Rikhoff, Jeffrey

From: Eccleston, Charles
Sent: Thursday, August 12, 2010 5:49 PM
To: Spangler, Nicole
Cc: Rikhoff, Jeffrey; Imboden, Andy; Pham, Bo; Eccleston, Charles
Subject: FW: Salem and Hope Creek Chapter 4 - Technical review of Land Use, Socioeconomics, and EJ Sections
Attachments: Chapter 4 -V 1_Part 2 - JJR edits 081210.docx

Nicole,

I have reviewed Jeff's changes and concur. Incorporate his changes into the current working version of Chapter 4.

Charles Eccleston

From: Rikhoff, Jeffrey
Sent: Thursday, August 12, 2010 4:27 PM
To: Eccleston, Charles
Cc: Imboden, Andy; Pham, Bo
Subject: RE: Salem and Hope Creek Chapter 4 - Technical review of Land Use, Socioeconomics, and EJ Sections

Charles,

Attached is my redline/strikeout markup, corrections, and comments on Salem HCGS SEIS Chapter 4. I revised and corrected the land use, socioeconomics, and environmental justice sections. Overall, AECOM did a good job on these sections. Most of the revisions reflect updates to the discussions.

Markups of Chapter 8 to follow.

Let me know if you have any questions.

Thanks,

jeff

Jeffrey Rikhoff
Senior Environmental Scientist, RERB
Division of License Renewal
Office of Nuclear Reactor Regulation
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301/415-1090
Jeffrey.Rikhoff@nrc.gov

From: Eccleston, Charles
Sent: Monday, August 09, 2010 12:22 PM
To: Rikhoff, Jeffrey
Subject: Skip previous email on Ch 4; use this version.

Jeff,

D-131

AECOM just sent me over chapter 4 split into two sections (it's a large file). Please make your changes to this integrated version instead of the earlier separate files that I sent you.

Charles H. Eccleston

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were no Federally listed species under its jurisdiction present on the Salem and HCGS site. FWS did identify two species Federally listed as threatened that potentially could occur along the transmission lines: the bog turtle (*Clemmys muhlenbergii*) and swamp pink (*Helonias bullata*) (FWS 2009a).

The NRC staff has prepared a Biological Assessment (BA) for NMFS that documents its review of the potential for the proposed action to affect the Federally listed species under the jurisdiction of NMFS. The BA is provided in Appendix D of this draft SEIS. During informal consultation with FWS regarding the potential for effects on terrestrial threatened or endangered species, the staff determined that a BA for FWS was not needed because there was no likelihood of adverse effects on potentially occurring Federally listed species under the jurisdiction of FWS.

4.7.1 Aquatic Threatened or Endangered Species of the Delaware Estuary

Pursuant to consultation requirements under Section 7 of the Endangered Species Act of 1973, the NRC staff requested in a letter to NMFS dated December 23, 2009 (NRC 2009) that NMFS provide information on federally listed endangered or threatened species, as well as proposed or candidate species. In its response on February 11, 2010, NMFS stated that the shortnose sturgeon, the Atlantic sturgeon, and four sea turtle species are known to occur in the Delaware River and estuary in the vicinity of Salem and HCGS, and that no critical habitat is currently designated by NMFS near these facilities (NMFS 2010a).

Consultation between NMFS and NRC with regard to the cooling water intake system (CWIS) for Salem and HCGS has been ongoing since before each facility began operation. In 1980, a Biological Opinion issued by NMFS concluded that the continued operation of these facilities was not likely to jeopardize the shortnose sturgeon. After sea turtles were impinged on the intake trash bars at the Salem facility, consultation was reinitiated in 1988 to evaluate the effects of these takes on the sea turtle species involved. (Takes are considered to include mortalities as well as turtles that are impinged but removed alive and released.) In 1991, NMFS issued a Biological Opinion which found that continued operation of Salem and HCGS would affect threatened or endangered sea turtles but was not likely to jeopardize any populations, and an incidental take statement was issued for Kemp's ridley, green, and loggerhead turtles and shortnose sturgeon. The number of turtles impinged in 1991 was unexpectedly high, exceeding the incidental take allowed and resulting in additional consultation. An opinion issued in 1992 revised the incidental take statement. The impingement of sea turtles exceeded the allowable take in 1992 as well, prompting additional consultation with NMFS (NMFS, 1999; NMFS, 2010a). A 1993 Biological Opinion required the tracking of all loggerhead sea turtles taken alive at the CWIS and released (NMFS, 1993). Also in 1993, PSEG implemented a policy of removing the ice barriers from the trash racks on the intake structure during the period between May 1 and October 24, which resulted in substantially lower turtle impingement rates at Salem.

In 1999, NRC requested that the studies of released turtles be eliminated due to the reduction in the number of turtles impinged after the 1993 change in procedure regarding the removal of ice barriers. NMFS responded in 1999 with a letter and an incidental take statement stating that these studies could be discontinued because it appeared that the reason for the relatively high impingement numbers previously was the ice barriers that had been left on the intake structure during the warmer months (NMFS, 1999). This letter allowed an annual incidental take of 5 shortnose sturgeon, 30 loggerhead sea turtles, 5 green sea turtles, and 5 Kemp's ridley sea turtles. In addition, the statement required ice barrier removal by May 1 and replacement after October 24, and it required that in the warmer months the trash racks must be cleaned weekly and inspected every other hour, and in the winter they should be cleaned every other week.

The statement requires that if a turtle is killed, the racks must be inspected every hour for the rest of the warm season. Dead shortnose sturgeon are required to be inspected for tags, and live sturgeon are to be tagged and released (NMFS, 1999). No sea turtles have been captured at Salem since 2001 (NMFS, 2009).

No shortnose sturgeon or sea turtles have been impinged at the HCGS intake (NMFS, 2009), and NMFS has not required monitoring at HCGS beyond normal cleaning of the intake structure (NMFS, 1993).

Table 4-21 summarizes information on the incidental take by impingement at the Salem intakes of sturgeon and sea turtles during the monitoring period 1978 – 2008.

The NRC staff evaluated the potential effects of entrainment, impingement, and thermal discharges on these and other important species in Sections 4.5.2, 4.5.3, and 4.5.4. Based on an evaluation of entrainment data provided by PSEG, there is no evidence that the eggs or larvae of either sturgeon species are commonly entrained at Salem and HCGS. Neither of the sturgeon species is on the list of species that has been collected in annual entrainment monitoring during the 1978 – 2008 period (Table 4-21). The life histories of these sturgeon, described in Section 2.2.7.1, suggest that entrainment of their eggs or larvae is unlikely. Shortnose sturgeon spawn upstream in fresh reaches of the Delaware River and are most abundant between Philadelphia and Trenton. Their eggs are demersal and adhere to the substrate, and their juvenile stages tend to remain in freshwater or fresher areas of the estuary for 3 to 5 years before moving to more saline areas such as the nearshore ocean. Thus, shortnose sturgeon eggs or larvae are unlikely to be present in the water column at the Salem or HCGS intakes well downstream of the spawning areas. Similarly, the life history of the Atlantic sturgeon makes entrainment of its eggs or larvae very unlikely.

Impingement data provided by the applicant suggest that both sturgeon and three of the four turtle species have been impinged at Salem. Table 4-21 summarizes information on the incidental take by impingement at the Salem intakes of sturgeon and sea turtles during the monitoring period 1978 – 2008. Atlantic sturgeon were collected in impingement studies in a single year, 2006 (PSEG biological monitoring reports 1995-2006). Impingement data for the shortnose sturgeon show that from 1978 to 2008, 19 fish were impinged at the Salem intakes, of which 16 died. Between 1978 and 2008, 24 Kemp's ridley sea turtles were impinged, of which ten died. Three green turtles (one died) and 68 loggerhead turtles (25 died) also were impinged. Impingement of the turtles was greatest in 1991 and 1992 (Table 4-21). After PSEG modified its use of the ice barriers in 1993, turtle impingement numbers returned to levels much lower than in 1991. From 1994 through 2008, there were six sea turtles impinged (all loggerheads), and four of these died. Also during this 15-yr period, 11 shortnose sturgeon were impinged, of which eight died.

Table 4-21. Impingement data for shortnose sturgeon and three sea turtle species with recorded impingements at Salem intakes, 1978-2008.

Year	Number Impinged[1]			
	Shortnose sturgeon	Kemp's ridley sea turtle	Green sea turtle	Loggerhead sea turtle
1978	2 (2)	0	0	0
1979	0	0	0	0
1980	0	1	1	2 (2)
1981	1 (1)	1 (1)	0	3 (2)
1982	0	0	0	1 (1)

Year	Number Impinged[1]			
	Shortnose sturgeon	Kemp's ridley sea turtle	Green sea turtle	Loggerhead sea turtle
1983	0	1 (1)	0	2 (2)
1984	0	1	0	2 (2)
1985	0	2 (1)	0	6 (5)
1986	0	1 (1)	0	0
1987	0	3 (1)	0	3
1988	0	2 (1)	0	8 (6)
1989	0	6 (2)	0	2
1990	0	0	0	0
1991	3 (3)	1	1	23 (1)
1992	2 (2)	4 (2)	1 (1)	10
1993	0	1	0	0
1994	2 (2)	0	0	1
1995	0	0	0	1 (1)
1996	0	0	0	0
1997	0	0	0	0
1998	3 (1)	0	0	1 (1)
1999	1	0	0	0
2000	1 (1)	0	0	2 (1)
2001	0	0	0	1 (1)
2002	0	0	0	0
2003	1 (1)	0	0	0
2004	1 (1)	0	0	0
2005	0	0	0	0
2006	0	0	0	0
2007	1 (1)	0	0	0
2008	1 (1)	0	0	0
Total	19 (16)	24 (10)	3 (1)	68 (25)

[1] Numbers in parentheses indicate the number of individuals out of the yearly total shown that were either dead when found at the intakes or died afterward. Impingements of Atlantic sturgeon or leatherback sea turtles were not reported in the data on which this table was based.

Source: PSEG (2010).

The potential impacts of thermal discharges on the aquatic biota of the Delaware Estuary is discussed in Section 4.5.4, and impacts on fish and invertebrates, including those preyed upon by sturgeon and sea turtles, are expected to be minimal. The high exit velocity of the discharge produces rapid dilution, which limits high temperatures to relatively small areas in the zone of initial mixing in the immediate vicinity of the discharge. Fish and many other organisms are largely excluded from these areas due to high velocities and turbulence. Shortnose and Atlantic sturgeon and the four sea turtle species have very little potential to experience adverse effects from exposure to the temperatures at the discharge because of their life history characteristics and their mobility. Sturgeon spawning and nursery areas do not occur in the area of the discharge in the estuary, and adult sturgeon forage on the bottom while the buoyant thermal plume rises toward the surface. Sea turtles prefer warmer water temperatures, occur in the

region only during warm months, and are unlikely to be sensitive to the localized area of elevated temperatures at the discharge. NMFS considered the possibility that the warm water near the discharge could cause sea turtles to remain in the area until surrounding waters are too cold for their safe departure in the fall, but it concluded that this scenario was not supported by any existing data (NMFS 1993).

The NRC staff reviewed information from the site audit, the applicant's Environmental Reports for Salem and HCGS, biological monitoring reports, other reports, and coordination with NMFS, FWS, and State regulatory agencies in New Jersey and Delaware regarding listed species. The NRC staff concludes that the impacts on federally listed threatened or endangered aquatic species of the Delaware Estuary during an additional 20 years of operation of the Salem and HCGS facilities would be SMALL.

4.7.2 Terrestrial and Freshwater Aquatic Threatened or Endangered Species

Two terrestrial or freshwater aquatic species that are Federally listed have the potential to occur near the Salem and HCGS facilities and their associated transmission line ROWs: the bog turtle and swamp pink. The characteristics, habitat requirements, and likelihood of occurrence of these species are discussed in Section 2.2.7.2. Coordination correspondence between PSEG and FWS indicates that no Federally listed species occur on the site of the Salem and HCGS facilities, but that the bog turtle and swamp pink potentially could occur within the transmission line ROWs (FWS 2009a).

