource.

For 69 of the 92 issues considered in the GEIS, the NRC staff analysis in the GEIS shows the following:

(1) The environmental impacts associated with the issue have been determined to apply either to all plants or, for some issues, to plants having a specific type of cooling system or other specified plant or site characteristics.

(2) A single significance level (i.e., SMALL, MODERATE, or LARGE) has been assigned to the impacts (except for collective offsite radiological impacts from the fuel cycle and from high-level waste (HLW) and spent fuel disposal).

(3) Mitigation of adverse impacts associated with the issue has been considered in the analysis, and it has been determined that additional plant-specific mitigation measures are likely not to be sufficiently beneficial to warrant implementation.

These 69 issues were identified in the GEIS as Category 1 issues. In the absence of new and significant information, the NRC staff relied on conclusions as amplified by supporting

(a) The title of 10 CFR 51.23 is "Temporary storage of spent fuel after cessation of reactor operations – generic determination of no significant environmental impact."

information in the GEIS for issues designated Category 1 in Table B-1 of 10 CFR Part 51, Subpart A, Appendix B. The NRC staff also determined that information provided during the public comment period did not identify any new issue that requires site-specific assessment.

Of the 23 issues that do not meet the criteria set forth above, 21 are classified as Category 2 issues requiring analysis in a plant-specific supplement to the GEIS. The remaining two issues, environmental justice and chronic effects of electromagnetic fields, were not categorized. Environmental justice was not evaluated on a generic basis and must also be addressed in a plant-specific supplement to the GEIS. Information on the chronic effects of electromagnetic fields was not conclusive at the time the GEIS was prepared.

This draft SEIS (the site-specific supplement to the GEIS) documents the NRC staff's consideration of all 92 environmental issues identified in the GEIS. The NRC staff considered the environmental impacts associated with alternatives to license renewal and compared the environmental impacts of license renewal and the alternatives. The alternatives to license renewal that were considered include the no-action alternative (not issuing renewed OLs for SSES Units 1 and 2) and alternative methods of power generation. These alternatives were evaluated assuming that the replacement power generation plant is located at either the SSES site or some other unspecified location.

9.1 Environmental Impacts of the Proposed Action – License Renewal

PPL and the NRC staff have established independent processes for identifying and evaluating the significance of any new information on the environmental impacts of license renewal. Neither PPL nor the NRC staff has identified information that is both new and significant related to Category 1 issues that would call into question the conclusions in the GEIS. Similarly, neither the scoping process, PPL, nor the NRC staff has identified any new issue applicable to the draft SSES that has a significant environmental impact. Therefore, the NRC staff relies upon the conclusions of the GEIS for all Category 1 issues that are applicable to SSES.

PPL's license renewal application presents an analysis of the Category 2 issues that are applicable to SSES Units 1 and 2, plus environmental justice and chronic effects from electromagnetic fields. The NRC staff has reviewed the PPL analysis for each issue and has conducted an independent review of each issue plus environmental justice and chronic effects from electromagnetic fields. Six Category 2 issues are not applicable because they are related to plant design features or site characteristics not found at SSES. Four Category 2 issues are not discussed in this draft SEIS because they are specifically related to refurbishment. PPL (PPL 2006b) has stated that its evaluation of structures and components, as required by 10 CFR 54.21, did not identify any major plant refurbishment activities or modifications as

necessary to support the continued operation of SSES for the license renewal period. In addition, any replacement of components or additional inspection activities are within the bounds of normal plant component replacement and, therefore, are not expected to affect the environment outside of the bounds of the plant operations evaluated in the *Final Environmental Statement Related to Operation of Susquehanna Steam Electric Station* (NRC 1981).

The NRC staff discusses in detail 11 Category 2 issues related to operational impacts and postulated accidents during the renewal term, as well as environmental justice and chronic effects of electromagnetic fields, in this draft SEIS. Five of the Category 2 issues and environmental justice apply to both refurbishment and to operation during the renewal term and are only discussed in this draft SEIS in relation to operation during the renewal term. For 10 of 11 Category 2 issues and environmental justice, the NRC staff concludes that the potential environmental effects would be of SMALL significance in the context of the standards set forth in the GEIS. For one Category 2 issue (historic and archaeological resources), the NRC staff determined that environmental impacts could be of MODERATE significance. In addition, the NRC staff determined that appropriate Federal health agencies have not reached a consensus on the existence of chronic adverse effects from electromagnetic fields. Therefore, no further evaluation of this issue is required. For severe accident mitigation alternatives (SAMAs), the NRC staff concludes that a reasonable, comprehensive effort was made to identify and evaluate SAMAs. Based on its review of the SAMAs for SSES and the plant improvements already made, the NRC staff concludes that none of the potentially cost-beneficial SAMAs relate to adequately managing the effects of aging during the period of extended operation; therefore, they need not be implemented as part of the license renewal pursuant to 10 CFR Part 54.

