Attachment 3 to PLA-6002

Supplemental Environmental Report

Supplemental Environmental Report
Extended Power Uprate
Susquehanna Steam Electric Station

PPL Susquehanna, LLC

Unit 1
Docket No. 50-387
License No. NPF-014

Unit 2
Docket No. 50-388
License No. NPF-022

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1.0 EXECUTIVE SUMMARY

This Supplemental Environmental Report contains the PPL Susquehanna, LLC (PPL Susquehanna) assessment of environmental impacts of the proposed Susquehanna Steam Electric Station (SSES) extended power uprate (EPU) from 3,489 megawatts-thermal (MWt) to 3,952 MWt at each unit. The intent is to provide sufficient information for the U.S. Nuclear Regulatory Commission (NRC) to evaluate the environmental impact of the power uprate in accordance with the requirements of 10 CFR 51.

The environmental impacts of the EPU are described and compared to those previously identified in Susquehanna Steam Electric Station Applicant's Environmental Report (PP&L 1972), the Final Environmental Statement (FES) related to the construction of Susquehanna Steam Electric Station (AEC 1973), the Environmental Report Operating License Stage (PP&L 1978), the FES related to the operation of Susquehanna Steam Electric Station (NRC 1981), and the two Environmental Assessments for the stretch uprates of Unit 2 and Unit 1 (Federal Register, Vol. 59, No. 53, pp. 12990-12992; Vol. 60, No. 9, pp. 3278-3280). The comparisons show that the conclusions of these documents remain valid for operation at 3,952 MWt.

The SSES EPU would be implemented without making extensive changes to plant systems that directly or indirectly affect the environment. They are mentioned in Chapter 4 and listed in EPU Application Attachment 7, List of Planned Modifications. All necessary modifications would be in or on existing facilities at SSES. This includes expansion of the two existing switchyards (230 KV and 500 KV). A proposed addition may be built onto the Turbine Building for an additional condensate filter (one per unit). There are no plans to construct any new buildings as part of EPU. There would be a small increase in the amount of water withdrawn from the Susquehanna River for increased Cooling Tower losses including tower blowdown, and in the amount of waste heat discharged to the same river. Generation of low-level radioactive waste (LLRW) would increase slightly compared to the current rate, but would still be bounded by the FES related to construction values. Likewise, there would be small increases in the quantity of radioactivity released to the environment through liquid effluents and airborne emissions. All offsite radiation doses would be within applicable regulatory standards.

PPL Susquehanna concludes that the environmental impacts of operation at 3,952 MWt are either bounded by impacts described in earlier National Environmental Policy Act (NEPA) assessments or within regulatory permitted limits. As a consequence, PPL Susquehanna believes that the EPU would not significantly (as defined in 40 CFR 1508.27) affect human health or the environment.

2.0 INTRODUCTION

PPL Susquehanna is committed to operating SSES in an environmentally responsible manner. Plant activities including design, construction, maintenance, and operations are conducted in a manner so as to protect the environment and preserve natural resources. SSES operates in compliance with state and federal environmental regulations, while providing safe, reliable, and economical electrical service to its customers.

In keeping with this commitment to environmental stewardship and in accordance with regulatory requirements, PPL Susquehanna has conducted a comprehensive environmental evaluation of the proposed EPU for SSES from 3,489 MWt to 3,952 MWt for Units 1 and 2. This would increase the potential electrical output of each of the nuclear units to approximately 1,300 megawatts-electric (MWe). The proposed uprate will serve the future generation requirements of PPL Corporation's customers, whose summer unrestricted peak load is expected to grow at an average annual rate of 1.8 percent over the next ten years.

This environmental evaluation is provided pursuant to 10 CFR 51.41 ("Requirements to Submit Environmental Information") and is intended to support the NRC environmental review of the proposed uprate. The uprate will require the issuance of operating license amendments for Units 1 and 2. The regulation (10 CFR 51.41) requires that applications to the NRC be in compliance with Section 102(2) of NEPA and consistent with the procedural provisions of NEPA (40 CFR 1500-1508). There are no NRC regulatory requirements or guidance documents specific to preparation of environmental reports for EPUs.

In July 1972, Pennsylvania Power and Light Company (PP&L) prepared the *Environmental Report for SSES* (PP&L 1972). In June 1973, the U.S. Atomic Energy Commission (AEC; predecessor agency to the NRC) published the *FES related to the construction of Susquehanna Steam Electric Station Units 1 and 2* (AEC 1973). PP&L finalized the *Environmental Report Operating License Stage* in 1978 (PP&L 1978) and NRC published the *FES related to the operation of Susquehanna Steam Electric Station Units 1 and 2* in June 1981. The NRC concluded that the action called for under NEPA and 10 CFR Part 51 was the issuance of operating licenses for Unit 1 and Unit 2 of the SSES (NRC 1981). The NRC subsequently issued licenses to SSES in 1982 (Unit 1) and 1984 (Unit 2) authorizing operation up to a maximum power level of 3,293 MWt per unit (Scientech 2005).

In 1994 (Unit 2) and 1995 (Unit 1), a 4.5 percent stretch uprate was implemented, increasing the licensed thermal power level of SSES Units 1 and 2 from 3,293 to 3,441 MWt. The NRC published Environmental Assessments in the Federal Register on March 18, 1994 (Unit 2) and January 13, 1995 (Unit 1) concluding that the uprate "...would have no significant impact on the quality of the human environment", and resulting in a Finding of No Significant Impact (Federal Register, Vol. 59, No. 53, pp. 12990-12992; Vol. 60, No. 9, pp. 3278-3280).

A Measurement Uncertainty Recapture (MUR) uprate of 1.4 percent, implemented in 2001, increased the licensed thermal power level of SSES Units 1 and 2 to 3,489 MWt. The NRC's Environmental Assessment of this uprate concluded that "...the proposed action will not have a significant effect on the quality of the human environment" and resulted in a Finding of No Significant Impact (Federal Register, Vol. 66, No. 122, pp. 33716-33717).

This Supplemental Environmental Report is intended to provide sufficient detail on both the radiological and non-radiological environmental impacts of the proposed EPU to allow NRC to make an informed decision regarding the proposed action.

3.0 PROPOSED ACTION AND NEED

SSES is located in Salem Township, Luzerne County, Pennsylvania on the Susquehanna River (Figure 3-1). The largest community within 10 miles is the borough of Berwick, Pennsylvania located approximately five miles southwest of SSES (PPL 2004a). PPL Susquehanna owns about 2,355 acres on both sides of the Susquehanna River. SSES is located on the west bank of the Susquehanna River on 1,574 acres that include the SSES property (1,173 acres) west of U.S. Route 11 and the Susquehanna Riverlands Recreation Area (401 acres) between U.S. Route 11 and the river (Fields 2005a). The Susquehanna Riverlands Recreation Area is a strip of land between the power generating facilities and the Susquehanna River that includes natural and recreational areas (PPL 2005a). Gould Island, a 65-acre island that lies just upstream of the Susquehanna Riverlands, is also owned by PPL Susquehanna. Land on the west side of the river and Gould Island are co- owned with Allegheny Electric Cooperative (10 percent). PPL Susquehanna also owns 717 mostly-undeveloped acres on the east side of the river including Council Cup, an 88-acre, 700-foot-high bluff that overlooks the Susquehanna River Valley (Fields 2005a; PPL 2005a).

SSES is a two-unit plant with boiling water reactors and generators supplied by General Electric (GE). Bechtel Corporation was the architect-engineer and construction contractor (PPL 2004a). Construction permits for Units 1 and 2 were issued on November 2, 1973. NRC approved the Unit 1 operating license (NPF-14) on July 17, 1982; commercial operation began June 8, 1983. NRC approved the Unit 2 operating license (NPF-22) on March 3, 1984; commercial operation began February 12, 1985 (Scientech 2005). The original steam turbines supplied by GE were replaced by Siemens-Westinghouse units in 2003 (Unit 2) and 2004 (Unit 1) (PPL 2005b; NEI 2003).

3.1 PROPOSED ACTION

The proposed action is to increase the licensed core thermal power level of SSES Units 1 and 2 from 3,489 MWt up to 3,952 MWt per unit, which represents an increase of approximately 14 percent of the original licensed core thermal power level. This is part of a total increase of 20 percent above the original licensed reactor power level of 3,293 MWt. This change in core thermal power level will require NRC to amend the facility's operating licenses. The EPU will add an average increase of 205 MWe (2 units) of base load generation to the interconnection grid.

PPL Susquehanna intends to increase the power level in two phases. The core thermal power level of Unit 2 will be increased by approximately 7 percent during the spring 2007 refueling outage and the remaining 7 percent during the spring 2009 refueling outage. Unit 1's core thermal power level will also be increased in two stages of about 7 percent each during the spring 2008 and spring 2010 refueling outages.

3.2 NEED FOR ACTION

SSES is located within the transmission area controlled by PJM Interconnection, L.L.C. (PJM). PJM is a regional transmission organization that plans generation and transmission expansion to ensure reliability, coordinates the movement of electricity through the system, and operates a competitive wholesale electricity market by matching the sale of electricity between generators and end users. Recently PJM expanded its area of responsibility and currently serves a 164,260-square-mile territory in all or parts of 13 states and the District of Columbia (PJM 2005). There are about 163,806 MWe of generating capacity within this area. PJM uses a queue system to keep track of requests to add or remove generation from the system PJM manages. The order of application for a queue position is used to determine the order of generation system impacts and responsibility for paying for mitigation of any adverse impacts.

The application for the SSES EPU generating capacity increases was placed in the queue on May 19, 2004. The Interconnection Service Agreements and Construction Service Agreements were signed for Unit 2 on July 7, 2005 and for Unit 1 on January 20, 2006. The Construction Service Agreements include the need for system mitigation (switchyard modifications) identified by the PJM. Switchyard modifications include the addition of capacitor banks are listed in Attachment 7, List of Planned Modifications and installation schedules are listed in Attachment 8, Startup Testing. Over the next 10 years, PJM is forecasting that the summer unrestricted peak load within the PJM Mid-Atlantic geographic zone where SSES is located will grow at an annual average rate of 1.8 percent. This represents an increase in peak load of almost 6,000 MWe between 2005 and 2010 when the EPU at SSES is completed. PJM uses the information on planned generation additions from the queues to project the reserve adequacy in the future based on the projected load growth. Through 2010, PJM projects reserves being just above the reserve required based on the current information.

The EPU at SSES is expected to produce additional generation for use in the PJM system at a cost lower than the projected market price. The EPU will add an average 205 MWe of base load generation to the grid from both units. The added electricity should be enough to meet the power needs of about 195,000 homes.