FWS coordinated with PSEG to review all of its transmission line spans in New Jersey and transmitted to PSEG the known locations of the presence or potential presence of Federally listed species along each span. FWS also recommended to PSEG conservation measures for each Federally listed species that potentially could occur along its transmission line spans (FWS 2009a). In October 2009, PSEG confirmed to FWS its commitment to protecting both Federally and State listed threatened or endangered species along PSEG transmission line ROWs, and it adopted the conservation measures recommended by FWS for each species (PSEG 2009). Based on PSEG's adoption of these conservation measures, FWS in November 2009 concurred that "continued vegetation maintenance activities within the transmission system are not likely to adversely affect federally listed or candidate species." (FWS 2009b) Thus, the Federally listed species potentially occurring in the transmission line ROWs for Salem and HCGS in New Jersey would not be adversely affected by future vegetation maintenance activities. The FWS New Jersey Field Office also coordinated with the FWS Chesapeake Bay Field Office regarding the transmission line ROW from HCGS that crosses the river and traverses New Castle County in Delaware. FWS concluded that "no proposed or federally listed endangered or threatened species are known to exist" within that ROW area (FWS 2009b).

The ROW maintenance procedures agreed upon for protection of the bog turtle include: use of a certified bog turtle surveyor to examine spans containing known or potential habitat, to flag areas of potential habitat plus a 150-ft buffer, and to be on site during maintenance activities in flagged areas; performance of maintenance activities by hand in flagged areas, including selective use of specific herbicides; no use of herbicide in known nesting areas, which include all flagged areas around extant occurrences; timing restrictions to avoid disturbance during nesting season; and provision of the surveyor's reports to FWS (PSEG 2009). The ROW maintenance procedures agreed upon for protection of the swamp pink include: use of a qualified botanist to survey suitable forested wetland habitat on and adjacent to the ROW for the plant; flagging of a 200-ft radius area around any identified populations of swamp pink; avoidance of any maintenance activities within the flagged areas without FWS approval;

limitation of herbicide use within 500 ft of a population to manual applications to woody stumps only; and provision of the surveyor's reports to FWS (PSEG 2009).

The NRC staff reviewed information from the site audit, Environmental Reports for Salem and HCGS, other reports, and coordination with FWS and State regulatory agencies in New Jersey and Delaware regarding listed species. The NRC staff concludes that the impacts on Federally listed terrestrial and freshwater aquatic species from an additional 20 years of operation and maintenance of the Salem and HCGS facilities and associated transmission line ROWs would be SMALL.

4.8 Human Health

The human health issues applicable to Salem and HCGS are discussed below and listed in Table 4-22 for Category 1, Category 2, and uncategorized issues.

Table 4-22. Human Health Issues. *Table B-1 of Appendix B to Subpart A of 10 CFR Part 51 contains more information on these issues.*

Issues	GEIS Section	Category
Radiation exposures to the public during refurbishment	NA[a]	1
Occupational radiation exposures during refurbishment	NA[a]	1
Microbiological organisms (occupational health)	4.3.6	1
Microbiological organisms (public health, for plants using lakes or canals or discharging small rivers)	4.3.6[b]	2
Noise	4.3.7	1
Radiation exposures to public (license renewal term)	4.6.2	1
Occupation radiation exposures (license renewal term)	4.6.3	1
Electromagnetic fields – acute effects (electric shock)	4.5.4.1	2
Electromagnetic fields – chronic effects	4.5.4.2	Uncategorized

[a] - Issues apply to refurbishment, an activity that neither Salem nor HCGS plan to undertake.

[b] - Issue applies to plant features such as cooling lakes or cooling towers that discharge to small rivers. Neither Salem nor HCGS have applicable features.

4.8.1 Generic Human Health Issues

The staff did not identify any new and significant information related to human health issues or radiation exposures during its review of the PSEG environmental reports, the site audit, or the scoping process. Therefore, there are no impacts related to these issues beyond those discussed in the GEIS. For these issues, the GEIS concluded that the impacts are SMALL, and additional site-specific mitigation measures are not likely to be sufficiently beneficial to be warranted (Category 1 issues). These impacts will remain SMALL through the license renewal term.

4.8.2 Radiological Impacts of Normal Operations

Category 1 issues in 10 CFR Part 51, Subpart A, Appendix B, Table B-1, applicable to Salem and HCGS in regard to radiological impacts are listed in Table 4-8. PSEG stated in its ER that it was not aware of any new radiological issues associated with the renewal of the Salem and HCGS operating licenses. The NRC staff has not identified any new and significant information, during its independent review of PSEG's ER, the site audit, the scoping process, or its evaluation of other available information. Therefore, the NRC staff concludes that there would be no impact from radiation exposures to the public or to workers during the renewal term beyond those discussed in the GEIS.

According to the GEIS, the impacts to human health are SMALL, and additional plant-specific mitigation measures are not likely to be sufficiently beneficial to be warranted

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

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

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

  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.

Therefore, the NRC staff expects that there would be no impacts during the renewal term beyond those discussed in the GEIS.

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

The information presented below is a discussion of selected radiological programs conducted at Salem and HCGS.

Radiological Environmental Monitoring Program

PSEG conducts a radiological environmental monitoring program (REMP) to assess the radiological impact, if any, to its employees, the public, and the environment around the plant site. The REMP provides measurements of radiation and of radioactive materials for the exposure pathways and the radionuclides which lead to the highest potential radiation exposures to the public. The REMP supplements the radioactive effluent monitoring program by verifying that any measurable concentrations of radioactive materials and levels of radiation in

the environment are not higher than those calculated using the radioactive effluent release measurements and transport models.

The objectives of the REMP are as follows:

- To fulfill the requirements of the radiological surveillance sections of the Plants' Technical Specifications and the Offsite Dose Calculation Manual.
- To determine whether any significant increase occurred in the concentration of radionuclides in critical pathways for the transfer of radionuclides through the environment to man.
- To determine if operation of the plants caused an increase in the radioactive inventory of long-lived radionuclides in the environment.
- To detect any change in ambient gamma radiation levels.
- To verify that operation of the plants have no detrimental effects on the health and safety of the public or on the environment.

An annual radiological environmental operating report is issued, which contains a discussion of the results of the monitoring program. The report contains data on the monitoring performed for the most recent year as well as graphs containing historical information. The REMP collects samples of environmental media in order to measure the radioactivity levels that may be present. The media samples are representative of the radiation exposure pathways that may impact the public. The REMP measures the aquatic, terrestrial, and atmospheric environment for radioactivity, as well as the ambient radiation. Ambient radiation pathways include radiation from radioactive material inside buildings and plant structures and airborne material that may be released from the plant. In addition, the REMP measures background radiation (i.e., cosmic sources, global fallout, and naturally occurring radioactive material, including radon). Thermoluminescent dosimeters (TLDs) are used to measure ambient radiation. The atmospheric environmental monitoring consists of sampling and analyzing the air for particulates and radioiodine. Terrestrial environmental monitoring consists of analyzing samples of locally grown vegetables and fodder crops, drinking water, groundwater, meat, and milk. The aquatic environmental monitoring consists of analyzing samples of surface water, fish, crabs, and sediment. An annual land use census is conducted to determine if the REMP needs to be revised to reflect changes in the environment or population that might alter the radiation exposure pathways. Salem and HCGS has an onsite groundwater protection program designed to monitor the onsite plant environment for early detection of leaks from plant systems and pipes containing radioactive liquid (PSEG 2009a, 2009b, 2010X5). Additional information on the groundwater protection program is contained later in this section and in the Ground Water Quality section in chapter 2 of this document.

The NRC staff reviewed the Salem and HCGS annual radiological environmental operating reports for 2005 through 2009 to look for any significant impacts to the environment or any unusual trends in the data (PSEG 2006X1, 2007X2, 2008X3, 2009X4, 2010X5). A five year period provides a representative data set that covers a broad range of activities that occur at a nuclear power plant such as; refueling outages, non-refueling outage years, routine operation, and years where there may be significant maintenance activities. Based on the Staff's review, no unusual trends were observed and the data showed that there was no significant radiological impact to the environment from operations at Salem and HCGS. Small amounts of radioactive

material (i.e., Tritium, Cesium-137, and Manganese-54) were detected that are below NRC's reporting values for radionuclides in environmental samples. Overall, the results, with the exception of the on-site groundwater contaminated with tritium, were comparable to the results obtained during the preoperational phase of the REMP and with historical results obtained since commercial operation.

The New Jersey Department of Environmental Protection's Bureau of Nuclear Engineering (NJDEP) performs an independent Environmental Surveillance and Monitoring Program (ESMP) in the environment around the Salem and Hope Creek Nuclear Generating Stations. The ESMP provides a comprehensive monitoring strategy that ensures that New Jersey citizens are aware of and if necessary, protected from harmful exposure to radioactive effluent discharges from New Jersey's nuclear power plants during normal or accident operations.

The specific objectives of the ESMP are to monitor pathways for entry of radioactivity into the environment in order to identify potential exposures to the population from routine and accidental releases of radioactive effluent, and to provide a summary and interpretation of this information to members of the public and government agencies.

The NRC staff reviewed the NJDEP's 2008 report (the most recent report available to the staff at the time this dSEIS was prepared) which contains information on the environmental sampling conducted during the time period of January 1, 2008 through December 31, 2008. The state reported the following: "Overall, the data collected by the NJDEP's ESMP throughout 2008 indicate that residents living in the area around Oyster Creek and Salem/Hope Creek nuclear power plants have not received measurable exposures of radiation above normal background" (NJDEP 2010?).

Radiological Groundwater Protection Program

In response to an identified radioactive liquid release from the Salem Unit 1 spent fuel pool in 2002, PSEG implemented a Remedial Action Work Plan (RAWP) and developed a voluntary Radiological Groundwater Protection Program (RGPP) in 2006 that added additional groundwater sampling locations, outside the scope of the REMP. The RAWP, which was reviewed by the NRC and approved by the NJDEP, is a program designed to remediate the site's groundwater to remove the tritiated groundwater and control the tritium plume from reaching the site boundary and impacting the off-site environment. The results of the RGPP groundwater monitoring program have been reported in the annual radiological environmental operating report since 2006.

The radiological monitoring data for 2009 showed a wide range of tritium concentrations in the on-site groundwater. For Hope Creek, the results show that tritium was detected at concentrations that ranged from the lower limit of detection value of 200 pCi/L to a maximum of 7778 pCi/L. As a result of the positive indications of tritium, the applicant increased the sampling frequency for the monitoring wells. Subsequent sampling did not reproduce the highest levels observed; however, variations in the levels were observed throughout 2009. As a result, the applicant continues to track the concentrations of tritium in the groundwater to determine if a trend can be observed. For the Salem units, the results show that tritium was detected in on-site groundwater in concentrations that ranged from the lower limit of detection value of 200 pCi/L to a maximum of 2,259 pCi/L. The applicant is tracking the tritium concentration levels to determine if a trend can be observed (PSEG 2010X5). The NRC staff notes that no groundwater samples reached the NRC's reporting level of 20,000 pCi/L for tritium in environmental samples.

As part of the applicant's investigation for new and significant information that is relevant to its license renewal application, the issue of tritium in the groundwater was evaluated. The applicant's evaluation concludes that changes in tritium-related groundwater quality are not significant at Salem and would not preclude current or future uses of the groundwater for the following reasons:

- Although tritium concentrations are elevated in the shallow aquifer beneath Salem, PSEG has been performing remedial actions since 2004, and concentrations continue to decrease.
- Tritium concentrations in groundwater are due to an historic incident; the source (spend fuel pool water leak) has been eliminated.
- Tritium concentrations above neither the EPA Drinking Water Standard nor the NJDEP Ground Water Quality Criterion have migrated to the property boundary or into geologic formations deeper than the shallow aquifer. Offsite tritium concentrations are below regulatory limits.
- There is no human exposure pathway and, therefore, no threat to public or employee health or safety.