Mitigation measures were considered for each Category 2 issue. For historic and archaeological resources, potential impacts could be reduced by implementing mitigation measures such as improved procedures.

Cumulative impacts of past, present, and reasonably foreseeable future actions were considered, regardless of what agency (Federal or non-Federal) or person undertakes such other actions. For purposes of this analysis, where SSES license renewal impacts are deemed to be SMALL, the NRC staff concluded that these impacts would not result in significant cumulative impacts on potentially affected resources. In some resource areas – such as terrestrial resources, aquatic resources, and surface water – past human actions independent of SSES operations or constructing potential future units onsite have already created MODERATE to LARGE cumulative impacts. Further, the NRC staff concluded that the impacts of continued operation of SSES during the license renewal period could contribute to cumulative impacts that range from SMALL to LARGE on potentially affected resources if one or two units are constructed at the site, with the largest potential impacts in areas of socioeconomics, as well as historical and archaeological resources. A complete review of the construction and operation of

the new unit(s) based on proposal-specific information would be included in future NEPA documentation if PPL proceeds with its COL application.

The following sections discuss unavoidable adverse impacts, irreversible or irretrievable commitments of resources, and the relationship between local short-term use of the environment and long-term productivity.

9.1.1 Unavoidable Adverse Impacts

An environmental review conducted at the license renewal stage differs from the review conducted in support of a construction permit because the plant is in existence at the license renewal stage and has operated for a number of years. As a result, adverse impacts associated with the initial construction have been avoided, have been mitigated, or have already occurred. The environmental impacts to be evaluated for license renewal are those associated with refurbishment and continued operation during the renewal term.

The adverse impacts of continued operation identified are considered to be of SMALL significance for most resource areas, excluding historic and archaeological resources. Impacts to historic and cultural resources related to continued SSES operation would likely be MODERATE, but could be mitigated by improved procedures. Overall, the adverse impacts of likely alternatives if SSES ceases operation at or before the expiration of the current OLs would be greater than those of continued operation.

9.1.2 Irreversible or Irretrievable Resource Commitments

The commitment of resources related to construction and operation of the SSES during the current license period was made when the plant was built. The resource commitments considered in this draft SEIS are associated with continued operation of the plant for an additional 20 years. These resources include materials and equipment required for plant maintenance and operation, the nuclear fuel used by the reactors, and ultimately, permanent offsite storage space for the spent fuel assemblies.

The most significant resource commitments related to operation during the renewal term are the fuel and the permanent storage space. SSES replaces approximately one third of the fuel assemblies in each of the two units on a 24-month refueling cycle with Units 1 and 2 refueling on alternate years.

Most of the likely power generation alternatives for replacement power if SSES ceases operation on or before the expiration of the current OLs will require a commitment of resources for construction of the replacement plants as well as for fuel to run the plants. One alternative – a combination alternative including OL renewal for one unit and replacing the other unit with an

equivalent amount of conservation capacity – may require a resource commitment similar to operating both SSES units. Given the long lead time to develop conservation programs prior to OL expiration, it is possible that resource commitment for conservation measures may only minimally exceed resource commitments in the absence of the measures.

9.1.3 Short-Term Use Versus Long-Term Productivity

An initial balance between short-term use and long-term productivity of the environment at the SSES site was set when the plant was approved and construction began. That balance is now well established. Renewal of the OLs for SSES and continued operation of the plant would not alter the existing balance, but may postpone the availability of the site for other uses. Denial of the application to renew the OLs would lead to shutdown of the plant and would alter the balance in a manner that depends on subsequent uses of the site. For example, the environmental consequences of turning the SSES site into a park or an industrial facility are quite different.

9.2 Relative Significance of the Environmental Impacts of License Renewal and Alternatives

The proposed action is issuance of renewed OLs for SSES. Chapter 2 describes the site, power plant, and interactions of the plant with the environment. As noted in Chapter 3, no refurbishment and no refurbishment impacts are expected at SSES. Chapters 4 through 7 discuss environmental issues associated with renewal of the OLs. The NRC staff discusses environmental issues associated with the no-action alternative and alternatives involving power generation and use in Chapter 8.