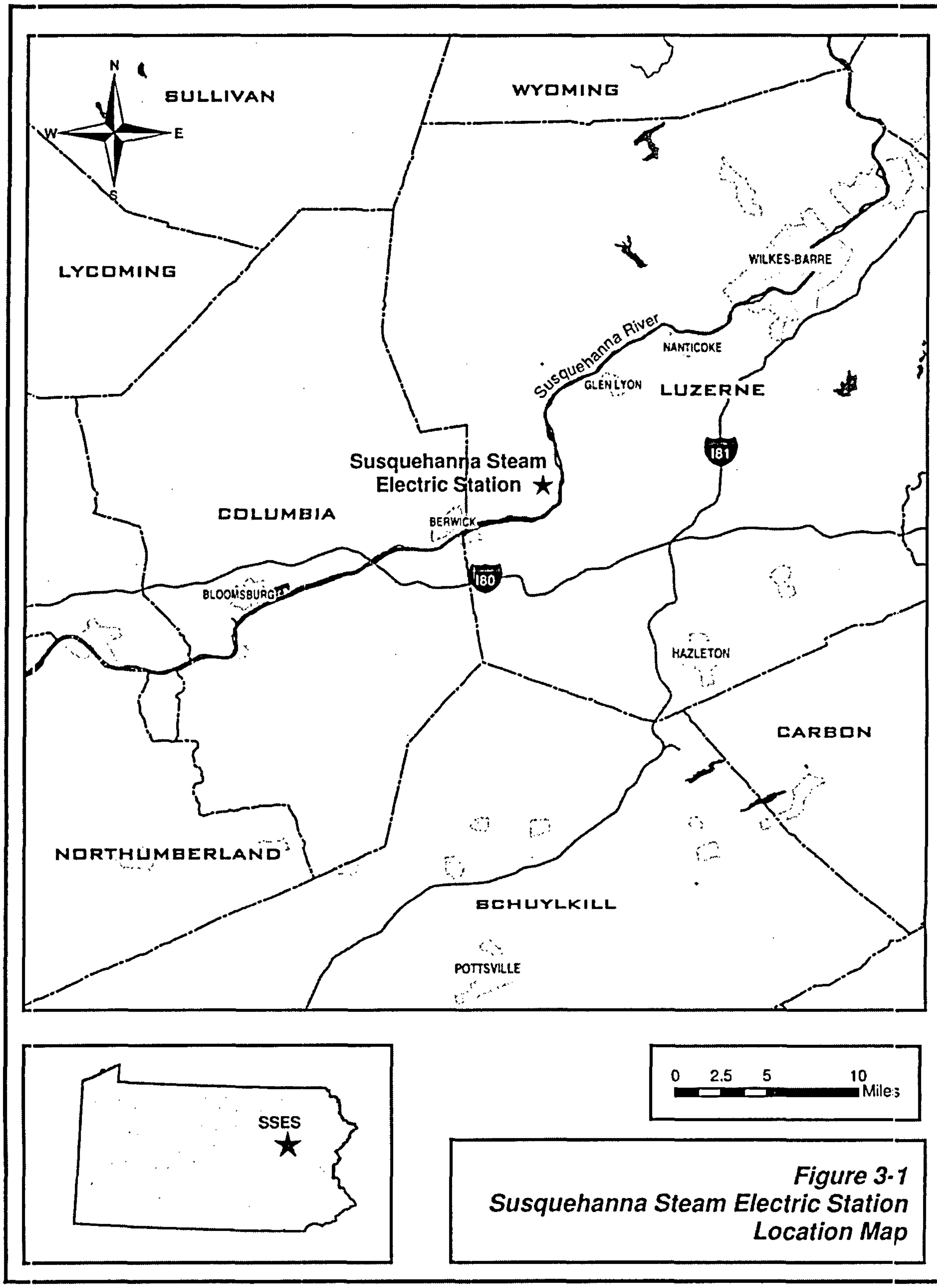

Figure 3-1
Susquehanna Steam Electric Station Location Map

4.0 OVERVIEW OF OPERATIONAL AND EQUIPMENT CHANGES

PPL Susquehanna proposes to uprate the power of the two SSES units in a phased manner over an approximately four-year period during normal refueling outages. Unit 2 modifications would generally lead Unit 1 modifications, with most of the Unit 2 work performed in Spring 2007, resulting in an uprate of approximately 7 percent. The majority of Unit 1 modifications would occur in Spring 2008, also resulting in an uprate of approximately 7 percent. Each unit's next refueling outage (Unit 2, Spring 2009 and Unit 1, Spring 2010) would result in an uprate of about 7 additional percent for a total of approximately 14 percent. Attachment 7 identifies the major modifications planned for the EPU and Attachment 8, Table 2, Modifications List, provides the refueling outage and date when these modifications would be installed.

The activities needed to produce thermal power increases are a combination of those that directly produce more power and those that must accommodate the effects of the power increase. More highly enriched uranium is generally needed to maintain existing cycle lengths operating at a higher power level. The primary means to achieve more power includes using a more uniform power distribution combined with improved fuel management techniques allowing increased steam and feedwater flow rates. Other changes include various electrical upgrades to accommodate the higher currents and to improve electrical grid stability, modifications to accommodate greater steam and feedwater flow rates, and instrumentation upgrades that include replacing parts, changing setpoints, and modifying software.

These modifications constitute planned actions on the part of PPL Susquehanna. Further evaluations may identify the need for additional modifications or, on the contrary, obviate the need for some modifications. Additionally, various minor modifications and adjustments to plant equipment may be necessary, and they are not listed.

5.0 SOCIOECONOMIC CONSIDERATIONS

The proposed EPU at SSES would provide economic benefits to the communities and school districts in Luzerne and Columbia counties through local business revenues generated by station's extended power uprate and continued gainful employment opportunities for the local population.

5.1 CURRENT SOCIOECONOMIC STATUS

Currently SSES employs approximately 1,200 full-time staff, 89 percent of whom live in Luzerne or Columbia Counties, and up to approximately 260 contract employees. During outages, approximately 1,400 personnel provide additional support. Through income, sales, and personal property taxes, employees' salaries contribute to the surrounding communities and have a positive influence on the economies of the region. Additionally, real estate property taxes paid by SSES to the Berwick Area School District (BASD), Salem Township, and Luzerne County are substantial. Table 5-1 presents information summarizing taxes SSES paid to the BASD, Luzerne County, and Salem Township for years 2000 through 2004.

In 1996, the Commonwealth of Pennsylvania changed the way it distributed real estate tax revenues from utilities to taxing jurisdictions. The Electricity Generation Customer Choice and Competition Act became law, which allowed consumers to choose among competitive generation suppliers. Prior to 1996, 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. As a result, beginning January 1, 2000, PPL Susquehanna began paying real estate taxes directly to local taxing jurisdictions, ceasing payments to the Commonwealth's PURTA fund.

Communities surrounding SSES have benefited and will continue to benefit from various local taxes paid by SSES and its employees.

Table 5-1. Susquehanna Steam Electric Station Tax Information 2000-2004

Year	Berwick Area School District (BASD)			Luzerne County			Salem Township		
	BASD Annual Revenues	Real Estate Tax Paid to BASD by SSES	Tax paid by SSES as Percent of BASD Revenues	Real Estate Tax Collected	Real Estate Tax Paid to Luzerne County by SSES	Real Estate Tax paid by SSES as Percent of Luzerne Tax Collected	Salem Township Real Estate, Municipal, and Street Light Tax Collected	Taxes Paid to Salem Township by SSES	Tax paid by SSES as Percent of Township Tax Collected
2000	$28,992,654 [a] (2000-2001)	$1,602,850 (2000-2001)	5.5	$47,635,994[b]	$1,128,775	2.4	NA[e]	NA[e]	NA[e]
2001	$30,888,277 [a] (2001-2002)	$1,703,022 (2001-2002)	5.5	$60,024,566[b]	$1,135,552	1.9	$123,480[f]	$62,140	50.3
2002	$28,543,127[a] (2002-2003)	$1,905,304 (2002-2003)	6.7	$60,643,642[b]	$1,135,552	1.9	$123,480[f]	$62,140	50.3
2003	$31,724,705 [c] (2003-2004)	$1,906,035 (2003-2004)	6.0	$61,285,895[d]	$1,111,857	1.8	$123,480[f]	$62,140	50.3
2004	$34,059,674[c] (2004-2005)	$2,365,363 (2004-2005)	6.9	$68,540,477[d]	$1,219,079	1.8	$118,626[g]	$63,895	53.9

Note: Between years 2003 and 2004 there was a 24 percent increase in the BASD tax.

a. BASD 2003
b. Luzerne County 2002
c. Martz 2005
d. Allabaugh 2005
e. Year 2000 numbers are not applicable for Salem Township.
f. Fields 2005b
g. Sampson 2005

5.2 EXTENDED POWER UPRATE IMPACTS TO SOCIOECONOMICS

The proposed EPU is not expected to change the size of the SSES workforce and would not have a permanent effect on the size of the labor force required for future refueling outages. However, there would be positive economic benefits to the local economy. Employee income, sales, and personal property taxes would continue to contribute to the communities surrounding the plant. The assessed value of SSES's real estate would continue to contribute to tax revenues for the surrounding taxing jurisdictions. Personal property value increase usually will not affect assessed value on real estate tax values unless the additional income approach to value would be extremely appreciated. In addition, engineering and consulting firms, equipment suppliers, and service industries would receive payments for EPU related work. The direct revenue associated with EPU implementation would not be sustained once modifications are complete. Because no new hires are expected, and because of the duration of the project, there are no expected impacts to housing, population, employment, or demands on public services. However, the economic benefits associated with the EPU would represent a positive impact on the regional economy, both in terms of the one-time benefit of EPU installation and in the long-term viability of operating SSES.

5.3 ENVIRONMENTAL JUSTICE

The NRC "Procedural Guidance for Preparing Environmental Assessments and Considering Environmental Issues" defines a minority population as: American Indian or Alaskan Native; Asian; Native Hawaiian or other Pacific Islander; Black Races; all other single races; multi-racial; and Hispanic ethnicity (NRC 2001, Appendix D). The guidance indicates that a minority population exists if the minority population percentage in the census block group or environmental impact site exceeds 50 percent, or is significantly greater (typically at least 20 percentage points) than the minority population percentage in the geographic area chosen for comparative analysis.

PPL Susquehanna defines the geographic area for SSES as the Commonwealth of Pennsylvania. NRC guidance calls for using the most recent U.S. Census Bureau (USCB) decennial census data. PPL Susquehanna used 2000 census data to determine the percentage of the total population in Pennsylvania for each minority category, and to identify minority populations within 50 miles of SSES.

For each of the 1,493 block groups within 50 miles of SSES, PPL Susquehanna compared the minority percentage to the corresponding geographic area's minority threshold percentages to determine whether minority populations exist. USCB data for Pennsylvania characterizes 0.15 percent of the Commonwealth as American Indian or Alaskan Native, 1.79 percent as Asian, 0.03 percent as Native Hawaiian or other Pacific Islander, 9.97 percent as Black Races, 1.53 percent as all other single minorities, 1.16 percent as multi-racial, 14.63 percent as an aggregate of minority races, and 3.21 percent as Hispanic ethnicity (USCB 2000).