Radioactive Effluent Release Program

All nuclear plants were licensed with the expectation that they would release radioactive material to both the air and water during normal operation. However, NRC regulations require that radioactive gaseous and liquid releases from nuclear power plants must meet radiation dose-based limits specified in 10 CFR Part 20, and the as low as is reasonably achievable (ALARA) criteria in Appendix I to 10 CFR Part 50. The regulatory limits protect plant workers and members of the public from radioactive material released by a nuclear power plant. In addition, nuclear power plants are required to file an annual report to the NRC which lists the types and quantities of radioactive effluents released into the environment. The radioactive effluent release and radiological environmental monitoring reports are available for review by the public through the NRC's ADAMS electronic reading room on the NRC website.

The NRC staff reviewed the annual radioactive effluent release reports for 2005 through 2009 (PSEG 2006Y1, 2007Y2, 2008Y3, 2009Y4, 2010Y5). The review focused on the calculated doses to a member of the public from radioactive effluents released from Salem and HCGS. The doses were compared to the radiation protection standards in 10 CFR 20.1301 and the ALARA dose design objectives in Appendix I to 10 CFR Part 50.

Dose estimates for members of the public are calculated based on radioactive gaseous and liquid effluent release data and atmospheric and aquatic transport models. The 2009 annual radioactive material release report (PSEG 2010Y5) contains a detailed presentation of the radioactive discharges and the resultant calculated doses. The following summarizes the calculated dose to a member of the public located outside the Salem and HCGS site boundary from radioactive gaseous and liquid effluents released during 2009:

Salem Units 1 and 2

- The total-body dose to an offsite member of the public from radioactive liquid effluents from Salem Unit 1 was 3.22 E-05 mrem (3.22 E-07 mSv) and 2.72 E-05 mrem (2.72 E-07 mSv) for Unit 2, which is well below the 3 mrem (0.03 mSv) dose criterion, for an individual reactor unit, in Appendix I to 10 CFR Part 50.

- The maximum dose to any organ (i.e., skin, thyroid, liver, G.I. tract, etc.) of an offsite member of the public from radioactive liquid effluents from Salem Unit 1 was 8.60 E-05

mrem (8.60 E-07 mSv) and 8.89 E-05 (8.89 E-07 mSv) for Unit 2, which is well below the 10 mrem (0.1 mSv) dose criterion, for an individual reactor unit, in Appendix I to 10 CFR Part 50.

- The air dose at the site boundary from gamma radiation in gaseous effluents from Salem Unit 1 was 1.28 E-04 mrad (1.28 E-06 mGy), and 2.74 E-05 mrad (2.74 E-07 mGy) for Unit 2, which is well below the 10 mrad (0.1 mGy) dose criterion, for an individual reactor unit, in Appendix I to 10 CFR Part 50.

- The air dose at the site boundary from beta radiation in gaseous effluents from Salem Unit 1 was 3.14 E-04 mrad (3.14 E-06 mGy) and 1.46 E-05 mrad (1.46 E-07 mGy) for Unit 2, which is well below the 20 mrad (0.2 mGy) dose criterion, for an individual reactor unit, in Appendix I to 10 CFR Part 50.

- The maximum dose to any organ (i.e., skin, thyroid, liver, G.I. tract, etc.) of a member of the public at the site boundary from radioactive iodine, tritium, and radioactive particulate matter from Unit 1 was 2.70 E-03 mrem (2.70 E-05 mSv) and 1.65 E-03 mrem (1.65 E-05 mSv) for Unit 2, which is well below the 15 mrem (0.15 mSv) dose criterion, for an individual reactor unit, in Appendix I to 10 CFR Part 50.

Hope Creek Generating Station

- The total-body dose to an offsite member of the public from radioactive liquid effluents from HCGS was 8.32 E-05 mrem (8.32 E-07 mSv), which is well below the 3 mrem (0.03 mSv) dose criterion, for an individual reactor unit, in Appendix I to 10 CFR Part 50.

- The maximum dose to any organ (i.e., skin, thyroid, liver, G.I. tract, etc.) of an offsite member of the public from radioactive liquid effluents from HCGS was 3.05 E-04 mrem (3.05 E-06 mSv), which is well below the 10 mrem (0.1 mSv) dose criterion, for an individual reactor unit, in Appendix I to 10 CFR Part 50.

- The air dose at the site boundary from gamma radiation in gaseous effluents from HCGS was 7.29 E-04 mrad (7.29 E-06 mGy), which is well below the 10 mrad (0.1 mGy) dose criterion, for an individual reactor unit, in Appendix I to 10 CFR Part 50.

- The air dose at the site boundary from beta radiation in gaseous effluents from HCGS was 7.34 E-04 mrad (7.34 E-06 mGy), which is well below the 20 mrad (0.2 mGy) dose criterion, for an individual reactor unit, in Appendix I to 10 CFR Part 50.

- The maximum dose to any organ (i.e., skin, thyroid, liver, G.I. tract, etc.) of a member of the public at the site boundary from radioactive iodine, tritium, and radioactive particulate matter from HCGS was 1.97 E-02 mrem (1.97 E-04 mSv), which is well below the 15 mrem (0.15 mSv) dose criterion, for an individual reactor unit, in Appendix I to 10 CFR Part 50.

Salem – Hope Creek Site Total

- The total-body dose to an offsite member of the public from the combined radioactive effluents from all three reactor units was 7.26 E-03 mrem (7.26 E-05 mSv), which is well below the 25 mrem (0.25 mSv) dose criterion in 40 CFR Part 190.

- The dose to any organ (i.e., skin, thyroid, liver, G.I. tract, etc.) of an offsite member of the public from the combined radioactive effluents from all three reactor units was 2.54 E-02 mrem (2.54 E-04 mSv), which is well below the 25 mrem (0.25 mSv) dose criterion in 40 CFR Part 190.

- The thyroid dose to an offsite member of the public from the combined radioactive effluents from all three reactor units was 2.41 E-02 mrem (2.41 E-04 mSv), which is well below the 75 mrem (0.75 mSv) dose criterion in 40 CFR Part 190.

Based on the Staff's review of the Salem and HCGS radioactive waste system's performance in controlling radioactive effluents and the resultant doses to members of the public in conformance with the ALARA criteria in Appendix I to 10 CFR Part 50, the NRC staff found that the 2009 radiological effluent data for Salem and HCGS are consistent, within reasonable variation attributable to operating conditions and outages, with the historical data. The results demonstrate that Salem and HCGS are operating in compliance with Federal radiation protection standards contained in Appendix I to 10 CFR Part 50, 10 CFR Part 20, and 40 CFR Part 190.

Routine plant operational and maintenance activities currently performed will continue during the license renewal term. Based on the past performance of the radioactive waste system to maintain the dose from radioactive effluents to be ALARA, similar performance is expected during the license renewal term.

The radiological impacts from the current operation of Salem and HCGS are not expected to change significantly. Continued compliance with regulatory requirements is expected during the license renewal term; therefore, the impacts from radioactive effluents would be SMALL.

Field Code Changed

4.8.3 Microbiological Organisms – Public Health

Both Salem and HCGS have thermal discharges to the Delaware Estuary, a large brackish, tidally-influenced water body that allows their thermal plumes to disperse quickly. There are no other facilities that release thermal discharges to the Estuary in the vicinity of Salem and HCGS.

Table B-1 of Appendix B to Subpart A of 10 CFR Part 51 and Table 4-8 above list the effects of thermophilic microbiological organisms on human health as a Category 2 issue and requires the conduct of a plant-specific evaluation before license renewal for those plants Issue applies to plant features such as cooling lakes or cooling towers that discharge to small rivers. NRC has determined that Salem and HCGS discharge to an estuary (NRC 1996). Neither Salem nor HCGS use cooling ponds, cooling lakes, cooling canals, or discharge to a small river. Therefore, this issue does not apply and the effects of plant discharges on microbiological organisms do not need to be addressed for license renewal.

4.8.4 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. 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 SEIS.

In the GEIS (NRC 1996), the NRC staff found that without a review of the conformance of each nuclear plant transmission line with National Electrical Safety Code (NESC) criteria, it was not possible to determine the significance of the electric shock potential (IEEE 2002). 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.

As described in Section 2.1.1.6, four 500-kilovolt (kV) transmission lines were specifically constructed to distribute power to the electrical grid from the Salem and HCGS. One 500-kV line, the HCGS-New Freedom line, was originally constructed to connect HCGS to the transmission system. Two additional lines, Salem-New Freedom North and Salem-Keeney (via Red Lion substation), were originally built for Salem but have since been connected to HCGS. The fourth line, Salem-New Freedom South, originates at Salem (PSEG 2009a, 2009b). PSEG conducted an analysis of the Salem HCGS transmission lines using a computer model of induced current under the line and the results were field verified. PSEG calculated electric field strength and induced current using a computer code called ACDCLINE, produced by the Electric Power Research Institute. The analysis determined that there are no locations under the transmission lines that have the capacity to induce more than 5 milliamperes (mA) in a vehicle parked beneath the line. Therefore, the lines meet the NESC 5 mA criterion. The maximum induced current calculated for the power lines was 4.2 mA, for the Salem-New Freedom South line (PSEG 2009a, 2009b).

PSEG also conducts regular aerial and ground surveillance and maintenance to ensure that design ground clearances do not change. The aerial patrols of all corridors include checks for encroachments, broken conductors, broken or leaning structures, and signs of burnt trees, any of which would be evidence of clearance problems. Ground inspections include examination for clearance at questionable locations, examination for integrity of structures, and surveillance for dead or diseased trees that might fall on the transmission line. Problems noted during any inspection are brought to the attention of the appropriate organizations for corrective action (PSEG 2009a, 2009b).

The staff has reviewed the available information, including the applicant's evaluation and computational results for the potential impacts of electric shock resulting from operation of Salem and HCGS and their associated transmission lines. The staff concludes that the potential impacts of electric shock during the renewal term would be SMALL.

4.8.5 Electromagnetic Fields – Chronic Effects

In the GEIS, the chronic effects of 60-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 (NIEHS 1999) contains the following conclusion:

Field Code Changed

> 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 non-cancer 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.

4.9 Socioeconomics

The socioeconomic issues applicable to Salem and HCGS during the license renewal term are listed in Table 4-23, including applicable GEIS section and category (Category 1, Category 2, or uncategorized).

Table 4-23. Socioeconomic Issues. *Section 2.2.8 of this report describes the socioeconomic conditions near Salem and HCGS.*

Issue	GEIS Section	Category
Housing impacts	4.7.1	2
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	1
Public services: public utilities	4.7.3.5	2
Public services: education (license renewal term)	4.7.3.1	1
Offsite land use (license renewal term)	4.7.4	2
Public services: transportation	4.7.3.2	2
Historic and archaeological resources	4.7.7	2
Aesthetic impacts (license renewal term)	4.7.6	1
Aesthetic impacts of transmission lines (license renewal term)	4.5.8	1
Environmental justice	Not addressed (a)	Uncategorized (a)

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

4.9.1 Generic Socioeconomic Issues

The NRC ~~staff~~ reviewed and evaluated the Salem and HCGS ERs (PSEG 2009a, b), scoping comments, and other available information, and visited the Salem and HCGS sites~~. The NRC staff~~ and did not identify any new and significant information that would change the conclusions presented in the GEIS. Therefore, ~~it is expected that~~ there would be no impacts related to the Category 1 issues during the period of extended operation beyond those discussed in the GEIS. For Salem and HCGS, ~~the staff incorporates~~ the GEIS conclusions for category 1 issues are incorporated by reference. Impacts for Category 2 and uncategorized issues are discussed in the following Sections 4.9.2 through 4.9.7~~, below~~.

4.9.2 Housing Impacts

~~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 of the site, and proximity measures population density and city size within 50 mi. Each factor has categories of density and size (GEIS, Table C.1). A matrix is used to rank the population category as low, medium, or high (GEIS, Figure C.1).~~

According to the 2000 Census, approximately 501,820 people lived within 20 mi of Salem and HCGS, which equates to a population density of 450 persons per square mile (PSEG 2009a, b). This density translates to GEIS Category 4 – least sparse (greater than or equal to 120 persons per square mile within 20 mi). Approximately 5,201,842 people live within 50 mi of Salem and HCGS (PSEG 2009a, b). This equates to a population density of 771 persons per square mile. Applying the GEIS proximity measures, this value translates to a ~~Salem and HCGS are classified as proximity~~ Category 4 – in close proximity (greater than or equal to 190 persons per square mile within 50 mi). Therefore, according to the sparseness and proximity matrix presented in the GEIS, the ~~Salem and HCGS rankings of~~ sparseness Category 4 and proximity Category 4 ~~result in the conclusion~~ indicate that Salem and HCGS are located in a high population area.