The significance of the environmental impacts from the proposed action (approval of the application for renewal of the OLs), the no-action alternative (denial of the application), alternatives involving nuclear or coal- or gas-fired generation of power at the SSES site and at an unspecified alternate site, as well as a combination of alternatives are compared in Table 9-1. Continued use of a closed-cycle cooling system for SSES is assumed for Table 9-1.

Table 9-1 shows that the significance of the environmental effects of the proposed action would be SMALL for most impact categories and MODERATE for historic and archaeological resources. No single significance level was assigned to collective offsite radiological impacts from the fuel cycle and from HLW and spent fuel disposal (see Chapter 6). The alternative actions, including the no-action alternative, may have environmental effects in at least some impact categories that reach MODERATE or LARGE significance.

Table 9-1. Summary of Environmental Significance of License Renewal, the No-Action Alternative, and Alternative Methods of Generation Using Closed-Cycle Cooling

Impact Category	Proposed Action (License Renewal)	No-Action Alternative (Denial of Renewal)	Coal-Fired Generation		Natural-Gas-Fired Generation		New Nuclear Generation		Combination of Alternatives
			SSES Site	Alternate Site	SSES Site	Alternate Site	SSES Site	Alternate Site	SSES Site
Land use	SMALL	SMALL to MODERATE	MODERATE	MODERATE to LARGE	SMALL to MODERATE	SMALL to LARGE	MODERATE	MODERATE to LARGE	SMALL
Ecology	SMALL	SMALL to MODERATE	MODERATE	SMALL to LARGE	SMALL	SMALL to LARGE	SMALL to MODERATE	SMALL to LARGE	SMALL
Water use and quality – surface water	SMALL	SMALL	SMALL	SMALL to MODERATE	SMALL	SMALL to MODERATE	SMALL	SMALL to MODERATE	SMALL
Water use and quality – groundwater	SMALL	SMALL	SMALL	SMALL to MODERATE	SMALL	SMALL to MODERATE	SMALL	SMALL to MODERATE	SMALL
Air quality	SMALL	SMALL	MODERATE	MODERATE	SMALL to MODERATE	SMALL to MODERATE	SMALL	SMALL	SMALL
Waste	SMALL	SMALL	MODERATE	MODERATE	SMALL	SMALL	SMALL	SMALL	SMALL
Human health	SMALL[a]	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL
Socioeconomics	SMALL	MODERATE to LARGE	SMALL TO MODERATE	SMALL to LARGE	SMALL to MODERATE	SMALL to MODERATE	SMALL TO MODERATE	SMALL to LARGE	MODERATE
Transportation	SMALL	SMALL	SMALL to MODERATE	SMALL to MODERATE	SMALL TO MODERATE	SMALL to MODERATE	MODERATE	MODERATE	SMALL to MODERATE
Aesthetics	SMALL	SMALL	SMALL to MODERATE	SMALL to LARGE	SMALL	SMALL to MODERATE	SMALL to MODERATE	SMALL to LARGE	SMALL
Historic and archaeological resources	MODERATE	MODERATE	MODERATE	SMALL to MODERATE	MODERATE	SMALL to MODERATE	MODERATE	SMALL to MODERATE	MODERATE
Environmental justice	SMALL	MODERATE to LARGE	SMALL	SMALL to MODERATE	SMALL	SMALL to MODERATE	SMALL	SMALL to MODERATE	SMALL to MODERATE

(a) Except for collective offsite radiological impacts from the fuel cycle and from HLW and spent-fuel disposal, for which a significance level was not assigned. See Chapter 6 for details.

9.3 NRC Staff Conclusions and Recommendations

Based on (1) the analysis and findings in the GEIS (NRC 1996, 1999); (2) the ER submitted by PPL (PPL 2006b); (3) consultation with Federal, State, and local agencies; (4) the NRC staff's own independent review; and (5) the NRC staff's consideration of public comments received, the preliminary recommendation of the NRC staff is that the Commission determine that the adverse environmental impacts of license renewal for SSES are not so great that preserving the option of license renewal for energy-planning decisionmakers would be unreasonable.

9.4 References

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

10 CFR Part 54. *Code of Federal Regulations*, Title 10, *Energy,* Part 54, "Requirements for Renewal of Operating Licenses for Nuclear Power Plants."

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