No census blocks within the 50-mile radius had American Indian or Alaska Native, Asian, Native Hawaiian or Pacific Islander, or multi-racial minority populations that exceeded the State average by 20 percent or more. Eleven census blocks within the 50-mile radius have Black Races populations that exceed the state average by 20 percent or more. None of those 11 census blocks has a Black Races population of 50 percent or more. Twenty-one census blocks within the 50-mile radius, all in Lehigh County, have all other single minority populations that exceed the state average by 20 percent or more. None exceeds the 50 percent criterion. Fifty-four census blocks within the 50-mile radius have aggregate minority populations that exceed the state average by 20 percent or more. Of those, 27 have aggregate minority populations of 50 percent or more. Forty census blocks within the 50-mile radius, all in Lehigh County, have Hispanic Ethnicity populations that exceed the state average by 20 percent or more. Of those, eight have Hispanic Ethnicity populations of 50 percent or more (USCB 2003). PPL Susquehanna's community outreach has identified small yet growing Hispanic populations in the Hazleton, Bethlehem, and Berwick areas. Generally speaking, there are relatively few census blocks exceeding the threshold for minority population within a 50-mile radius and none within 5 miles of the station.

NRC guidance defines low-income based on statistical poverty thresholds (NRC 2001, Appendix D). PPL Susquehanna divided the number of USCB low-income households in each census block group by the total households in that block group to obtain the percentage of low-income households per block group. USCB data (USCB 2004) characterize 11.0 percent of Pennsylvania households as low-income households. A low-income population is considered to be present if the percentage of households below the poverty level in the census block group or the environmental impact site exceeds 50 percent or is significantly greater (typically at least 20 percentage points) than the low-income households percentage in the geographic area chosen for comparative analysis.

Fifty census blocks within the 50-mile radius have low-income households that exceed the state average by 20 percent or more. Of those 50 census blocks, 7 have 50 percent or more low-income households. Again, there are relatively few census blocks exceeding the threshold for low-income populations within a 50-mile radius, and none within 5 miles of the station.

5.4 CONCLUSION

The socioeconomic impacts of implementing the EPU at SSES would be positive. Maintaining SSES as a reliable employer, a tax paying entity, and a source of electrical power contributes a measure of stability and of prosperity to the local economy.

6.0 COST-BENEFIT ANALYSIS

The EPU at SSES would provide an additional 205 MWe of base load generating capacity. The cost-benefit analysis for determining whether or not to proceed with the EPU at SSES was based on a comparison of the projected market price and the projected cost of producing more power from SSES. The projected market price was used for comparison because the PJM System operates a competitive wholesale electricity market by matching the sale of electricity between generators and end users. Other companies are making similar analyses to determine whether or not to pursue generation addition options available to them causing the market price to reflect the lowest cost options available. As a result, by having projected costs lower than the projected market price, the EPU at SSES demonstrated that it was among the lower cost options available.

Nuclear power plants, such as SSES, do not emit sulfur dioxide, nitrogen oxides, carbon dioxide or other atmospheric pollutants from their nuclear units. As a result, the SSES EPU would not contribute to greenhouse gases or acid precipitation. SSES does have a PaDEP air quality permit to operate emergency and backup diesel generators. Many of these sources are part of station safety systems and are only operated infrequently. Operation of diesel generators during EPU is expected to be the same or similar to the present. Air emissions from these sources are minimal compared with alternative gas- and coal-fired generating stations.

There would be a small increase in the generation of spent nuclear fuel. The added spent fuel will be stored in SSES's currently licensed storage facilities with future potential for disposal at a federal repository.

The discussion above leads to the conclusion that the SSES EPU provides a cost competitive advantage over other options to provide additional generation. Furthermore, EPU produces little environmental impact making it a preferred option for providing additional generation.

7.0 NON-RADIOLOGICAL ENVIRONMENTAL IMPACTS

7.1 TERRESTRIAL EFFECTS

7.1.1. Land Use

The proposed EPU would not affect land use at the 2,355-acre (approximate) SSES site or in adjoining areas of Luzerne County. No new construction is planned outside of existing facilities and no expansion of buildings, roads, parking lots, equipment storage areas, or transmission facilities would be required to support the EPU with three exceptions. The Turbine Building may be expanded for installation of condensate filters. Both the 230 KV switchyard across the river from the station located on PPL Electric Utilities property and the SSES's 500 KV switchyard will be expanded due to the addition of capacitor banks. The site road adjacent to the 500 KV switchyard would be moved to accommodate the expansion. The EPU is not expected to require substantial additional volumes of industrial chemicals, fuels, or lubricants. Additional aboveground storage tanks may be required to support Cooling Tower basin acid injection, but if built these tanks would be located in the developed part of the site. No additional Cooling Tower capacity is planned to accommodate the EPU.

As discussed in Section 5.2, the EPU would not affect the size of the workforce at SSES. Because no land disturbance would be required outside the power block area and because there would be no expansion of the existing workforce, impacts to aesthetic resources and historic/archeological resources would be negligible. The conclusions of the 1981 FES for operation with respect to land use, aesthetics, and historic/archeological resources remain valid for the EPU.

7.1.2 Transmission Facilities

<u>Transmission Lines</u>

As listed in Attachments 7 and 8, PPL Susquehanna intends to install capacitor banks (200 MegaVar (MVAR)) in the 500 and 230 KV switchyards as part of the EPU. The 200 MVAR capacitor banks will be installed in accordance with PPL Electric Utility substation design/modification procedures. A power delivery environmental risk identification evaluation will be conducted prior to installation. Any potential oil leaks from these capacitor banks will be collected and should not leak from the site. This is the only major modification of transmission facilities that is planned. The EPU would not require any new transmission lines and would not require changes in the maintenance and operation of existing transmission lines, switchyards, or sub-stations. Right-of-way maintenance practices (including vegetation management) would not be affected by the

EPU. The only operational change from EPU would be increased current. PPL Electric Utilities has evaluated all related transmission facilities and found these facilities to be within acceptable design parameters. Voltage would be unchanged.

Shock Hazards

Power uprate should not increase the probability or magnitude of shock from primary or secondary currents because there would be no change in voltage. Increased current may cause transmission lines to sag more, but adequate clearance between energized conductors and the ground would prevent electrical shock to ecological receptors. Transmission lines are designed in accordance with the applicable shock prevention provisions of the National Electric Safety Code®.

Electromagnetic Fields (EMF)

The increased electrical power output would cause a corresponding current rise on the transmission system and this would result in an increased magnetic field. PPL Susquehanna adopts by reference the NRC conclusion that chronic effects of EMF on humans are not quantified at this time and no significant impacts to terrestrial biota have been identified (NRC 1996).

7.1.3 Miscellaneous Wastes

PPL Susquehanna evaluated a number of plant systems and associated (non-radiological) discharges for potential effects from the proposed EPU. Discharge limits for systems such as building drains and outside area low-volume sumps (e.g., Service and Administration Building, Turbine Building (Units 1 and 2) and the sewage treatment plant are set in the station's National Pollutant Discharge Elimination System (NPDES) permit. Discharges from these systems are not expected to change under EPU conditions; therefore, the impact on the environment would not change. Non-radiological discharges would remain within the bounding conditions established in the NPDES permit, and as a consequence no significant impacts will result from the operation of SSES under EPU conditions.

SSES generates both hazardous and non-hazardous wastes. They are handled and disposed of properly as part of the station's waste management program. SSES is a large quantity generator of hazardous waste. It generates wastes such as batteries, paint thinners, solvents, and corrosives. In addition, non-hazardous wastes such as trash, maintenance wastes, wood, and non-friable asbestos are managed in the station's program. Plant modifications may generate additional small amounts of hazardous and non-hazardous wastes. Both will be managed under the existing waste management program, which is designed to minimize the amount of hazardous waste generated and encourage recycling whenever possible. SSES is committed to recycling paper, glass, cardboard, waste oil, and plastic. Additional recyclables generated from EPU modifications should also be minimal.

7.1.4 Noise

The FES for operation of SSES (NRC 1981) evaluated potential noise impacts of operation of the station; it indicated that the station's Cooling Towers and large pumps and motors of the cooling water system (e.g., four makeup water pumps in river intake structure) would be the most significant sources of noise. The FES predicted that pump and motor noise would not exceed ambient (baseline) levels in offsite areas and that Cooling Tower noise would be audible (exceeding ambient levels) for no more than a mile offsite to the west, southwest and southeast of the station (NRC 1981). The NRC concluded that "...noise emissions during station operation will not cause other than minor nuisance problems" with the possible exception of a small area 670 to 915 meters southwest of the station where the noise level was projected to be 56 dBA. This estimate was slightly higher than the noise level (55 dBA) the U.S. Environmental Protection Agency (EPA) had suggested as a threshold level to protect against interference with outdoor activity (EPA 1974). It should be noted, however, that the EPA stipulated that the document was informational and did "not constitute a standard, specification, or regulation" (EPA 1974). It was, rather, intended to provide a basis for state and local governments establishing noise standards.

Noise surveys were performed in 1985 after commercial operation of both units began (Wood and Barnes 1986) and in 1995 following the stretch uprate (Wood and Barnes 1995). The June 1995 noise measurements were similar to those reported in 1985, and no noise complaints were received following the stretch uprate. The 1995 noise survey concluded that no additional noise mitigation was needed (Wood and Barnes 1995).

The EPU, like the stretch uprate, would not produce measurable changes in the character, sources, or intensity of noises generated by the station's Cooling Tower makeup pumps or circulating water pumps, nor would it change noise levels associated with the station's Cooling Towers. Most of the equipment necessary to implement power uprate would be installed within or upon existing buildings at SSES. No significant increase in ambient noise levels is expected inside or outside of the Station. The FES conclusions for noise levels and noise impacts remain valid for EPU conditions.

7.1.5 Terrestrial Biota

Natural communities at SSES consist of river floodplain forest, upland forest, and marshes. The river floodplain forest at SSES is dominated by silver maple, river birch, and Northern red oak. The upland forest is dominated by Virginia pine, sweet birch, flowering dogwood, white oak, Northern red oak, black oak, and yellow poplar. The marsh is dominated by a variety of emergent vegetation such as sedges, bulrush, cattail, and cutgrass (NRC 1981). The SSES property includes the Susquehanna Riverlands, a 401-acre nature preserve on the west side of the Susquehanna River used for outdoor recreation, environmental education, and wildlife habitat. The National Audubon Society has designated the Susquehanna Riverlands as an Important Bird Area in Pennsylvania because of the extensive riparian forests and the numerous bird species that use the area. Additional natural, recreational, and wildlife lands (approximately 275 acres) are found on the east side of the river. The FES for operation (NRC 1981) contains detailed descriptions of the plant communities at SSES and the animals that are associated with them.

Direct observations and a review of databases maintained by the U.S. Fish and Wildlife Service (FWS 2004) and the Pennsylvania Natural Heritage Program (PDCNR 2004, 2005) indicate that several animal and plant species that are state- or federally-listed as endangered or threatened occur in counties where SSES and its associated transmission lines are located (Table 7-1).