Table B-1 of Appendix B to Subpart A of 10 CFR Part 51 states that impacts on housing availability are expected to be of small significance in high-density population areas where growth control measures are not in effect. Since ~~the~~ Salem and HCGS ~~site is~~ are located in a high population area, and Cumberland, Gloucester, Salem, and New Castle Counties are not subject to growth control measures that would limit housing development, any changes in ~~Salem and HCGS~~ employment ~~related impact on housing availability in these counties~~ at Salem and HCGS would ~~likely be small~~ have little noticeable effect on housing availability in these counties. Since PSEG has ~~indicated that that there would be no major plant refurbishment and~~ no plans to add non-outage employees ~~would be added~~ during the license renewal ~~term~~ period, employment levels at Salem and HCGS would remain relatively constant with no additional demand for permanent housing during the license renewal term. In addition, the number of available housing units has kept pace with or exceeded the growth in the area population. Based on this information, there would be no additional impact on ~~permanent~~ housing during the license renewal term beyond what has already been experienced.

4.9.3 Public Services: Public Utilities

As discussed in Section 4.7.4 of the GEIS, ~~i~~impacts on public utility services (e.g., water, sewer) are considered SMALL if ~~there is little or no change in~~ the public utility has the ability ~~of the system~~ to respond to changes in demand and ~~thus there is~~ would have no need to add ~~capital~~ or modify 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 system 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 facility demand and facility-related population growth. As previously discussed in Section 2.1.7, Salem and HCGS obtain their potable water supply directly from groundwater sources. The facility does not purchase water from a public water system. Water usage by Salem and HCGS has not stressed the supply source capacity (usage is approximately 41 percent of the permitted withdrawal [DRBC 2000; NJDEP 2004]) and is not currently an issue. PSEG has no plans to increase Salem and HCGS staffing due to refurbishment or new construction activities, and has identified no operational changes during the license renewal term that would increase potable water use by the facilities.

~~Salem and HCGS operations during the license renewal term would not increase facility-related population demand for public water services. Given that~~ Since PSEG has ~~indicated that there would be no major plant refurbishment, overall~~ no plans to add non-outage employees during the license renewal period, employment levels at Salem and HCGS would remain relatively ~~constant~~ unchanged ~~during this period~~ with no additional demand for public water services. ~~In addition, p~~Public water systems in the region ~~would be~~ are adequate to ~~provide the capacity required to~~ meet the demand of residential and industrial customers in the area. ~~Based on a review of available public water supply use and capacity information in the region~~Therefore, there would be no additional impact to public water services during the license renewal term beyond what is currently being experienced.

4.9.4 Offsite Land Use – License Renewal Period

Off-site land use during the license renewal term is a Category 2 issue. Table B-1 of Appendix B to Subpart A of 10 CFR Part 51 notes that "significant changes in land use may be associated with population and tax revenue changes resulting from license renewal." In Section 4.7.4 of the GEIS, ~~defines~~ the magnitude of land-use changes as a result of plant operation during the period of extended operation is defined 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 PSEG has no plans to add non-outage employees ~~to Salem and HCGS~~ during the license renewal period, there would be no noticeable change in land use conditions in the vicinity of the Salem and HCGS ~~site~~. Therefore, there would be no population-related land use impacts during the license renewal term beyond those already being experienced.

Tax Revenue-Related Impacts

As previously discussed in Section 2.2.8.6, PSEG and the Salem site's minority owner Exelon pay annual real estate taxes to Lower Alloways Creek Township. From 2003 through 2009, the owners paid between $1.2 and $1.5 million annually in property taxes to Lower Alloways Creek Township. This represented between 54 and 59 percent of the township's total annual property tax revenue. Each year, Lower Alloways Creek Township forwards this tax money to Salem County, which provides most services to township residents. The property taxes paid annually for Salem and HCGS during 2003 through 2009 represent approximately 2.5 to 3.5 percent of Salem County's total annual property tax revenues during that time period. PSEG pays annual property taxes to the City of Salem for the Energy and Environmental Resource Center, located in Salem. However, the tax payments for the Center would continue even if the licenses for Salem and HCGS were not renewed; therefore, these tax payments are not considered in the evaluation of tax revenue-related impacts during the license renewal term.

Since PSEG started making payments to the local jurisdiction, population levels and land use conditions in Lower Alloways Creek Township and Salem County have not changed significantly, which might indicate that these tax revenues have had little or no effect on land use activities within the township or county. ~~However, discontinuing the current level of tax revenues would have a significant negative economic impact on Lower Alloways Creek Township.~~

Since PSEG has no plans to add non-outage employees during the license renewal period, employment levels at ~~indicated that there would be no major plant refurbishment or license renewal related construction activities necessary to support the continued operation of~~ Salem and HCGS would remain relatively unchanged ~~during the license renewal period~~. ~~Accordingly,~~ tThere would be no increase in the assessed value of Salem and HCGS, and annual property tax payments to Lower Alloways Creek Township would be expected to 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 beyond those already being experienced.

4.9.5 Public Services: Transportation Impacts

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 (see 10 CFR 51.53(c)(3)(ii)(J)).

~~Given that~~Since ~~Salem and HCGS~~PSEG has~~ve~~ no plans to add non-outage employees 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~~ Salem and HCGS ~~site~~would not change. Therefore, there would be no transportation impacts during the license renewal term beyond those already being experienced.

4.9.6 Historic and Archaeological Resources

The National Historic Preservation Act (NHPA) requires that Federal agencies take in to account the effects of their undertakings on historic properties. The historic preservation review process mandated by Section 106 of the NHPA is outlined in regulations issued by the Advisory Council on Historic Preservation at 36 CFR Part 800. Renewal of an operating license is an undertaking that could potentially affect historic properties. Therefore, according to the NHPA, the NRC is to make a reasonable effort to identify historic properties in areas of potential effects. If no historic properties are present or affected, the NRC is required to notify the State Historic Preservation Officer 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.

4.9.6.1 Site Specific Cultural Resources Information

A review of the New Jersey State Museum (NJSM) files shows that there are no previously recorded archaeological or above ground historic architectural resources identified on the Salem/Hope Creek property. As noted in Section 2.2.9.1 literature review and background research of the plant property was conducted as part of the applicant's Environmental Review, however, no systematic pedestrian or subsurface archaeological surveys have been conducted at the Salem/Hope Creek site to date. Background research identified a total of 23 National Register of Historic Places listed resources within a ten mile radius of the facility, however, none are located within the boundaries of the Salem/Hope Creek property.

There is little potential for historic and archaeological resources to be present on most of the Salem/Hope Creek property. As noted in Section 2.2.9.2, due to the fact that the Salem and Hope Creek generating stations are located on a manmade island, there is little potential for prehistoric archaeological resources to be present. However, because the creation of the island dates to the historic period, there is potential for historic-period archaeological resources to be present in areas not previously disturbed by construction activities.

4.9.6.2 Conclusions

No new facilities, service roads, or transmission lines are proposed for the Salem/Hope Creek site as a part of this operating license renewal, nor are refurbishment activities proposed. Therefore, the potential for National Register eligible historic or archaeological resources to be impacted by renewal of this operating license is SMALL. Based on this conclusion there would be no need to review mitigation measures.

4.9.7 ENVIRONMENTAL JUSTICE

Under Executive Order (EO) 12898 (59 FR 7629), Federal agencies are responsible for identifying and addressing, as appropriate, 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 EO 12898, and strives to meet those goals as part of its NEPA review process."

The Council of Environmental Quality (CEQ) provides the following information in *Environmental Justice: Guidance Under the National Environmental Policy Act* (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~~ employed by the National Environmental Policy Act [NEPA]) and appreciably exceeds the risk or exposure rate for the general population or for another appropriate comparison group (CEQ, 1997).
>
> **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~~ employed 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 (CEQ, 1997).

Comment [JJR1]: See language used in *Environmental justice Guidance Under the National Environmental Policy Act*, CEQ, December 10, 1997 (http://ceq.hss.doe.gov/nepa/regs/ej/justice.pdf).

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 Salem and HCGS 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 P60, on Income and Poverty.

~~The NRC published an environmental justice policy in 2004. This policy stated that for licensing and regulatory actions pertaining to nuclear power plants, a radius of 50 mi should be used to determine potential impacts to environmental justice populations. This policy retained the Office of Nuclear Reactor Regulations' previous radius determination (69 FR 52040). The geographic area included in this environmental justice analysis consists of those census block groups with all or part of their area within a 50-mi radius of Salem and HCGS.~~

Comment [JJR2]: We don't need to justify the 50-mile radius. The 50-mile radius was determined, because it is consistent with the analysis conducted for human health impacts.

Minority Population in 2000

There are a total of 23 counties in the 50-mi radius surrounding Salem and HCGS. Of these, seven are in New Jersey (Salem, Cumberland, Cape May, Atlantic, Gloucester, Camden and Burlington), three are in Delaware (New Castle, Kent and Sussex), six are in Pennsylvania (Philadelphia, Montgomery, Delaware, Chester, Lancaster, and York) and seven are in Maryland (Harford, Cecil, Baltimore, Kent, Queen Anne's, Caroline and Talbot).

According to 2000 Census data, 35.1 percent of the population (1,872,783 persons) residing within ~~an~~ 50-mi radius of Salem and HCGS identified themselves as minority individuals. The largest minority group was Black or African American (1,213,122 persons or 19.5 percent), followed by Asian (190,983 persons or 3.1 percent). A total of 341,886 persons (5.5 percent) identified themselves as Hispanic or Latino ethnicity (USCB, 2003).

Of the (4,579) census block groups located wholly or partly within the 50-mi radius of Salem and HCGS, 1,860 block groups were ~~reported in the 2000 Census as~~ determined to have~~ing high density~~ minority population percentages that exceeded the 50-mi radius ~~average~~ percentage (USCB, 2000a). The largest minority group was Black or African American, with 1,284 block groups that exceed the 50-mi radius ~~average~~percentage. These block groups are primarily located in Philadelphia County, Pennsylvania. There were 24 block groups with Asian, 94 block groups with Some Other Race, and 1 block group with Two or More Races minority classifications that exceeded the 50-mi radius ~~average~~percentage. A total of 202 block groups exceeded the 50-mi radius ~~average~~ percentage for Hispanic or Latino ethnicity. The ~~high density~~ minority population nearest to Salem and HCGS is ~~centered~~ located in the City of Salem, New Jersey.

Based on 2000 Census data, Figure 4-1 shows ~~the~~ minority block groups ~~with high density minority populations~~ within an 80-km (50-mi) radius of Salem and HCGS.

Low-Income Population in 2000

According to 2000 Census data, 119,283 families (2.2 percent) and 620,903 individuals (11.6 percent) residing within a 50-mi radius of Salem and HCGS ~~-~~were identified as living below the Federal poverty threshold in 1999 (USCB, 2003). (The 1999 Federal poverty threshold was $17,029 for a family of four.) The USCB reported 6.3 percent of families and 8.5 percent of individuals in New Jersey, 6.5 percent of families and 9.2 percent of individuals in Delaware, 7.8 percent of families and 11.0 percent of individuals in Pennsylvania, and 6.1 percent of families and 8.5 percent of individuals in Maryland living below the Federal poverty threshold in 1999 (USCB, 2000a; USCB, 2000b).

Census block groups were considered ~~high density~~ low-income block groups if the percentage of families and individuals living below the Federal poverty threshold exceeded the 50-mi radius ~~average~~percentage. Based on 2000 Census data, there were 1,778 block groups within a 50-mi radius of Salem and HCGS that ~~are~~ could be considered ~~high density~~ low-income block groups. The majority of low-income population census block groups ~~with low-income populations~~ were located in Philadelphia County, Pennsylvania. The ~~high density~~ low-income population nearest to Salem and HCGS is located in Lower Alloways Creek Township in Salem County, New Jersey. Figure 4-2 shows ~~high density~~ low-income census block groups within an 80-km (50-mi) radius of Salem and HCGS.

Analysis of Impacts

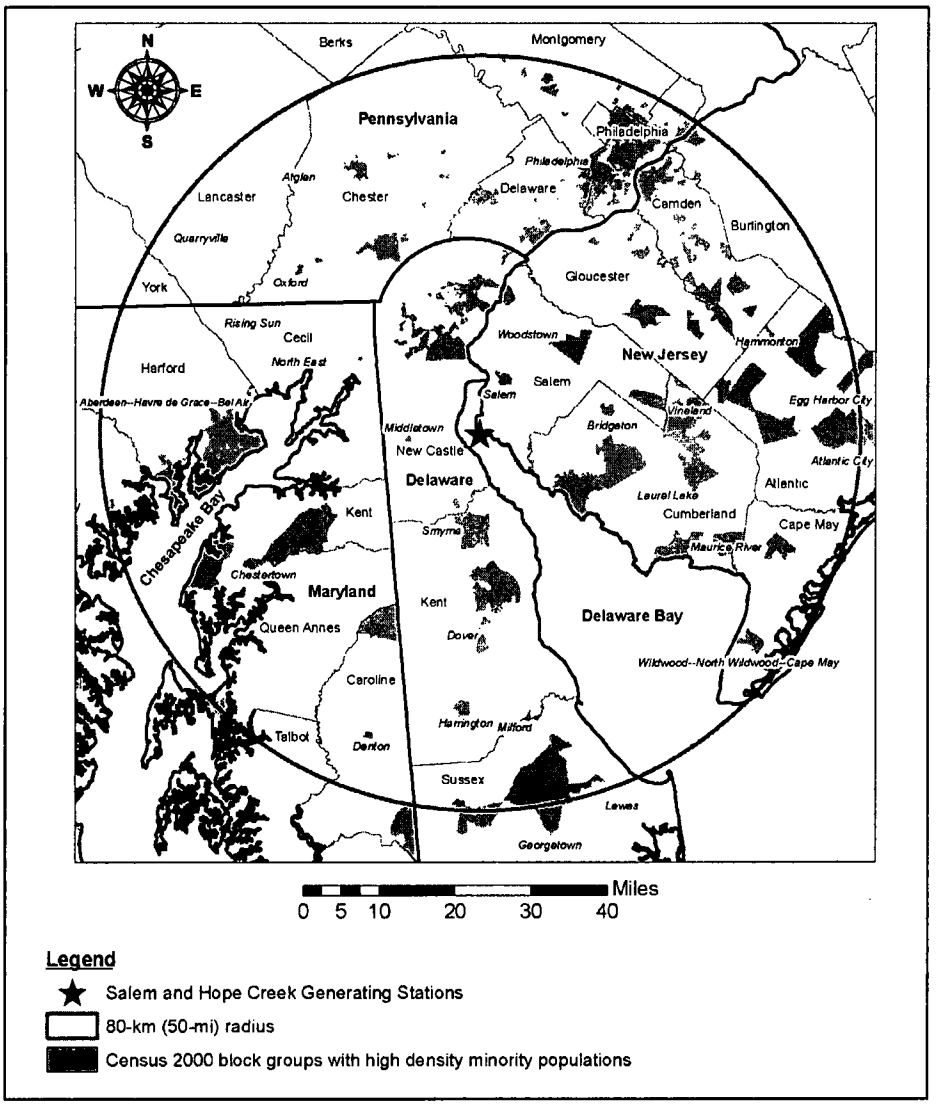
The NRC addresses environmental justice matters for license renewal through (1) identification of minority and low-income populations that may be affected by the proposed license renewal, and (2) examining any potential human health or environmental effects on these populations to determine if these effects may be disproportionately high and adverse.

The discussion and figures above indentifies the location of minority and low-income populations residing within a 50-mile (80-kilometer) radius of Salem and HCGS. This area of impact is consistent with the impact analysis for public and occupational health and safety, which also considers the radiological effects on populations located within a 50-mile (80-kilometer) radius of the plant. As previously discussed for the other resource areas in Chapter 4, the analyses of impacts for all resource areas indicated that the impact from license renewal would be SMALL.

Chapter 5 discusses the environmental impacts from postulated accidents that might occur during the license renewal term, which include both design basis and severe accidents. In both cases, the Commission has generically determined that impacts associated with such accidents are SMALL because nuclear plants are designed to successfully withstand design basis accidents, and that any risk associated with severe accidents were also SMALL.

Therefore, based on the overall findings discussed in Chapters 4 and 5, the NRC concludes that there would be no disproportionately high and adverse impacts to minority and low-income populations from the continued operation of Salem and HCGS during the license renewal term. ~~The discussion above indentifies the minority and low-income populations who reside within a 50-mi radius of Salem and HCGS. This area is consistent with the impact analysis for public and occupational health and safety, which similarly focuses on populations within a 50-mi radius of the facilities. Based on the analysis of impacts for all resource areas presented in this draft SEIS, it was determined that there would be no significant adverse health impacts on members of the public and, therefore, there would be no disproportionate and adverse impacts experienced by minority or low-income populations within the area of interest from the continued operation of Salem and HCGS during the license renewal period. Similarly, given the potential~~

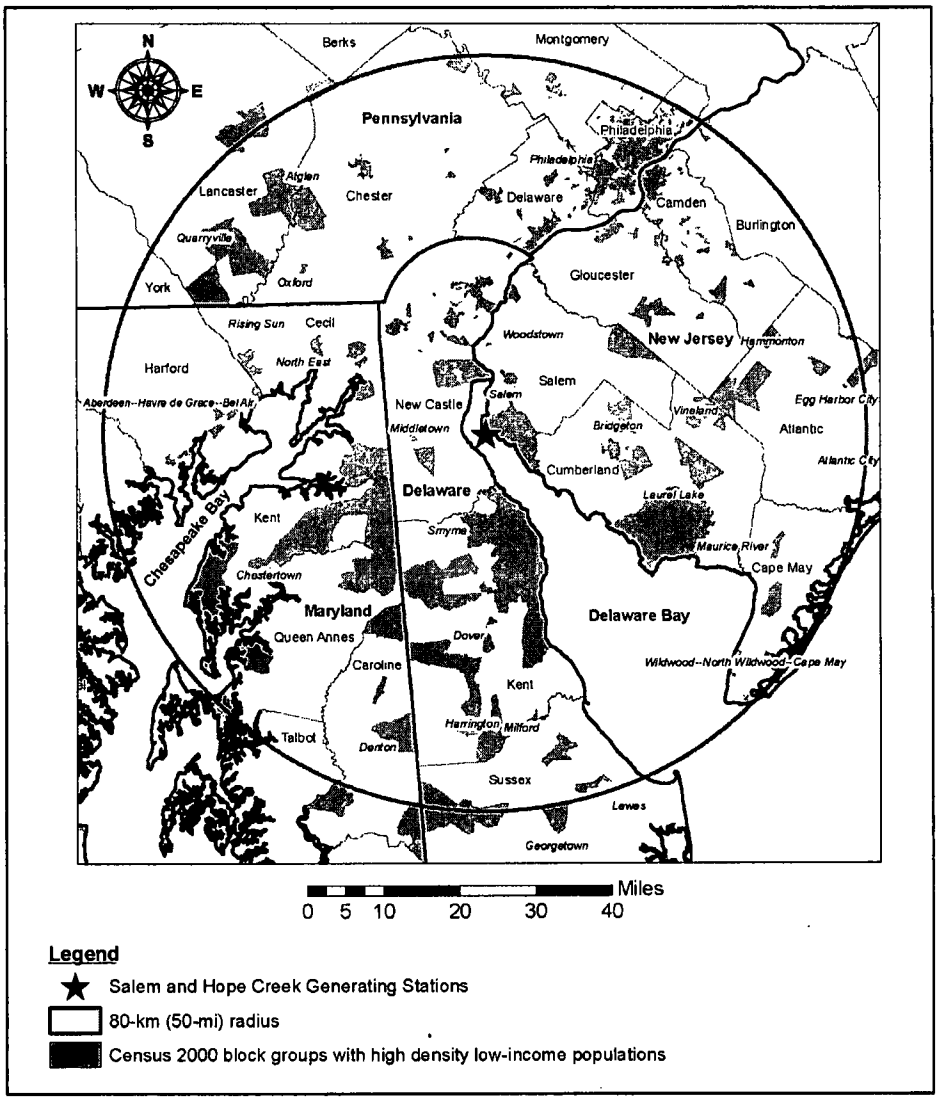
~~environmental effects of continued operation on the physical environment (water, air, aquatic and terrestrial resources) and socioeconomic conditions, there would be no disproportionately high and adverse impacts on minority and low-income populations because of adverse environmental effects.~~



Source: USCB 2003

Figure 4-1. Census 2000 minority block groups within a 50-mi radius of Salem and HCGS

Comment [JJR3]: Delete the words "high density" in figure legend.



Source: USCB 2003

Figure 4-2. Census 2000 low-income block groups within a 50-mi radius of Salem and HCGS

Comment [JJR4]: Delete the words "high density" in figure legend.

As part of addressing environmental justice associated with license renewal, NRC also analyzed the risk of radiological exposure through the consumption patterns of special pathway receptors, including subsistence consumption of fish and wildlife, 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, discussed below, 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 that 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 Salem and HCGS were considered.

PSEG has an ongoing comprehensive Radiological Environmental Monitoring Program (REMP) at Salem and HCGS to assess the impact of site operations on the environment. To assess the impact of the facilities on the environment, the radiological monitoring program at Salem and HCGS uses indicator-control sampling. Samples are collected at nearby indicator locations downwind and downstream from the facilities and at distant control locations upwind and upstream from the facilities. Control locations are usually 9 to 18 miles away from the facilities. A facility effect would be indicated if the radiation level at an indicator location was significantly larger than at the control location. The difference would also have to be greater than could be accounted for by typical fluctuations in radiation levels arising from other naturally-occurring sources (PSEG, 2010). The 2009 Salem and Hope Creek REMP report is incorporated by reference in this SEIS.

Samples are collected from the aquatic and terrestrial pathways in the vicinity of Salem and HCGS. The aquatic pathways include fish, Delaware Bay and River (Delaware estuary) surface water, groundwater, and sediment. The terrestrial pathways include airborne particulates, milk, and food product garden (leaf) vegetation, and direct radiation. During 2009, analyses performed on collected samples of environmental media showed no significant or measurable radiological impact from Salem and HCGS site operations (PSEG, 2010).

Aquatic sampling in the vicinity of Salem and HCGS consists of semi-annual upstream and downstream collections of fish, blue crabs, and bottom sediments. Delaware estuary surface water is collected monthly from upstream and downstream locations. All samples are analyzed for gamma-emitting isotopes. Surface water is additionally analyzed for gross beta and tritium. Drinking water is collected daily from the City of Salem Water and Sewer Department water sources (surface water and groundwater) and composited in a monthly sample. Monthly composites are analyzed for gross alpha, gross beta, tritium, iodine-131, and gamma- emitting isotopes. Well water is collected monthly from one nearby farm's well, located upgradient from Salem and HCGS, and is analyzed for gross alpha, gross beta, tritium, and gamma emitters (PSEG, 2010).

Fish were sampled twice at three locations in 2009 and blue crabs were collected twice at two locations. In the fish and blue crab samples, only naturally-occurring radionuclides were detected, at concentrations less than the pre-operational levels. There was no indication of an effect from Salem and HCGS operations (PSEG, 2010).

Sediment samples were collected twice from six indicator stations and one control station. Naturally occurring potassium-40, thorium-232, and radium-226 and radium-228 (RA-NAT) were found at all indicator and control stations, and naturally occurring beryllium-7 was detected at one indicator station; all of these detections were less than pre-operational concentrations. Cesium 137 was detected in two indicator samples, and no control samples. The positive samples showed lower levels than pre-operational samples. Manganese-54 was detected at one indicator station. There are no pre-operational data for this radionuclide; however, the average concentration of all positive sample results from 1988 to 2008 is slightly higher than the 2009 detected concentration. There was no indication of an effect from operation of the Salem and HCGS facilities (PSEG, 2010).