Four species in Table 7-1 are federally-listed as endangered or threatened. Indiana bats (*Myotis sodalis*), which are federally endangered, hibernate in Luzerne County (FWS 2004). Bog turtles (*Clemmys muhlenbergii*), federally threatened, occur in Lehigh and Northampton counties. Bald eagles, federally-listed as threatened, nest in Northumberland County. Populations of the Northeastern bulrush (*Scirpus ancistrochaetus*), federally endangered, are known to be in Carbon and Lehigh counties (FWS 2004).

In addition to the Indiana bat, state-listed mammals in counties crossed by the transmission lines are the Eastern woodrat (*Neotoma magister*), the small-footed myotis (*Myotis leibii*), and the Eastern fox squirrel (*Sciurus niger vulpinus*) (PDCNR 2004). In addition to the Northeastern bulrush, state-listed plants recorded in counties crossed by the transmission lines are the variable sedge (*Carex polymorpha*), wild bleeding-hearts (*Dicentra eximia*), crested dwarf iris (*Iris cristata*), matted spike-rush (*Eleocharis intermedia*), Torrey's rush (*Juncus torreyi*), Carey's smartweed (*Polygonum careyi*), jeweled shooting star (*Dodecatheon radicatum*), and spreading globeflower (*Trollius laxus laxus*) (PDCNR 2004, 2005).

The Susquehanna River and riparian wetlands near the river at SSES are used by several special-status bird species, especially during autumn and spring migrations. Ospreys (*Pandion haliaetus*) and bald eagles (*Haliaeetus leucocephalus*) have become relatively common along the river near SSES during migrations and bald eagles winter along the Susquehanna River in Luzerne and Columbia counties (Ecology III 1995). Peregrine falcons (*Falco peregrinus*), short-eared owls (*Asio flammeus*), American bitterns (*Botaurus lentiginosus*), least bitterns (*Ixobrychus exilis*), and great egrets (*Ardea alba*) are occasionally observed in undeveloped portions of SSES. The sedge wren (*Cistothorus platensis*), upland sandpiper (*Bartramia longicauda*), and black tern (*Chlidonias niger*) have each been recorded only once at SSES (Ecology III 1995). None of the bird species listed in Table 7-1 is known to nest at SSES (Ecology III 1995). Osprey nests have been recorded in Luzerne, Carbon, and Northampton counties, and the upland sandpiper is known to nest in Northumberland County (PDCNR 2004).

Because the EPU would not involve land disturbance, a measurable increase in noise levels outside the Plant, an increase in the size of the SSES workforce, or changes in the right-of-way maintenance practices, there would be no impacts to terrestrial biota (including threatened or endangered species) beyond those described in the FES for operation.

Table 7-1. Endangered and Threatened Species that Occur in the Vicinity of SSES or in Counties Crossed by SSES Transmission Lines[a].

Scientific Name	Common Name	Federal Status[b]	State Status[b]
Mammals			
Neotoma magister	Eastern woodrat	-	T
Myotis sodalist	Indiana bat	E	E
Myotis leibii	Small-footed myotis	-	T
Sciurus niger vulpinus	Eastern fox squirrel	-	T
Birds			
Asio flammeus	Short-eared owl	-	E
Bartramia longicauda	Upland sandpiper	-	T
Botaurus lentiginosus	American bittern	-	E
Casmerodius alba	Great egret	-	E
Chlidonias niger	Black tern	-	E
Cistothorus platensis	Sedge wren	-	T
Falco peregrinus	Peregrine falcon	-	E
Haliaeetus leucocephalus	Bald eagle	T	E
Ixobrychus exilis	Least bittern	-	E
Pandion haliaetus	Osprey	-	T
Reptiles			
Clemmys muhlenbergii	Bog turtle	T	E
Plants			
Carex polymorpha	Variable sedge	-	E
Dicentra eximia	Wild bleeding-hearts	-	E
Dodecatheon radicatum	Jeweled shooting star	-	T
Eleocharis intermedia	Matted spike-rush	-	T
Iris cristata	Crested dwarf iris	-	E
Juncus torreyi	Torrey's rush	-	T
Polygonum careyi	Carey's smartweed	-	E
Scirpus ancistrochaetus	Northeastern bulrush	E	E
Trollius laxus stricto	Spreading globeflower	-	E

a. Counties crossed by the transmission line: Luzerne (the location of SSES), Carbon, Columbia, Lehigh, Northampton, Northumberland, Montour, and Snyder.
b. E = Endangered; T = Threatened; - = Not listed.

7.2 HYDROLOGY

7.2.1 SSES Cooling Water System

At SSES, the River Water Make-up System provides water to the Circulating Water and Service Water Systems via the Cooling Tower basins. Blowdown from these systems discharge to the Susquehanna River through the basins into a common discharge structure downstream of the intake structure. SSES employs a closed-cycle, Cooling Tower based heat dissipation system to remove waste heat from the condensers. The cooling water River Intake Structure, located on the west bank of the Susquehanna River, houses four 13,500 gallon-per-minute (gpm) intake pumps (NRC 1981). Station load operation (100 percent power) of both units can usually be supported by three pumps, which equates to an intake flow of approximately 40,500 gpm (NRC 1981; PP&L 1994). At certain times of the year, the fourth intake pump is rotated into service. EPU will increase the amount of time that the fourth pump is used. The 30-day average consumptive use is expected to increase from approximately 38 million gallons per day (MGD) to 44 MGD with EPU.

Following EPU, water will be withdrawn from the Cooling Tower basins, circulated through the main condensers, and returned to the Cooling Towers at the rate of 968,000 gpm (484,000 gpm per tower). Cooling Tower blowdown will be discharged at a rate of 11,200 gpm via the underground diffuser system which includes a submerged diffuser pipe located on the bottom of the Susquehanna River (Fields 2005b). Warm circulating water from the Cooling Towers can be diverted to the intake structure in winter to prevent icing. This deicing system generally operates from November through March.

An 8-acre lined concrete spray pond (Figure 7-1), containing 25 million gallons of water, is the station's ultimate heat sink for the Engineered Safeguard Service Water System. This pond provides auxiliary cooling and supplies cooling water for the diesel generators and the residual heat removal service water system. Makeup water for the spray pond is supplied by the River Water Makeup System (PPL 2004a).

Groundwater usage from the SSES well system should not be affected by EPU. Well system usage has averaged approximately 94,000 gallons per day.

7.2.2 Discharges

Liquid effluents (including Cooling Tower blowdown, the spray pond overflow, and liquid radwaste treatment effluents) are discharged to the Susquehanna River through a common discharge structure, approximately 600 feet downstream of the intake structure (Figure 7-1). The discharge consists of a buried pipe leading to a submerged discharge structure/diffuser located on the river's bottom. The diffuser pipe is 200 feet long; the last 120 feet has 72 four-inch portals facing downstream designed to direct the discharge upward at a 45 degree angle. The end of the pipe has a steel plate that can be removed for periodic cleaning of the diffuser (NRC 1981). The station's treated sewage plant effluent discharges to the Susquehanna River through a concrete outfall structure located between the river intake and discharge structures.

Surface water and wastewater discharges at SSES are regulated by the Commonwealth of Pennsylvania. The NPDES permit is periodically reviewed and re-issued by the Pennsylvania Department of Environmental Protection. The current NPDES permit (PA-0047325), was effective September 1, 2005 and expires on August 31, 2010, and limits Free Available Chlorine (daily maximum of 0.2 mg/L), Total Zinc (daily maximum of 1.0 mg/L), and Total Chromium (daily maximum of 0.2 mg/L) in Cooling Tower blowdown. Other outfalls have limits on pH, Total Suspended Solids, oil and grease, and fecal coliform bacteria (Sewage Treatment Plant).

The SSES NPDES permit contains no discharge temperature limits, per se, but discharges must adhere to state water quality standards for waters designated "WWF" (warm water fishes). Water quality standards for WWF waters are intended to ensure the "maintenance and propagation of fish species and additional flora and fauna which are indigenous to a warm water habitat" (Section 93.3 of Pennsylvania Water Quality Standards).

The highest temperature allowed under the water quality standards for waters designated "WWF" is 87°F over the July 1-August 31 timeframe (Section 93.7 of Pennsylvania Water Quality Standards). Maximum allowable temperatures at other times of the year are considerably lower, as low as 40°F over the January 1 - February 29 period. The dissolved oxygen standards for waters designated WWF are 5.0 mg/L (minimum daily average) and 4.0 mg/L (instantaneous minimum) (Section 93.7 of Pennsylvania Water Quality Standard).

There would be no major changes in Cooling Tower chemistry as a result of the EPU. The current cycles of concentration generally range from 3 to 5 (summer and winter, respectively) and would be maintained. Because there would be a small increase (from 10,800 to 11,200 gpm) in blowdown flow when the uprate is implemented, there could be an equivalent increase in amounts of chemicals discharged to the river. The composition and concentration of constituents in Cooling Tower blowdown would continue to be governed by the station's NPDES permit.

7.2.3 Entrainment and Impingement

As discussed previously, the EPU would not require major modifications to SSES plant systems that directly or indirectly affect the Susquehanna River. The amount of water withdrawn from the Susquehanna River for Cooling Tower makeup and other plant needs would increase slightly, from approximately 40,500 (PP&L 1994) to 42,300 gpm (Fields 2005b). This represents an increase of approximately 4.4 percent. Assuming a direct relationship between the volume of water pumped from the Susquehanna River and the number of fish impinged and entrained, an increase of 4.4 percent in impingement and entrainment rates would be expected under uprate conditions.

PPL Susquehanna (then operating as PP&L) conducted an evaluation of potential impingement and entrainment losses associated with a small (4.5 percent) stretch uprate in 1994. The analysis showed that increasing river water withdrawal from approximately 39,100 gpm to approximately 40,500 gpm, a 3.6 percent increase, would increase impingement by one fish per day (from 20 to 21) and entrainment by 13,000 larvae per day (from 350,000 to 363,000) during spawning periods (PP&L 1994). The NRC, in its Environmental Assessments of the stretch uprates for Units 1 and 2 noted that losses of this magnitude "represent a negligible impact to the river ecosystem" (Federal Register, Vol. 59, No. 53, pp. 12990-12992; Vol. 60, No. 9, pp. 3278-3280).

The additional 4.4 percent increase in river water withdrawal expected under EPU conditions would result in the impingement of approximately one more adult/juvenile fish per day (22 total) and 15,972 more fish larvae per day (from 363,000 to 378,972) during spawning seasons would be entrained. Again, these changes are very small relative to the number of adult and juvenile fish in the Susquehanna River in the vicinity of SSES. This would have no discernible impact on local fish populations.

Based on the fact that SSES's four river water makeup pumps are designed to pump up to 54,000 gpm, the station is subject to the EPA's Final Rule to Establish Regulations for Cooling Water Intake Structures at Phase II Existing Facilities (Federal Register, Volume 69, Number 131, July 9, 2004). This Final Rule establishes impingement and entrainment "performance standards" for large, baseload generating facilities like SSES with a design intake flow of 50 million gallons per day (MGD) or more. When all four river intake pumps are taken into consideration, SSES's design intake flow is approximately 78 MGD.