Surface water samples collected monthly at four indicator stations and one control station revealed trace amounts of tritium (slightly above the minimum detectable concentration range) at the indicator stations and none at the control locations. Gross beta activity was found at both indicator and control locations at levels similar to the pre-operational samples. Naturally occurring potassium-40, thorium-232 and RA-NAT were found in both indicator and control samples. Two potable water samples yielded gross alpha activity below per-operational levels, all samples had gross beta activity below pre-operational levels, no tritium or iodine-131 was detected, and naturally occurring potassium-40, thorium-232 and RA-NAT were detected at levels comparable to previous years sampled. Well water (groundwater) samples had no measureable amounts of tritium, and trace amounts of gross alpha activity. Beta activity levels were lower than the pre-operational data. Potassium-40 and RA-NAT were detected in well water at levels similar to pre-operational levels. There was no indication of an effect from operation of the Salem and HCGS facilities (PSEG, 2010).

Vegetables and fodder crops are collected annually at harvest and are analyzed for gamma-emitting isotopes. Vegetable crops contained only naturally-occurring radionuclides. Potassium 40 was detected at similar levels at both indicator and control locations, at concentrations below pre-operational levels. RA-NAT was not detected in any of the indicator samples, but was detected at two of the control locations. Beryllium 7 was detected in four of the indicator samples, at concentrations comparable to previous years sampled. Fodder crops contained beryllium-7 and potassium-40 at similar concentrations at both indicator and control locations. Milk samples were collected semi-monthly from three indicator farms and one control farm when cows were at pasture, and monthly when cows were not at pasture, and analyzed for iodine-131 and gamma-emitting isotopes. Iodine-131 was not detected in any of the samples, while potassium-40 and RA-NAT were detected at naturally levels less than those found in pre-operational samples. There was no indication of an effect from operation of the Salem and HCGS facilities (PSEG, 2010).

Air quality samples were collected weekly from six locations. These samples were analyzed for gross beta and iodine-131 as a weekly composite and for gamma-emitting isotopes on a quarterly composite basis. Air particulate samples had similar results for both indicator and control locations, and were also comparable to pre-operational levels. Air iodine was not detected. There was no indication of an effect from operation of the Salem and HCGS facilities (PSEG, 2010).

Previously, PSEG had also tested muskrat populations in the area. Muskrats are trapped and consumed by the local population (PSEG, 2006). As of 2006, no muskrat samples have been available for testing as the trappers who were supplying PSEG with samples were no longer operating (PSEG, 2007). The last muskrat data collected in 2005 resulted in only one sample with detectable levels of potassium-40; no other radionuclides were found (PSEG, 2006).

The results of the 2009 REMP sampling and previous REMP reports (~~and~~ including the consideration of ~~the~~ 2005 REMP muskrat data) demonstrate that the routine operation at Salem and HCGS has had no significant or measurable radiological impact on the environment. No elevated radiation levels ~~were~~ have been 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 Salem and HCGS 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. The REMP continues to demonstrate that the dose to a member of the public from the operation of Salem and HCGS remains significantly below the federally required dose limits specified in 10 CFR 20, 10 CFR 72, and 40 CFR 190.~~

The New Jersey Department of Environmental Protection (NJDEP) Bureau of Nuclear Engineering (BNE) also samples the area around Salem and HCGS for radionuclides that could be elevated due to the presence of the two facilities. Ten stations within the vicinity are monitored with thermoluminescent dosimetry. During 2008, all station results were comparable to previous years. Air samples were taken at three locations, with results not significantly different from ambient background levels. Surface water was collected from the Delaware River at the onsite surface water inlet building discharge and at a location on the west bank of the river upstream from Salem's effluent discharge; potable well water samples were taken on site. No gamma emitting isotopes or tritium were found in these samples. Additionally, NJDEP BNE monitors the groundwater on site at Artificial Island in conjunction with the remedial action being undertaken by PSEG to address tritium contamination detected in shallow groundwater near Salem Unit 1. There is no evidence that the tritium has reached any areas outside of the PSEG property. Analyses of fish, shellfish, vegetation, and sediment samples detected only potassium-40, a naturally-occurring radionuclide. Trace amounts of strontium-90 were found in all milk samples, at levels consistent with what is expected as a result of nuclear weapons testing in the 1950s and 1960s (NJDEP, 2009).

Based on ~~recent~~ these monitoring results, concentrations of contaminants in native leafy vegetation, sediments, surface water, and fish and game animals in areas surrounding Salem and HCGS have been quite low. Consequently, 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.

4.10 Evaluation of Potential New and Significant Information

New and significant information is: (1) information that identifies a significant environmental issue not covered in the GEIS and codified in Table B-1 of 10 CFR Part 51, Subpart A, Appendix B, or (2) information that was not considered in the analyses summarized in the GEIS and that leads to an impact finding that is different from the finding presented in the GEIS and codified in 10 CFR Part 51.

The Staff has a process for identifying new and significant information. That process is described in detail in NUREG-1555, Supplement 1, *Standard Review Plans for Environmental Reviews for Nuclear Power Plants, Supplement 1: Operating License Renewal* (NRC, 1999b).

The search for new information includes: (1) review of an applicant's ER and the process for discovering and evaluating the significance of new information; (2) review of records of public comments; (3) review of environmental quality standards and regulations; (4) coordination with Federal, State, and local environmental protection and resource agencies, and (5) review of the technical literature. New information discovered by the Staff is evaluated for significance using the criteria set forth in the GEIS. For Category 1 issues where new and significant information is identified, reconsideration of the conclusions for those issues is limited in scope to the assessment of the relevant new and significant information; the scope of the assessment does not include other facets of an issue that are not affected by the new information.

The Staff has not identified any new and significant information on environmental issues listed in Table B-1 of 10 CFR Part 51, Subpart A, Appendix B, related to the operation of Salem and HCGS during the period of license renewal. The Staff also determined that information provided during the public comment period did not identify any new issues that require site-specific assessment.

The Staff reviewed the discussion of environmental impacts in the GEIS (NRC, 1996) and conducted its own independent review (including two public scoping meetings held in November 2009) to identify new and significant information.

4.11 Cumulative Impacts

The Staff considered potential cumulative impacts in the environmental analysis of continued operation of Salem and HCGS. For the purposes of this analysis, past actions are those related to the resources at the time of the power plants licensing and construction; present actions are those related to the resources at the time of current operation of the power plants; and future actions are considered to be those that are reasonably foreseeable through the end of plant operations including the period of extended operation. Therefore, the analysis considers potential impacts through the end of the current license terms as well as the 20-year renewal license renewal terms. The geographic area over which past, present, and future actions would occur depend on the type of action considered and is described below for each impact area.

4.11.1 Cumulative Impact on Water Resources

For the purposes of this cumulative impact assessment, the spatial boundary of the groundwater system is the Potomac-Raritan-Magothy aquifer, which is a large aquifer of regional importance for municipal and domestic water supply. Although other aquifers (the shallow water-bearing zone, Vincentown Aquifer, and Mt. Laurel-Wenonah Aquifer) underlie the Salem and HCGS facilities, almost all groundwater use by the facilities is from the Potomac-Raritan-Magothy aquifer. The spatial boundary for potential cumulative surface water impacts is the Delaware River Basin.

Actions that can impact groundwater and surface water resources in the region include overuse of groundwater resources, unregulated use of water resources, drought impacts, and the need for flow compensation in the Delaware River for consumptive water use.

Within the Salem and HCGS local area, groundwater is not accessed for public or domestic water supply within 1 mile (1.6 km) of the Salem and HCGS facilities (PSEG 2009a, PSEG 2009b). However, groundwater is the primary source of municipal water supply within Salem and the surrounding counties, and groundwater within the Potomac-Raritan-Magothy aquifer is an important resource for water supply in a region extending from Mercer and Middlesex

counties in New Jersey to the north, and towards Maryland to the southwest. Groundwater withdrawal from the early part of the twentieth century through the 1970s resulted in the development of large-scale cones of depression in the elevation of the piezometric surface, and therefore had a cumulative adverse impact on the availability of groundwater within the aquifer (USGS 1983). In reaction to this impact, NJDEP implemented, water management measures, including limitations on pumping. As of 1998, NJDEP-mandated decreases in water withdrawals had resulted in general recovery of water level elevations in both the Upper and Middle Potomac-Raritan-Magothy aquifers in the Salem County area (USGS 2001). Therefore, the use of groundwater by the facilities is not contributing to a cumulative effect on local groundwater users or larger regional users. Based on these observations, the Staff concludes that, when added to the groundwater usage from other past, present, and reasonably foreseeable future actions, the cumulative impact on groundwater use is SMALL.

Although the Salem and HCGS facilities use surface water from the Delaware River for cooling purposes, the Delaware River is a tidal estuary at the facility location. Therefore, there is no potential for cumulative surface water use conflicts, and the cumulative impact on surface water use is SMALL.

4.11.2 Cumulative Impacts on Estuarine Aquatic Resources

This section addresses past, present, and future actions that have created or could result in cumulative adverse impacts on the aquatic resources of the Delaware Estuary, the geographic area of interest for this analysis. Cumulative impacts on freshwater aquatic resources other than the Delaware River are discussed with terrestrial resources in Section 4.11.3.

A wide variety of historical events have cumulatively affected the Delaware Estuary and its resources. Europeans began settling the estuary region early in the 17th century. By 1660 the English had established multiple small settlements, and major changes in the environment began. Philadelphia had 5,000 inhabitants by 1700 and became the predominant city and port in America. Agriculture grew throughout the region, and the clearing of forest led to erosion. Dredging, diking, and filling gradually altered extensive areas of shoreline and tidal marsh. By the late 1800s, industrialization had altered much of the watershed of the upper estuary, and fisheries were declining due to overfishing as well as pollution from ships, sewers, and industry. By the 1940s, anadromous fish were blocked from migrating upstream to spawn due to a barrier of low oxygen levels in the Philadelphia area. This barrier combined with small dams on tributaries nearly destroyed the herring and shad fisheries. A large increase in industrial pollution during and after World War II resulted in the Delaware River near Philadelphia becoming one of the most polluted river reaches in the world. Major improvements in water quality began in the 1960s through the 1980s as a result of State, multi-State, and Federal action, including the Clean Water Act and the activities of the Delaware River Basin Commission (Delaware Estuary Program, 1995).

In addition to past events, a variety of current and likely future activities and processes also have cumulative impacts on the aquatic resources of the Delaware Estuary to which the proposed action may contribute. Stressors associated with the proposed action and other activities or processes that may contribute to cumulative impacts on the aquatic resources of the estuary include the following:

- continued operation of the once-through cooling system for Salem Units 1 and 2
- continued operation of the closed-cycle cooling system for HCGS
- construction and operation of proposed additional unit at Salem/HCGS site

- continued withdrawal of water to support power generation, industry, and municipal water suppliers
- fishing pressure
- habitat loss and restoration
- changes in water quality
- climate change.

Each of these stressors may influence the structure and function of estuarine food webs and result in observable changes to the aquatic resources in the Delaware Estuary. In most cases, it is not possible to determine quantitatively the impact of individual stressors or groups of stressors on aquatic resources. The stressors affect the estuary simultaneously, and their effects are cumulative. A discussion follows of how the stressors listed above may contribute to cumulative impacts on aquatic resources of the Delaware Estuary.

Continued Operation of the Salem Once-Through Cooling System

Based on the assessment presented in Section 4.5 of this draft SEIS, the NRC staff concluded that entrainment, impingement, and thermal discharge impacts on aquatic resources from the operation of Salem Units 1 and 2 collectively have not had a noticeable adverse effect on the balanced indigenous community of the Delaware Estuary in the vicinity of Salem. The continued operation of Salem during the renewal term would continue to contribute to cumulative impacts on the estuarine community of fish and shellfish. As discussed in Sections 4.5.2 through 4.5.5, there has been extensive, long-term monitoring of fish and invertebrate populations of the Delaware Estuary. The data collected by these studies reflect the cumulative effects of multiple stressors acting on the estuarine community. For example, data from 1970 through 2004 were analyzed using commonly accepted techniques for assessing species richness (the average number of species in the community) and species density (the average number of species per unit volume or area). This analysis found that in the vicinity of Salem and HCGS since 1978, when Salem began operation, finfish species richness has not changed, and species density has increased (PSEG, 2006a). Operation of Salem during the relicensing period likely would continue to contribute substantially to cumulative impacts on aquatic resources in conjunction with HCGS and other facilities that withdraw water from or discharge to the Delaware Estuary. However, given the long-term improvements in the estuarine community during recent decades while these facilities were operating, their cumulative impacts are expected to be limited, with effects on individual species populations potentially ranging from negligible to noticeable.