The Final Rule notes (page 41601) that "Under [Title 40 CFR] Section 125.94(a)(1)(I) any facility that reduces its flow to a level commensurate with a closed-cycle, recirculating system meets the performance standards in today's rule because such a reduction in flow is deemed to satisfy any applicable impingement mortality and entrainment performance standards for all waterbodies." SSES employs a closed-cycle, recirculating cooling water system that uses roughly 5 to 10 percent of the cooling water that a once-through plant of the same size would use (see Federal Register, Volume 69, Number 131, July 9, 2004, page 41601, footnote 44). Impingement and entrainment losses are therefore small in both absolute and relative terms (to a once-through plant) and would continue to be small when EPU is implemented.

7.2.4 Thermal Discharge Effects

The NRC conducted a detailed analysis of blowdown plume characteristics in its FES for operation (NRC 1981). The analysis considered river flows in winter (December), early summer (June), and late summer (August) and evaluated both mean flows and the seven-day 10-year (7Q10) low flows. The analysis assumed a circulating water flow rate of 478,000 gpm/unit and a diffuser (blowdown) flow rate of 10,000 gpm, which are in reasonable agreement with the current circulating water flow rate of 484,000 gpm and diffuser flow rate of 10,800 gpm. The NRC also assumed a small mixing zone (120 feet wide, the width of the diffuser, and less than 200 feet long), which, presumably, accounts for the plume prior to its surfacing. The NRC found that, for a blowdown temp of 91.8°F (August), a river temperature of 85°F, and 7Q10 river flow the temperature rise at 115 feet downstream of the diffuser would be 0.9°F. This translates into a plume temperature of 85.9°F (NRC 1981, Table 4.1). This is well within the 87°F state water quality standard for industrial discharges, despite conservative assumptions. Actual operating experience has shown blowdown temperatures to be lower than 91.8°F in late summer and river temperatures to be lower than 85°F.

PPL Susquehanna has also made conservative assumptions in estimating blowdown temperatures under EPU conditions. The conservative blowdown and river temperatures that were used in the NRC's original analysis were used in this analysis. The presumption is that the FES analysis is still applicable (and conservative) with respect to current plant operations. It was estimated that for wet bulb temperatures around the design point (the region of interest vis-à-vis maximum blowdown temperatures), the blowdown temperature would increase (uprate versus present conditions) by less than 2°F (the increase lessening as the wet bulb/water temperature increases).

Assuming a blowdown temperature increase of 2.0°F (corresponding to the conditions at which the present operations blowdown temperature is 91.8°F as assumed in the FES), to 93.8°F, under EPU conditions, then plume temperature rise at the end of the mixing zone can be approximated by applying the NRC's (NRC 1981, Table 4.1) concentration factor delta-t/delta-t discharge (Temperature at mixing zone boundary minus river temperature/Temperature of blowdown minus river temperature) at the end of the mixing zone of 0.148. The resulting plume temperature at the end of the mixing zone would be 85°F + 1.30°F (i.e., 0.148 x [93.8-85]) = 86.30°F; this compares with a temperature of 85.9°F predicted in the FES (85 + 0.9 temperature rise).

An increase in blowdown flow from 10,000 gpm (the blowdown flow rate used in the NRC's analysis) to 11,200 gpm (the EPU blowdown flow rate) could also increase the river temperature. For estimating purposes, it was assumed that the flow increase of 12 percent translates to a temperature rise increase of 12 percent (same excess heat). This is a conservative assumption because the increased flow will engender increased momentum effects which include increased plume mixing and the plume remaining below the surface for a somewhat greater distance. A delta-t increase of 12 percent is taken as equal to 1.12 x (93.8 - 85) = 9.86°F, corresponding to a discharge temperature of 94.86°F (85 + 9.86). Again applying the FES concentration factor, the temperature at the end of the mixing zone would be 85 + 1.5 (i.e., 0.148 x [94.86 – 85]) = 86.5°F. It should be noted that the effects of the increased flow and increased temperature will somewhat balance (i.e., the momentum and buoyancy forces both increasing from the existing discharge conditions similar percentages). Therefore, the maximum temperature at the edge of the mixing zone for uprate conditions of 86.5°F is judged to be a good approximation. Furthermore, it should be noted that the river and blowdown temperatures of the analysis are greater than recent measurements of river (2002) and blowdown (2004/2005) temperatures.

PPL Susquehanna concludes that EPU will have a small effect on blowdown temperatures and that thermal discharges will remain in compliance with state water quality standards.

7.2.5 Aquatic Biota

PPL Susquehanna has conducted studies of water quality and aquatic biota in the Susquehanna River up- and downstream of SSES since 1971. This long-term monitoring program has made it possible for PPL Susquehanna to monitor the overall health of the Susquehanna River and its aquatic communities, to identify any chronic or recurring water quality problems that might be traced to operation of SSES, and to detect more subtle short-term changes in aquatic community structure caused by SSES operations. The comprehensive monitoring program that assessed water quality, algae (periphyton and phytoplankton), macroinvertebrates, and fish from 1971 to 1994 was reduced in scope in 1995 to focus on water quality and fish populations as key indicators of possible SSES-related impacts.

Water quality in the Susquehanna River in the area of SSES has improved steadily since PPL Susquehanna began monitoring in 1971. This improvement has been attributed to a reduction in mine drainage pollutants from upstream sources and a reduction in point source pollutants from upstream municipal water treatment plants and industrial facilities (chiefly in the Wilkes-Barre area) following the enactment of the Clean Water Act in 1972. From 1973 to 2003, there was a decreasing trend in levels of turbidity, sulfate, total iron, and total suspended solids and an increasing trend in river temperature, pH, total alkalinity, and dissolved oxygen concentrations (Ecology III 2003). The most obvious change in 30 years of water quality monitoring at SSES has been the reduction in total iron levels in this reach of the Susquehanna River. Most, if not all, of these water quality improvements were associated with the decline, in the 1970s, of anthracite coal mining in the Wyoming Valley region upriver of SSES (Ecology III 2003).

Based on fish studies conducted annually since 1976, the Susquehanna River in the vicinity of SSES supports a diverse assemblage of coolwater and warmwater fishes including Notropids (minnows), Catastomids (suckers), Ictalurids (catfish), Centrarchids (sunfish), and Percids (darters and perch). Water quality improvements in the 1970s and 1980s brought fishermen back to the River in increasing numbers (Ecology III 1987). Creel surveys conducted in 1986 in the vicinity of SSES revealed that muskellunge, smallmouth bass, and walleye were the species most often sought by anglers and that walleye, channel catfish, and smallmouth bass were the species most often caught. Although no recent creel data are available, anecdotal information suggests that these same species continue to be sought and harvested by fishermen in the vicinity of SSES. Smallmouth bass fishing appears to be growing in popularity, however, as the quality of the smallmouth bass fishing improves.

PPL Susquehanna has monitored water quality and aquatic biota in the vicinity of SSES since 1971. Water quality and health of aquatic communities, such as benthic macroinvertebrates, have improved over this period, largely as a result of the decline of coal mining in the region. Improved upstream wastewater treatment may also have benefited aquatic communities. Although subtle changes have been detected in fish community structure downstream of the SSES outfall (relative to control areas upstream of the station), it is unclear if these changes are actually due to the influence of SSES or due to improvement in water quality upstream of the station. The EPU, with its modest and localized increases in water temperatures and blowdown constituents (i.e., salts and suspended solids), would have little or no impact on aquatic communities in the vicinity of the station.

Monitoring for biofouling mollusks continues at SSES. No zebra mussels have been observed to date at the station or in its vicinity in the North Branch of the Susquehanna River. However, the Asiatic clam (*Corbicula fluminea*) has been in this branch of the river for a few years and was collected by scuba divers in the SSES's Engineered Safeguard Service Water Spray Pond in July 2005. Beginning this year, plant personnel and contractors plan to treat the pond with an approved molluscicide to control the clams.

7.2.6 Sensitive Aquatic Species

No sensitive aquatic species are known to occur in the vicinity of SSES. SSES lies on a reach of the Susquehanna River that was degraded in the 1970s by acid drainage from upstream coal mining operations. Although water quality in the river is much improved in recent years and fish populations are flourishing, no rare mussel or fish species has appeared or re-established itself. Therefore, the EPU would have no impact on sensitive aquatic species.

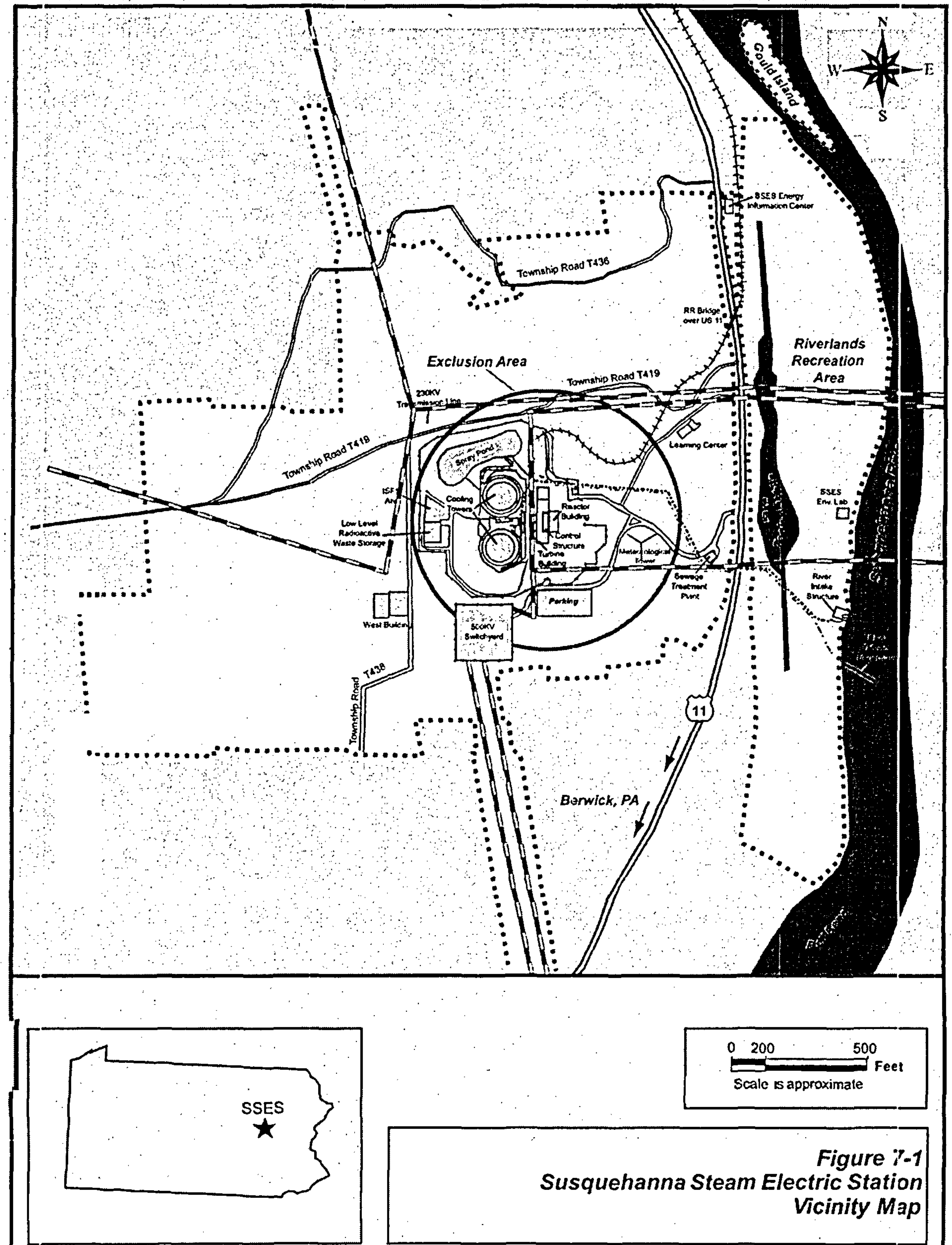

Figure 7-1
Susquehanna Steam Electric Station
Vicinity Map

8.0 RADIOLOGICAL ENVIRONMENTAL IMPACTS

8.1 RADIOACTIVE WASTE STREAMS

The radioactive waste systems at SSES are designed to collect, process, and dispose of radioactive wastes in a controlled and safe manner. The design bases for these systems during normal operation are to limit discharges in accordance with 10 CFR 20, to limit exposures to the requirements of 40 CFR 190, and to satisfy the design objectives of 10 CFR 50 Appendix I. Adherence to these limits and objectives would continue under the proposed EPU.

Operation at EPU conditions would not result in any physical changes to the solid waste, liquid waste, or gaseous waste systems. The safety and reliability of these systems would be unaffected by the proposed EPU. Also, EPU would not affect effluent and environmental monitoring of any of these waste streams or the radiological monitoring requirements of the SSES Technical Requirements Manual. Under normal operating conditions, EPU would not introduce any new or different radiological release pathways and would not increase the probability of an operator error or equipment malfunction that would result in an uncontrolled radioactive release from the radioactive waste streams. The specific effects of the proposed EPU on each of the radioactive waste systems are evaluated in the following sections.

8.1.1 Solid Waste

Solid radioactive wastes include solids recovered from the reactor process system, solids in contact with reactor process system liquids or gases, and solids used in the reactor process system operation. The largest volume of solid radioactive waste at SSES is LLRW. Sources of LLRW at SSES include resins and charcoal, sludges and filters from water processing, dry active waste (DAW) from outages and routine maintenance, and oil from plant systems. DAW includes paper, plastic, wood, rubber, glass, floor sweepings, cloth, metal, and other types of waste routinely generated during site maintenance and outages. Table 8-1 presents the annual volume and activity of LLRW generated at SSES for the period 2000 through 2004 by waste type.

PPL Susquehanna is planning several EPU-related modifications to SSES, including the installation of an additional condensate filter vessel and the installation of an eighth condensate demineralizer. These modifications could result in increased LLRW generation.

Table 8-1. SSES Low-Level Radioactive Waste Generation by Waste Type, 2000 - 2004.

Waste Type	2000		2001		2002		2003		2004	
	Volume (ft^3)	Activity (Ci)	Volume (ft^3)	Activity (Ci)	Volume (ft^3)	Activity (Ci)	Volume (ft^3)	Activity (Ci)	Volume (ft^3)	Activity (Ci)
Class A	4,140	1,580	2,890	549	2,165	2,585	7,246	1,440	5,760	2,870
Class B	125	415	393	1,880	172	2,330	372	6,484	283	2,550
Class C	637	188,000	40	71.4	155	864	362	99,210	42	88
Total	4,900	189,995	3,330	2,500	2,492	5,779	7,980	107,134	6,085	5,508

Source: PPL 2001, 2002, 2003, 2004b, 2005c.

It is estimated that the EPU would result in an increase of approximately 11 percent in the generation of resins, sludges, and used filters (LLRW) and an increase in DAW of less than 2 percent. Even if all LLRW, including DAW were to increase by 14 percent over the year 2004 values, this rate (6,937 cubic feet [ft^3]) would be bounded by the FES, which predicted an annual radwaste shipping rate of 200 ft^3 per week (10,400 ft^3 per year) (AEC 1973).

8.1.2 Liquid Waste

Liquid radioactive wastes include liquids from the reactor process systems and liquids that have become contaminated with process system liquids. Table 8-2 presents liquid releases from SSES for the period 2000 through 2004. The SSES liquid effluent reduction program has implemented a strategy to maintain liquid releases to as low as reasonably achievable (ALARA). This philosophy is based on processing and returning to the plant all radioactive waste inputs that would not impact reactor water chemistry. As noted for example in Table 8-2, 917,400 gallons and 25.04 millicuries of fission and activation products, 62,060 millicuries of tritium, and 0.0937 millicuries of dissolved and entrained gases were released in the year 2004. The year 2004 was considered a typical operational year. Liquid effluent release volumes and activity are not expected to increase significantly (less than 1 percent) as a result of EPU because the concentration would continue to be reduced to minimal levels due to operation of the liquid waste management system (LWMS) and condensate demineralizers. The offsite radiation dose consequences of these effluent releases are described in Section 8.2.

Table 8-2. Liquid Effluent Releases From the SSES, 2000 – 2004.

Year	Gallons Released	Fission and Activation Products Activity Released (mCi)	Tritium (mCi)	Dissolved and Entrained Gases (mCi)
2000	1,126,200	36.95	47,360	0.0926
2001	477,800	24.26	24,440	7.52×10^{-4}
2002	1,063,000	29.82	66,120	0.295
2003	1,035,600	28.28	70,250	0.162
2004	917,400	25.04	62,060	0.0937

Source: PPL 2001, 2002, 2003, 2004b, 2005c.

8.1.3 Gaseous Waste

Gaseous radioactive wastes principally include activation gases and fission product radioactive noble gases vented from process equipment and, under certain conditions, building ventilation exhaust air. Table 8-3 presents gaseous releases from SSES for the period 2000 through 2004. Radioactive releases with EPU are expected to increase in proportion to the increase in power level. If the year 2004 release values are assumed to be a valid representation of future normal operations, this would result in releases of approximately 10.85 curies of noble gases, 8.19×10^{-4} curies of particulates and iodines, and 182.4 curies of tritium per year after EPU. The offsite radiation dose consequences of these effluent releases are described in Section 8.2.

Table 8-3. Gaseous Effluent Releases From the SSES, 2000 – 2004.

Year	Fission and Activation Gases (Ci)	Particulates and Iodines (Ci)	Tritium (Ci)
2000	0	3.23×10^{-3}	95.2
2001	6.78	7.43×10^{-3}	129.2
2002	9.68	6.30×10^{-3}	136.9
2003	0.311	1.54×10^{-3}	156.3
2004	9.52	7.19×10^{-4}	160.0

Source: PPL 2001, 2002, 2003, 2004b, 2005c.

8.2 RADIATION LEVELS AND OFFSITE DOSE

8.2.1 Operating and Shutdown In-Plant Levels

In-plant radiation levels and associated doses are controlled by the ALARA program, as required by 10 CFR 20. PPL Susquehanna has a policy of maintaining occupational dose equivalents to the individual and the sum of dose equivalents received by all exposed workers to ALARA levels. This ALARA philosophy is implemented in a manner consistent with SSES operating, maintenance, and modification requirements and accounts for the state of technology, the economics of improvements relative to the state of technology, the economics of improvements relative to public health and safety benefits, the public interest relative to utilization of nuclear energy and licensed materials, and other societal and socioeconomic considerations. Table 8-4 presents the collective SSES occupational radiation doses for the period 2000 through 2004. In calendar year 2003, the average annual collective dose per reactor for boiling water reactors was 162 person-rem (NRC 2004). For two boiling water reactors, this equates to a collective occupational radiation dose of 324 person-rem.

Table 8-4. Collective Occupational Radiation Dose at SSES, 2000 – 2004.

Year	Collective dose (person-rem)
2000	330
2001	290
2002	260
2003	250
2004	270

Source: Ingram 2005.

The SSES ALARA program manages exposure by:

- Minimizing the time personnel spend in radiation areas,
- Maximizing the distance between personnel and radiation areas,
- Maximizing shielding to minimize radiation levels in routinely occupied plant areas and in the vicinity of plant equipment requiring attention, and
- Reducing the amount of radioactive material that could lead to worker radiation doses (source term reduction).

Shielding is used throughout the plant to protect personnel against radiation emanating from the reactors and their auxiliary systems, and to limit radiation damage to operating equipment. PPL Susquehanna has reviewed the current radiation shielding and plant radiation zoning in relation to the projected increase in dose rates due to EPU and proposed appropriate plant changes. These plant modifications and their installation schedules are listed in Attachments 7 and 8. Radiation measurements will be taken during Startup Testing to validate radiation zoning and ALARA program compliance.

Normal operation radiation levels may increase up to the percentage increase of the EPU. In some cases, near the reactor for example, main steam line piping and equipment may experience slightly higher increases in radiation levels. For conservatism, many aspects of the plant were originally designed for higher-than-expected radiation sources. This includes for example plant radiation shielding. The increase in radiation levels would be offset by conservatism in the original design, source terms used, and analytical techniques. Therefore, no new dose reduction programs are planned and the ALARA program would continue in its current form.

8.2.2 Offsite Doses at EPU Conditions

The primary sources of offsite dose to the public from the operation of SSES result from the transportation and storage of radioactive materials and waste, gamma (nitrogen -16) radiation shine from turbine equipment, and radioactive gaseous and liquid waste effluents. With the implementation of EPU, it is conservatively estimated that radiation shine from the turbine building will increase by 20% and offsite doses due to the release of radioactive effluents will increase slightly due to an increase in normal operation activity levels in the reactor coolant and process equipment. Offsite doses from the transport and storage of radioactive material and waste products will be essentially unchanged with EPU.

For years 2000 through 2004 the reported annual whole body dose to the public from all SSES radiological sources ranged from 0.2 to 1.3 mrem, (PPL 2001, 2002, 2003, 2004b, and 2005c). Conservatively assuming an overall 20% increase with EPU, the whole body dose to the public will be well below 40 CFR 190.10 (a) limits of 25 mrem per year.

Offsite doses from radioactive effluents and direct radiation are calculated at SSES by measuring the concentration of radioactivity in the liquid and gaseous effluents to determine the total amount of each radionuclide release through these pathways, then applying computer models, as described in the Offsite Dose Calculation Manual, to calculate radiation doses from these measured releases.

Offsite doses from liquid effluents are summarized and averaged for 2000 through 2004 (Table 8-5), according to 10 CFR 50, Appendix I. For the five-year period, average annual total body dose was 2.05×10^{-3} millirem (mrem), and average annual organ dose was 5.31×10^{-3} mrem. As discussed in Section 8.1, no significant change in the volume or activity of water treated and released is expected as a result of EPU. Therefore, all offsite doses from liquid effluent releases would remain well below the regulatory standards contained in 10 CFR 50, Appendix I. These doses would also be bounded by the analysis in the FES for Operation (NRC 1981), which predicted an offsite whole body dose of 0.48 mrem/year and a maximum organ dose (bone) of 0.99 mrem/year.