Continued Operation of the HCGS Closed-Cycle Cooling System

As discussed in Section 4.5.1, the closed-cycle cooling system used by HCGS substantially reduces the volume of water withdrawn by the facility and similarly reduces entrainment, impingement, and thermal discharge effects. Accordingly, the impacts of these effects from operation of the HCGS cooling system during the relicensing period would be limited, and the incremental contribution of HCGS to cumulative impacts on the estuarine community would be minimal. The analysis of cumulative effects on the aquatic community discussed above incorporates the effects of both HCGS and Salem. Operation of HCGS during the relicensing period would continue to contribute to cumulative impacts in conjunction with Salem and other facilities that withdraw water from or discharge to the Delaware Estuary. As described above for Salem, these cumulative impacts are expected to be limited, with effects on individual species populations potentially ranging from negligible to noticeable.

Construction and Operation of Proposed Additional Unit at Salem/HCGS Site

If PSEG decides to proceed and construct a new nuclear power unit at the Salem/HCGS site, it would contribute to cumulative impacts on aquatic resources during construction and operation. The impacts of this action on aquatic resources during the construction period may be substantial in the immediate vicinity of the construction activities but would be limited in extent and unlikely to significantly contribute to cumulative impacts on the estuarine community. The contribution from the long-term operation of the new facility to cumulative impacts on the estuarine community likely would be minor given the expected use of a closed-cycle cooling system. The specific impacts of this action ultimately would depend on the actual design, operating characteristics, and construction practices proposed by the applicant. Such details are not available at this time, but if a combined license application is submitted to NRC, the detailed impacts of this action at the Salem/ HCGS site then would be analyzed and addressed in a separate NEPA document prepared by NRC.

Continued Water Withdrawals and Discharges

Downstream of Artificial Island, there are no large industrial facilities on either side of the estuary south to the mouth of Delaware Bay. Upstream of Artificial Island, there is an oil refinery in Delaware approximately 8 mi (13 km) to the north, and there are many industrial facilities upstream from there (PSEG, 2009a). Many of these facilities are permitted to withdraw water from the river and to discharge effluents to the river. In addition, water is withdrawn from the nontidal, freshwater reaches of the river to supply municipal water throughout New Jersey, Pennsylvania, and New York (DRBC 2010). In the tidal portion of the river, water is used for power plant cooling systems as well as industrial operations. DRBC-approved water users in this reach include 22 industrial facilities and 14 power plants in Delaware, New Jersey, and Pennsylvania (DRBC, 2005). Of these facilities, Salem uses by far the largest volume of water, with a reported water withdrawal volume in 2005 of 1,067,892 million gallons (4,025,953 million liters) (DRBC, 2005). This volume exceeds the combined total withdrawal for all other industrial, power, and public water supply purposes in the tidal portion of the river. The volume of water withdrawn by HCGS in 2005 was much lower, at 19,561 million gallons (73,745 million liters).

These activities are expected to continue in the future, and water supply withdrawals likely will increase in the future in conjunction with population growth. Because water withdrawals from the Delaware River will continue, and are likely to increase, during the relicensing term, this activity will continue to contribute to cumulative effects in the estuary. Similarly, ongoing discharges of effluents to the river and estuary will continue to have cumulative effects. Withdrawals and discharges are regulated by Federal and State agencies as well as by the DRBC, limiting the magnitude of their effects. Permit requirements are expected to limit adverse effects from withdrawals and discharges, and cumulative impacts from these activities

on the aquatic resources of the Delaware Estuary are expected to be minimal.

Fishing Pressure

The majority of the RS and EFH species at Salem are commercially or recreationally important and, thus, are subject to effects from the harvesting of fish stocks. Losses from fish populations due to fishing pressure are cumulative in conjunction with losses due to entrainment and impingement at Salem and Hope Creek as well as other water intakes. In most cases, the commercial or recreational catches of RS are regulated by Federal or State agencies, but losses of some RS continue to occur as bycatch caught unintentionally when fishing for other species. The extent and magnitude of fishing pressure and its relationship to cumulative impacts on fish populations and the overall aquatic community of the Delaware Estuary are difficult to determine because of the large geographic scale of the fisheries and the natural variability that occurs in fish populations and the ecosystem. Fishing pressure (and protection of fisheries through catch restrictions) has the potential to influence the food web of the Delaware Estuary by affecting fish and invertebrate populations in areas extending from the Atlantic Ocean and Delaware Bay through the estuary and upriver.

Habitat Loss and Restoration

As described above, alterations to terrestrial, wetland, shoreline, and aquatic habitats have occurred in the Delaware Estuary since colonial times. Development, agriculture, and other upland habitat alterations in the watershed have affected water quality. The creation of dams and the filling or isolation of wetlands to support industrial and agricultural activities have dramatically changed patterns of nutrient and sediment loading to the estuary. Such activities also have reduced productive marsh habitats and limited access of anadromous fish to upstream spawning habitats. In addition, historic dredging and deposition activities have altered estuarine environments and affected flow patterns, and future activities, such as dredging to deepen the shipping channel through the estuary, may continue to influence estuarine habitats. Development along the shores of the estuary in some places also has resulted in the loss of shoreline habitat.

Although habitat loss in the vicinity of the Delaware Estuary remains a concern, habitat restoration activities have had a beneficial effect on the estuary and are expected to continue during the license renewal term as a requirement of the Salem NJPDES permit (see Section 4.5.5). In addition, wetland permitting regulations are expected to limit future losses of wetland habitat to development in the watershed. Thus, the net cumulative impacts on aquatic habitats associated with the estuary are likely to be minimal in the future, and restoration activities are expected to provide ongoing habitat improvements.

Water Quality

In general, there is evidence to conclude that water quality in the Delaware River Basin, including the estuary, is improving. Upgrades to wastewater treatment facilities and improved agricultural practices during the past 25 years have reduced the amount of untreated sewage, manure, and fertilizer entering the river and contributed to reductions in nutrients and an apparent increase in dissolved oxygen. Chemical contaminants persist in sediments and the tissues of fish and invertebrates, and nonpoint discharges of chemicals still occur (Kauffmann, Belden, and Homsey, 2008). Water quality in the Delaware Estuary likely will continue to be a concern; however, improvement may continue in many components and the incremental contribution of Salem and HCGS to adverse effects on water quality is expected to be minimal.

Climate Change

The potential cumulative effects of climate change on the Delaware Estuary, whether from

natural cycles or related to anthropogenic activities, could result in a variety of changes that would affect aquatic resources. The environmental changes that could affect estuarine systems include sea level rise, temperature increase, salinity changes, and wind and water circulation changes. Changes in sea level could result in dramatic effects on tidal wetlands and other shoreline communities. Water temperature increases could affect spawning patterns or success, or influence species distributions when cold-water species move northward while warm-water species become established in new habitats. Changes in estuarine salinity patterns could influence the spawning and distribution of RS and the ranges of exotic or nuisance species. Changes in precipitation patterns could have a major effect on water circulation and change the nature of sediment and nutrient inputs to the system. This could result in changes to primary production and influence the estuarine food web on many levels. Thus, the extent and magnitude of climate change impacts may make this process an important contributor to cumulative impacts on the aquatic resources of the Delaware Estuary, and these impacts could be substantial over the long term.

Final Assessment of Cumulative Impacts on Aquatic Resources

Aquatic resources of the Delaware Estuary are cumulatively affected to varying degrees by multiple activities and processes that have occurred in the past, are occurring currently, and are likely to occur in the future. The food web and the abundance of RS and other species have been substantially affected by these stressors historically. The impacts of some of these stressors associated with human activities have been and can be addressed by management actions (e.g., cooling system operation, fishing pressure, water quality, and habitat restoration). Other stressors, such as climate change and increased human population and associated development in the Delaware River Basin, cannot be directly managed and their effects are more difficult to quantify and predict. It is likely, however, that future anthropogenic and natural environmental stressors would cumulatively affect the aquatic community of the Delaware Estuary sufficiently that they would noticeably alter important attributes, such as species ranges, populations, diversity, habitats, and ecosystem processes. Based on this assessment, the NRC staff concludes that cumulative impacts during the relicensing period from past, present, and future stressors affecting aquatic resources in the Delaware Estuary would range from SMALL to MODERATE. The incremental contribution from the continued operation of Salem and HCGS to impacts on aquatic resources of the estuary would be SMALL for most impacts.

4.11.3 Cumulative Impacts on Terrestrial and Freshwater Resources

This section addresses past, present, and future actions that could result in adverse cumulative impacts on terrestrial resources, including resources associated with uplands, wetlands, and bodies of freshwater other than the Delaware River (discussed in Section 4.11.2). For the purpose of this analysis, the geographic area of interest includes the Salem and HCGS site on Artificial Island and the associated transmission line ROWs identified in Section 2.1.5.

Impacts on terrestrial and freshwater resources in the area began with historical development. Colonial settlement of the Delaware River area of southern New Jersey began in 1638 with a group of Swedish and Finnish settlers who sought high quality agricultural land across the river from Wilmington, Delaware. During the 1640s, they built Fort Elfsborg as a fortification for the colony in an area that was mostly swampland between Salem and Alloway Creek in the present day township of Elsinboro. Dutch and English groups also were early settlers in the area. As settlement by Europeans, including Dutch and English, progressed, forested regions in this part of southern New Jersey were cleared for towns, farming, and lumber. Industrial development, beginning with the glassmaking industry in the early 1700s, continued through the 1800s (Morris

Land Conservancy, 2006). Land use changes brought about by the Industrial Revolution and other historical trends continued the loss of terrestrial communities of native vegetation and wildlife.

The Salem and HCGS facilities are located on 300 ha (740 ac) of PSEG property on Artificial Island. Construction of Salem and HCGS converted 151 ha (373 ac; 220 ac for Salem and 153 ac for HCGS) in the southwest corner of Artificial Island to facilities and industrial uses. Artificial Island was originally created by deposition of hydraulic dredge material in the early 20th century, and all terrestrial resources on the island have become established since then. Before the historical clearing of land at the Salem and HCGS sites, the terrestrial communities of the island consisted mainly of typical coastal plant species, including salt-tolerant grasses such as cordgrass (*Spartina* spp.) and common reed (*Phragmites australis)*, which could survive in the brackish habitats. There was no known previous development or use of Artificial Island prior to the construction of Salem and HCGS. Currently, the Salem and HCGS sites are developed and maintained for operation of the facilites. The remainder of Artificial Island consists mainly of undeveloped areas of tidal marsh with poor quality soils and very few trees. Non-wetland areas are vegetated mainly with grasses, small shrubs, and planted trees in developed areas (PSEG, 2009a; PSEG, 2009b).

Construction of the transmission line ROWs maintained by PSEG for Salem and HCGS resulted in subsequent changes to the wildlife and plant species present within the vicinity of Artificial Island and along the length of the transmission line ROWs. The transmission lines ROWs have a total length of approximately 240 km (149 mi) and occupy approximately 1,771 ha (4,376 ac). The three ROWs for the Salem and HCGS power transmission system pass through a variety of habitat types, including marshes and other wetlands, agricultural or forested land, and some urban and residential areas (PSEG, 2009a; PSEG, 2009b). Fragmentation of the previously contiguous forested, agricultural, and swamp areas that the transmission ROWs traverse likely resulted in edge effects such as changes in light, wind, and temperature; changes in abundance and distribution of interior species; reduced habitat ranges for certain species; and an increased susceptibility to invasive species. ROW maintenance is likely to continue to have future impacts on terrestrial habitat, such as prevention of natural succession stages within the ROWs, increases in edge species, decreases in interior species, and increases in invasive species.