Doses to individuals from gaseous releases are summarized and averaged for 2000 through 2004 (Table 8-6) according to 10 CFR 50 Appendix I categories. For the five-year period, average annual whole body dose at the site boundary from releases of iodines, tritium, and particulate radionuclides was 0.788 mrem. As discussed in Section 8.1, gaseous effluents and consequently offsite doses can be expected to increase approximately in proportion to the increase in power level. The offsite doses for the 2000 through 2004 period of operation were well below the 10 CFR 50 Appendix I standards, with the highest percentage of the regulatory standard being 2.6 percent for the average annual whole body dose at the site boundary from releases of iodines, tritium, and particulate radionuclides. Therefore, after EPU, offsite doses from gaseous effluent releases would remain well below the regulatory standards contained in 10 CFR 50 Appendix I.

Table 8-5. Radiation Dose from Liquid Effluent Pathways, 2000 – 2004.

	2000	2001	2002	2003	2004	Average 2000-2004	10 CFR 50 Appendix I Limit
Maximum Individual Dose							
Total Body (millirem)	2.68×10^{-3}	2.60×10^{-3}	2.10×10^{-3}	1.89×10^{-3}	9.74×10^{-4}	2.05×10^{-3}	6
Organ (millirem)	7.08×10^{-3}	6.32×10^{-3}	6.06×10^{-3}	5.00×10^{-3}	2.08×10^{-3}	5.31×10^{-3}	20

Source: PPL 2001, 2002, 2003, 2004b, 2005c.

Table 8-6. Radiation Dose from Gaseous Effluent Pathways, 2000 – 2004.

	2000	2001	2002	2003	2004	Average 2000-2004	10 CFR 50 Appendix I Limit
Noble gas air dose at site boundary							
Gamma Air Dose (mrad)[a]	0	9.98×10^{-3}	0.113	2.21×10^{-3}	8.45×10^{-2}	4.19×10^{-2}	20
Beta Air Dose (mrad)[a]	0	1.29×10^{-2}	0.04	3.21×10^{-3}	3.08×10^{-2}	1.74×10^{-2}	40
Iodines, tritium, and particulate dose to an offsite individual							
Maximum dose at site boundary for all pathways (mrem)[b]	0.137	0.184	1.27	1.17	1.18	0.788	30
Collective dose to members of the public within the Riverlands/Information Center Complex							
Collective Dose (Person-rem)	2.35×10^{-4}	5.03×10^{-3}	2.04×10^{-3}	1.46×10^{-3}	1.76×10^{-3}	2.11×10^{-3}	NA

Source: PPL 2001, 2002, 2003, 2004b, 2005c.
a. mrad = millirad.
b. mrem = millirem.
NA Not Applicable

8.3 RADIOLOGICAL CONSEQUENCES OF ACCIDENTS

This section reviews the potential environmental impact of reactor accidents which may be radiologically significant due to the postulated release of radioactivity to the environment. Section 6.1.4.1, "Design Basis Accidents" of the Susquehanna Units 1 and 2 FES (NRC 1981) analyzed the potential consequences of several postulated reactor accidents to ensure the design features of SSES met acceptable design and performance criteria. These analyses were performed using both conservative and realistic radioactivity release assumptions. Three categories of accidents were considered in these analyses: (1) incidents of moderate frequency, i.e. events that can reasonably be expected to occur during any year of operation, (2) infrequent accidents, i.e., events that might occur once during the life of the plant, and (3) limiting faults, i.e. accidents not expected to occur but that have the potential for significant releases of radioactivity.

Incidents of moderate frequency are also called anticipated operational occurrences and are results of events that are included as part of the evaluation of routine radioactive releases discussed under Section 8.2. Some of the initiating events postulated for infrequent accidents and limiting faults are shown in Table 8-7 along with the anticipated radiological consequences. These data are taken from FES Table 6.1.4-1. The subject events are designated as design basis accidents and the consequences presented in this table were considered to be realistic estimates reflecting credit for the operation of engineered safety features and average annual atmospheric dispersion conditions.

Table 8-7. Accidents reported in the Final Environmental Statement for Operation

Accident	Whole Body Dose (rem)
Radiological waste equipment leakage or malfunction	0.19
Release of waste gas storage tank contents	0.077
Release of liquid waste storage tank contents	5×10^{-4}
Small Break LOCA	5×10^{-5}
Fuel Handling Accident	0.044
Main steam line break	0.016
Control rod drop	0.004
Large-break Loss of Coolant Accident	0.028

Under EPU conditions, the dose consequences estimated in the FES can be reasonably and conservatively expected to increase by the percentage change in power level from the original licensed power to the EPU power level. In numerical terms this is approximately 20% (from 3293 MWt to 3952 MWt).

Based upon the estimated doses in the FES, Table 6.1.4-1, the collective exposure to the 50-mile population ranges from a small fraction of 1 person-rem to about 37 person-rem. This population dose was based on 1970 data and updating from 1970 to 2000 would show essentially no change (decreasing by approximately 3 percent). Conservatively assuming that the increase in dose consequences for EPU would be equivalent to the 20% change in power level, the projected population dose with EPU would become a maximum of about 44 person-rem.

The NRC staff also carried out calculations to estimate the potential upper bound for individual exposures from the same initiating accidents listed in Table 6.1.4-1 based upon more pessimistic (worst case) assumptions. These assumptions included much larger amounts of released radioactive material, degraded operation of safety equipment, and very poor meteorological dispersion conditions. It can be reasonably assumed that the worst case doses are associated with a design basis loss of coolant accident. The results of these calculations show that for these events the limiting exposures to any individual at the site boundary are not expected to exceed a combined exposure of 1 rem whole body and 150 rem to the thyroid. The results of this NRC staff evaluation can be placed into the currently used total effective dose equivalent (TEDE) acceptance criteria. Using the recommended conversion prescription found in Regulatory Guide 1.183[1] (NRC 2000), the original dose consequences are approximately 5.5 rem TEDE. Under EPU conditions adjusting this FES estimated TEDE dose for the 20% increase in power would result in a worst case estimated dose consequence of 6.6 rem TEDE.

SSES has performed Design Basis Accident analyses at the EPU power level in support of a proposed License Amendment Request to implement a full scope Alternative Source Term in accordance with 10 CFR 50.67 (PPL 2005d). The accidents analyzed are those identified in Regulatory Guide 1.183. Table 8-8 presents the results of these calculations utilizing worst-case accident sequences, plant design assumptions and conservative site meteorological conditions. The table also provides the dose criteria for acceptance based upon Regulatory Guide 1.183.

1 Per RG 1.183, page 9, footnote 7: when "necessary to compare dose results expressed in terms of whole body and thyroid with new results expressed in terms of TEDE...the previous thyroid dose should be multiplied by 0.03 and the product added to the whole body dose."

When the worst case FES accident dose consequences are scaled to the extended power uprate level and placed into the TEDE format, good agreement is found between the originally evaluated and current doses for individuals located at the Exclusion Area Boundary for the Loss of Coolant Accident.

As shown in Table 8-8, the accident consequences under EPU conditions satisfy the current 10 CFR 50.67 regulatory acceptance limits and the dose consequences are comparable to the previously estimated FES environmental impact for the postulated design basis accidents.

Table 8-8. EPU Design Basis Accident Doses reported in the Alternative Source Term License Amendment Request

Accident	Alternative Source Term Dose (rem TEDE)	Regulatory Guide 1.183 Dose Criteria (rem TEDE)
Fuel/Equipment Handling Accident:		
Exclusion Area Boundary:	1.7[a]	6.3
Low Population Zone:	0.10[a]	6.3
Main steam line break:		
Exclusion Area Boundary:	2.0	25
Low Population Zone:	0.12	25
Control rod drop:		
Exclusion Area Boundary:	2.3	6.3
Low Population Zone:	0.18	6.3
Large-break Loss of Coolant Accident:		
Exclusion Area Boundary:	7.8	25
Low Population Zone:	3.8	25

a. Highest value of any reported scenario

8.4 OTHER POTENTIAL ENVIRONMENTAL ACCIDENTS

Other potential environmental accidents could involve chemicals, industrial gases, oil, oil products, or other hazardous substances. PPL Susquehanna is planning several EPU-related modifications to SSES, including modifications that would result in increased rates of consumption of hazardous substances. For example, there would be an increase in the hydrogen and oxygen flows as a result of the increased feedwater flow rate at EPU conditions. Similarly, PPL Susquehanna plans additional acid injection capability at the Cooling Tower basin to prevent scaling of the condensers (PPL 2005e). A secondary benefit of acid injection is maintaining an acceptable blowdown pH. Although hazardous substances would be consumed at a higher rate at EPU conditions, PPL Susquehanna, with the exception of upgrading the Circulating Water Acid Injection System, does not plan to alter their inventory, storage, or control requirements at SSES, and no new hazardous substances would be used or introduced. There are plans to increase the amount of sulfuric acid in this acid injection system from 11,000 gallons (two 5,500-gallon temporary tanks) to 30,000 gallons (two 15,000-gallon permanent tanks). A plan has been developed to ensure that leaks from the Acid Injection System tanks, piping, and equipment will be collected prior to being released to the environment. The risk from oil or chemical spills, releases of industrial gases, or other events involving non-radioactive hazardous material would not increase significantly as a result of the EPU.

9.0 ENVIRONMENTAL EFFECTS OF URANIUM FUEL CYCLE ACTIVITIES AND RADIOACTIVE WASTE TRANSPORT

NRC regulations (10 CFR 51.51, Table S-3) provide the basis for evaluating the contribution of the environmental effects of the uranium fuel cycle to the environmental impacts of licensing a nuclear power plant. NRC regulations (10 CFR 51.52, Table S-4) describe the environmental impacts of transporting nuclear fuel and radioactive wastes. Tables S-3 and S-4 were developed in the 1970s. Since that time, most plants have increased both the uranium-235 enrichment and the burnup of their nuclear fuel.

In 1988, NRC generically evaluated the impacts of extended burnup fuel and increased enrichment on the uranium fuel cycle, including transportation of nuclear fuel and wastes, to determine whether higher burnup and enrichment could result in environmental impacts greater than those described in Tables S-3 and S-4. The Environmental Assessment and Finding of No Significant Impact (53 FR 6040; February 29, 1988) concluded that burnup limits of up to 50,000 megawatt-days per metric ton of uranium (MWd/MTU) or higher (as long as the peak rod average burnup is no greater than 60,000 MWd/MTU) and uranium-235 enrichment up to 5 weight percent would have no significant adverse environmental effects on the uranium fuel cycle or the transport of nuclear fuel and wastes, and would not change the impacts presented in Tables S-3 and S-4.

In 1996, in connection with the *Generic Environmental Impact Statement (GEIS) for License Renewal of Nuclear Power Plants*, NRC looked at transporting higher enrichment and higher burnup spent nuclear fuel to a geologic repository (NRC 1996). The conclusion of that evaluation was that the environmental impacts would be consistent with the values presented in Table S-4 and that the impacts in Table S-4 are bounding.

For the proposed EPU, design studies project that the fuel enrichment will increase and the maximum fuel burnup will remain at approximately 54,000 MWd/MTU (Fields 2005c). The SSES fuel cycles will remain bounded by the impacts in Tables S-3 and S-4 of 10 CFR 51. Therefore, PPL Susquehanna concludes that impacts to the uranium cycle and transport of nuclear fuel from the proposed action would be insignificant and not require mitigation.

The EPU will require more fuel assemblies per reload. Design studies project an increase of 10 percent from the current reload batch size due to higher cycle energy requirements (Fields 2005c). There are no planned changes associated with handling and storage of additional fresh and spent fuel to support the larger reload batch size. The number of required dry fuel storage casks would increase. However, no expansion of the SSES dry fuel storage facility would be necessary. Dose from station operation including additional storage casks of spent fuel will remain below 40 CFR 190 requirements.

As described in Section 8.1, the proposed action would generate about 11 percent more volume of solid radioactive waste. The amount of LLRW generated annually by SSES operations averaged less than 5,000 ft^3 per year (2000-2004) and 6,085 ft^3 in 2004 a typical year (see Section 8.1.1). The FES predicted a LLRW shipping rate of two containers holding 100 ft^3 each per week, or 10,400 ft^3 per year (AEC 1973). Even if the low-level waste volumes were to increase by 14 percent, the number of shipments would still be bounded by the FES values. The increased waste volume resulting from the EPU is not expected to affect the transportation of low-level wastes.

10.0 EFFECTS OF DECOMMISSIONING

NRC has prepared the GEIS and a supplement on the environmental impacts of decommissioning domestic nuclear power reactors (NRC 1988, 2002). Procedures for decommissioning a nuclear power plant are found in NRC regulations at 10 CFR 50.75, 50.82, 51.53, and 51.95.

The NRC defines *decommissioning* as the safe removal of a nuclear facility from service and the reduction of residual radioactivity to a level that permits release of the property and termination of the license (10 CFR 50). NRC regulation 10 CFR 50.82 specifies the regulatory actions that NRC and a licensee must take to decommission a nuclear power facility. NRC regulation 10 CFR 20, Subpart E (10 CFR 20.1401 to 20.1406) identifies the radiological criteria that must be met for license termination.

Decommissioning must occur because regulations do not permit an operating license holder to abandon a facility after ending operations. Decommissioning commercial power generating units has not produced impacts beyond those considered in the Final GEIS on decommissioning (NRC 1988).

The FES for operation of SSES Units 1 and 2 (NRC 1981) evaluated the environmental effects of decommissioning. Prior to decommissioning at SSES, PPL Susquehanna would submit a post-shutdown decommissioning activities report to describe planned decommissioning activities, any environmental impacts of those activities, a schedule, and estimated costs.

According to the NRC, decommissioning a nuclear facility that has reached the end of its useful life generally has a positive environmental impact. The air quality, water quality, and ecological impacts of decommissioning are expected to be substantially smaller than those of power plant operation because the level of activity and the releases to the environment are expected to be smaller during decommissioning than during construction and operation. Experience with decommissioned power plants has shown that the occupational exposures during the decommissioning period are comparable to those associated with operational refueling and plant maintenance (NRC 2002). The major environmental impact is the commitment of small amounts of land for waste burial in exchange for the potential reuse of the land where the facility is located. Socioeconomic impacts of decommissioning would result from the demands on, and contributions to, the community by the workers employed to decommission a power plant (NRC 1988, NRC 2002).

The potential incremental decommissioning environmental impacts that would occur because of the proposed EPU would be due to increases in the feedwater flow rate and increased neutron fluence. These increases could increase the amount of activated corrosion products and consequently, post-shutdown radiation levels. Increases in radiation levels are expected to be insignificant, and would be addressed in the post-shutdown decommissioning activities report.

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Attachment 7 to PLA-6002

List of Planned Modifications

ATTACHMENT 7

PPL SUSQUEHANNA LLC
SUSQUEHANNA STEAM ELECTRIC STATION (SSES)
UNITS 1 AND 2

REQUEST FOR LICENSE AMENDMENT FOR
EXTENDED POWER UPRATE OPERATION

LIST OF PLANNED MODIFICATIONS

The following is a list of planned modifications necessary to support Extended Power Uprate (EPU) for Susquehanna Steam Electric Station (SSES) Units 1 and 2.

This list is reorganized from the similar list in the EPU submittal to illustrate implementation sequencing.

Susquehanna Units 1 and 2 EPU Planned Modifications	
Modification	**Description**
Pre-EPU Implementation Phase (U212RIO-2005 and U114RIO-2006)	
Vibration/Acoustic Monitoring (Steam dryer monitoring instruments on Unit 1 Only)	• Install accelerometers on Main Steam, Reactor Recirculation, RHR and RWCU Lines for vibration monitoring • Install instrumentation on main steam lines for steam dryer acoustic wave monitoring
Cross Around Relief Valve Set Point Change (Unit 1 Only)	• Revise setpoint for EPU conditions • Revise design pressure of associated piping for EPU conditions • Replace relief line expansion joints for EPU steam flow conditions
Reactor Feed Pump Seal Water (Unit 1 Only)	• Revise Temperature Control Valve settings per vendor recommendation • Revise drain line vent piping for increased drain flow
Power Range Neutron Monitoring System (Unit 1 Only)	• Replace existing GE analog system with GE digital NUMAC system [Provided for completeness only. NRC approval has been requested in a separate, prior submittal]

Susquehanna Units 1 and 2 EPU Planned Modifications	
Modification	**Description**
EPU Phase I Implementation (U213RIO-2007 and U115RIO-2008)	
Ultimate Heat Sink (Non-Outage)	• Install a second isolation valve, manually operated, in each of two Spray Pond Spray Header Bypass Lines to reduce effects of a single bypass line isolation valve failure-to-close under accident conditions. • Reduce number of large array nozzles to improve spray efficiency
ESW to Fuel Pool Check Valve (Non-Outage)	• Valve change to reduce mission dose for post-LOCA manual action
ARTS/MELLLA (Unit 1 Non-Outage)	• Revise the APRM flow-biased scram and rod block trip setpoints [Provided for completeness only. NRC approval has been requested in a separate, prior submittal]
Vibration/Acoustic Monitoring (Unit 2 Only)	• Install instrumentation on main steam lines for steam dryer acoustic wave monitoring
Cross Around Relief Valve Set Point Change (Unit 2 Only)	• Revise setpoint for EPU conditions • Revise design pressure of associated piping for EPU conditions • Replace relief line expansion joints for EPU steam flow conditions
Reactor Feed Pump Seal Water (Unit 2 Only)	• Revise Temperature Control Valve settings per vendor recommendation • Revise drain line vent piping for increased drain flow
Power Range Neutron Monitoring System (Unit 2 Only)	• Replace existing GE analog system with GE digital NUMAC system [Provided for completeness only. NRC approval has been requested in a separate, prior submittal]
Neutron Monitoring System Settings	• APRM Flow-biased SCRAM • APRM Flow-biased Rod Block • APRM Upscale Setdown SCRAM • APRM Upscale Setdown Rod Block

Susquehanna Units 1 and 2 EPU Planned Modifications	
Modification	**Description**
EHC System	• Install accumulators on Turbine Control Valve EHC FAS lines • Install Steam Line Resonance Cards on pressure transmitter loops to dampen 3rd harmonic frequency • Modify Turbine Control Valve Digital Positioning Cards • Recalibrate Power Load Unbalance circuit
MSIV High Flow Isolation Setpoint	• Revise setpoint for EPU conditions (this will require new switches)
Reactor Recirculation Runback Limiter #2	• Logic change
HP Turbine Instrument Change	• RPS SCRAM Bypass • RWM Setpoints • RSCS Setpoints • Power dependent condenser high pressure alarm power signal
Reactor Feed Pump Low Suction Pressure	• Revise setpoints for EPU Conditions
Instrument Calibration and Computer Software Changes	• Recalibrate instruments and revise software for EPU conditions
Generator Rewind	• Increase main generator electrical rating to EPU conditions
High Pressure Turbine	• Replace High Pressure Turbine for increased steam flow at EPU conditions
Condensate Pump Impellers	• Replace Condensate Pump Impellers for increased Condensate flow at EPU conditions • Replace minimum flow valve internals and controls to allow a larger minimum flow • Replace pump discharge valve motors to accommodate higher differential pressure
#5 Feedwater Heaters	• Increase design pressure and increase shell relief valve setpoints
Standby Liquid Control Boron Enrichment	• Replace existing sodium pentaborate solution • Modify system logic to allow for single pump initiation
Circulating Water Box Vents	• Add automatic Circulating Water Box vent valves to prevent air binding of condenser tubes
Hydrogen Water Chemistry	• Increase hydrogen, oxygen and zinc injection flows due to increased Feedwater flow under EPU conditions
EPU Implementation	• Configuration modification for EPU implementation. No physical work involved

Susquehanna Units 1 and 2 EPU Planned Modifications	
Modification	**Description**
Acid Injection	• Provide additional acid injection capability for the Cooling Tower basin
Reactor Feed Pump Suction Piping	• Replace suction flanges, revise piping design pressure, revise relief valve setpoints
Main Steam, Feedwater, and Extraction Steam Piping Supports	• Revise piping supports as necessary for EPU conditions
Gaseous Radwaste Recombiner Drain Piping	• Revise drain piping for increased EPU flow conditions
#3 FWH Emergency Dump Valves	• Replace valves for EPU conditions.
Power Distribution/Switchyard	• Install new switchyard capacitor banks to meet PJM reactive power requirements for generators • Replace Unit 1 Sync Breaker and associated controls with a breaker having a higher amperage rating • Uprate Unit 2 main transformers and change tap settings to meet EPU conditions
Potential EQ Changes	• As required for EPU environmental conditions
Appendix R RHR Pump Logic Change	• Logic change and raceway protection to eliminate fire-induced failure mechanisms • Provide cross-divisional cooling to RHR pump motor oil coolers
FW Heaters	• Changes to manage velocity and tube vibration issues at EPU conditions
Potential Steam Dryer Changes	• Reinforce steam dryer to mitigate structural loads at EPU conditions
EPU Phase II Implementation (U214RIO-2009 and U115RIO-2010)	
FW Heaters	• Additional changes to manage velocity and tube vibration issues at EPU conditions
Reactor Feed Pump Turbines	• Replace Reactor Feed Pump Turbines due to higher turbine speeds required at EPU conditions • Upgrade turbine speed controls and overspeed trip to digital controls
Condensate Demineralizer	• Install an 8th Condensate Demineralizer to maintain Condensate water quality under increased EPU flow conditions
Condensate Filter	• Install a 7th Condensate Filter to maintain Condensate water quality under increased EPU flow conditions