Land use data provide an indication of the impacts on terrestrial resources that have resulted from historical and ongoing development. Current land uses in the region are discussed by county in Section 2.2.8.3 of this draft SEIS. In Salem County, based on 2008 data, farmland under active cultivation is the predominant type of land cover (42 percent), followed by tidal and freshwater wetlands (30 percent), forests (12 percent), residential/commercial/industrial uses (13 percent), and other undeveloped natural areas (3 percent) (Morris Land Conservancy, 2008). In the two adjacent counties in New Jersey (Cumberland and Gloucester), agriculture accounts for 19 and 26 percent of the land cover, and urban land use in the two counties was 12 percent and 26 percent, respectively (DVRPC, 2009; Gloucester County, 2009). Thus, commercial and industrial facilities, including the Salem and HCGS site and ROWs, have had a smaller impact on the loss of native terrestrial forest and wetland habitats in the region compared to agricultural development.

Although development of PSEG property on Artificial Island has contributed minimally to impacts on terrestrial resources from historical and ongoing development in the region, portions of both PSEG land and the island have been protected from development. Approximately 25 percent (40 ha [100 ac]) of PSEG property and approximately 80 percent (485 ha [1200 ac]) of Artificial Island remain undeveloped. These areas consist predominantly of estuarine marsh

and freshwater emergent marsh, wetlands, and ponds. The U.S. government owns the portions of the island adjacent to Salem and HCGS (to the north and east), while the State of New Jersey owns the rest of the island as well as much nearby inland property (LACT,1988a; LACT, 1988b; PSEG 2009a; PSEG, 2009b). In conjunction with the Artificial Island wetlands, public lands in the region also preserve forest and wetland habitat and have a beneficial cumulative impact on terrestrial resources.

PSEG has indicated the possibility of constructing a new reactor unit at the Salem and HCGS site on Artificial Island (PSEG, 2010). It would be primarily located on previously disturbed land adjacent to the existing Salem and HCGS units. It is not know at this time whether new transmission lines would be constructed. If additional ROW needs to be cleared, terrestrial habitats and the wildlife they support could potentially be affected in the areas it would traverse.

The NRC staff concludes that cumulative impacts from past, present, and reasonably foreseeable future actions on terrestrial resources in the region are MODERATE relative to predevelopment conditions, while the incremental contribution of continued operation of Salem and HCGS would be SMALL.

4.11.4 Cumulative Human Health Impacts

The radiological dose limits for protection of the public and workers have been developed by the NRC and EPA to address the cumulative impact of acute and long-term exposure to radiation and radioactive material. These dose limits are codified in 10 CFR Part 20 and 40 CFR Part 190. For the purpose of this analysis, the area within a 50-mi (80.4-km) radius of the Salem and HCGS was included. The radiological environmental monitoring program conducted by PSEG in the vicinity of the Salem and HCGS site measures radiation and radioactive materials from all sources (i.e., hospitals and other licensed users of radioactive material); therefore, the monitoring program measures cumulative radiological impacts. Within the 50-mi (80-km) radius of the Salem and HCGS site there are no other nuclear power reactors or uranium fuel cycle facilities.

On May 25, 2010 PSEG submitted an application for a Early Site Permit (ESP) for the possible construction of a fourth reactor at the Salem and HCGS site (PSEG 2010?). A specific reactor design has not been selected; therefore, the application uses a plant parameter envelope approach to evaluate the suitability of the site based on the potential environmental impacts from a blend of reactor types. This approach uses surrogate values as upper and lower bounds for issues such as; power level, radioactive effluents, public dose estimates, thermal discharges, air quality, accident consequences, etc., for each of the potential reactor designs being considered. This is a conservative approach allowed by the NRC for the analysis of the environmental impacts from an unspecified reactor design at a specific location. A final decision by the applicant on the reactor design will be deferred until the submission of an application for either a construction permit or a combined construction permit and operating license.

The NRC will evaluate the ESP application in accordance with its regulations to ensure the application meets the NRC requirements for adequate protection and safety of the public and the environment. As discussed above, any new potential source of radioactive emissions from a uranium fuel cycle facility will be evaluated during the licensing process to address the cumulative impact of acute and long-term exposure to radiation and radioactive material.

The applicant constructed an independent spent fuel storage installation (ISFSI) on the Salem

and HCGS site in 2007 for the storage of its spent fuel. Currently, only spent fuel from HCGS is being stored in the ISFSI. The installation and monitoring of this facility is governed by NRC requirements in 10 CFR Part 72, "Licensing Requirements for the Independent Storage of Spent Nuclear Fuel, High-Level Radioactive Waste, and Reactor-Related Greater Than Class C Waste." Radiation from this facility as well as from the operation of Salem and HCGS are required to be within the radiation dose limits in 10 CFR Part 20, 40 CFR Part 190, and 10 CFR Part 72. The NRC performs periodic inspections of the ISFSI and the Salem and HCGS to verify their compliance with licensing and regulatory requirements.

Radioactive effluent and environmental monitoring data for the 5-year period from 2005 to 2009 were reviewed as part of the cumulative impacts assessment. These reports show that past and current annual radiological doses to a maximally exposed member of the public at the site boundary are well below regulatory dose limits. In Section 4.8 the Staff concluded that impacts of radiation exposure to the public and workers from operation of Salem and HCGS during the renewal term are SMALL. The possible addition of a fourth reactor to the three-reactor site is not expected to result in any substantial increases in doses that would cause the cumulative dose impact to approach regulatory limits. This is because the reactor would be required to maintain its radiological release within NRC's dose limits for individual reactor units and the cumulative dose from all reactor units and the ISFSI on the site. Also, the NRC and the State of New Jersey would regulate any future actions in the vicinity of the Salem and HCGS site that could contribute to cumulative radiological impacts. Therefore, the staff concludes that the cumulative radiological impact to the public and workers from continued operation of Salem and HCGS, its associated ISFSI, and a possible fourth power reactor would be SMALL.

The NRC staff has determined that the electric-field-induced currents from the Salem and HCGS transmission lines are below the NESC criteria for preventing electric shock from induced currents. Therefore, the Salem and HCGS transmission lines do not significantly affect the overall potential for electric shock from induced currents within the analysis area; the impact is SMALL. The potential effect from the chronic exposure to these electric fields continues to be studied and is not known at this time. The NRC staff considers the GEIS finding of "Uncertain" still appropriate and will continue to follow developments on this issue.

4.11.5 Cumulative Air Quality Impacts

The Salem and HCGS facilities are located in Salem County, which is included with the Metropolitan Philadelphia Interstate Air Quality Control Region (AQCR), which encompasses the area geographically located in five counties of New Jersey, including Salem and Gloucester Counties, New Castle County Delaware, and five counties of Pennsylvania (40 CFR 81.15). Salem County is designated as in attainment/unclassified with respect to the NAAQSs for PM2.5, SO2, NOx, CO, and lead. The county, along with all of southern New Jersey, is a nonattainment area with respect to the 1-hour primary ozone standard and the 8-hour ozone standard. For the 1-hour ozone standard, Salem County is located within the multi-state Philadelphia-Wilmington-Trenton non-attainment area, and for the 8-hour ozone standard, it is located in the Philadelphia-Wilmington-Atlantic City (PA-NJ-DE-MD) non attainment area. Of the adjacent counties, Gloucester County in New Jersey is in non-attainment for the 1-hour and 8-hour ozone standards, as well as the annual and daily PM2.5 standard (NJDEP 2010a). New Castle County, Delaware, is considered to be in moderate non-attainment for the ozone standards, and non-attainment for PM2.5 (40 CFR 81.315).

The State of New Jersey has implemented several measures to address greenhouse gas (GHG) emissions within the state. In February 2007, the governor signed Executive Order 54 calling for a reduction in GG emissions to 1990 levels by 2020, and to 80 percent below 2006

levels by 2050. These objectives became mandatory in July 2007, with passage of the Global Warming Response Act. New Jersey also joined with nine other northeastern and mid-Atlantic states in the Regional Greenhouse Gas Initiative (RGGI) through Assembly Bill 4559 in January 2008. The RGGI caps carbon dioxide emissions from power plants, and requires utilities to purchase emissions credits, with the funds used to finance energy efficiency and renewable energy programs.

Potential cumulative effects of climate change on the State of New Jersey, whether or not from natural cycles of anthropogenic (man-induced) activities, could result in a variety of changes to the air quality of the area. As projected in the "Global Climate Change Impacts in the United States" report by the United States Global Change Research Program (USGCRP, 2009), the temperatures in the mid-Atlantic have already risen up to 1°F since the 1961-1979 baseline, and are projected to increase by 3 to 6°F more by 2090. Increases in average annual temperatures, higher probability of extreme heat events, higher occurrences of extreme rainfall (intense rainfall or drought) and changes in the wind patterns could affect concentrations of the air pollutants and their long-range transport, because their formation partially depends on the temperature and humidity and is a result of the interactions between hourly changes in the physical and dynamic properties of the atmosphere, atmospheric circulation features, wind, topography, and energy use (IPCC, 2010).

Consistent with the findings in the GEIS, the Staff concludes that the impacts from continued operation of the Salem and HCGS facilities on air quality are SMALL. As no refurbishment is planned at the facilities during the license renewal period, no additional air emissions would result from refurbishment activities (PSEG, 2009a; PSEG, 2009b). In comparison with construction and operation of a comparable fossil-fueled power plant, license renewal would result in a new cumulative deferral of GHG emissions, which would otherwise be produced if a new gas or coal-fired plant were instead constructed. When compared with the alternative of a new fossil-fuel power plant, the option of license renewal also results in a substantial new cumulative deferral in toxic air emissions.

For the purpose of this cumulative air impact assessment, the spatial bounds include the Metropolitan Philadelphia Interstate Air Quality Control Region (AQCR), which encompasses the area geographically located in five counties of New Jersey, including Salem and Gloucester Counties, New Castle County Delaware, and five counties of Pennsylvania. The Staff concludes that, combined with the emissions from other past, present, and reasonably foreseeable future actions, cumulative hazardous and criteria air pollutant emission impacts on air quality from Salem and HCGS-related actions would be SMALL. When considered with respect to an alternative of building a fossil-fuel powered plant, continuing the operation of the Salem and HCGS facilities would constitute a net cumulative beneficial environmental impact in terms of emissions offsets (i.e., reducing hazardous, criteria, and GHG air emissions) that would otherwise be generated by a fossil-fuel plant.

4.11.6 Cumulative Socioeconomic Impacts

As discussed in Section 4.9 of this draft SEIS, continued operation of Salem and HCGS during the license renewal term would have no impact on socioeconomic conditions in the region beyond those already being experienced. Since PSEG has no plans to hire additional workers during the license renewal term~~indicated that there would be no major plant refurbishment, overall expenditures and~~ employment levels at Salem and HCGS would remain relatively

constant with no additional demand for permanent housing, public utilities, and public services. In addition, since employment levels and ~~the value of Salem and HCGS~~ tax payments would not change, there would be no population and tax revenue-related land use impacts. There would also be no disproportionately high ~~and~~ or adverse human health or environmental impacts on minority and low-income populations in the region. Based on this and other information presented in Chapter 4 of this draft SEIS, there would be no cumulative socioeconomic impacts from Salem and HCGS operations during the license renewal term beyond what is already being experienced.

~~If~~ Should PSEG receive approval from the NRC and decides to ~~proceed and~~ construct a new nuclear power plant unit at the Salem and HCGS site, the cumulative short-term construction-related socioeconomic impacts of this action could be MODERATE to LARGE in counties located in the immediate vicinity of Salem and HCGS. These impacts would be caused by the short-term increased demand for rental housing and other commercial and public services used by construction workers during the years of power 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 Salem and HCGS site.

The cumulative long-term operations-related socioeconomic impacts of this action during the operation of the new power plant unit 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, from the addition of operations workers at the Salem and HCGS site during the years of new 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 Salem and HCGS site.

Since Salem County has less housing and public services available to handle the influx of construction workers in comparison to New Castle, Gloucester, and Cumberland Counties, the cumulative short-term construction-related socioeconomic impacts on Salem County would likely be MODERATE to LARGE. Over the long-term, cumulative operations impacts on Salem County would likely be SMALL to MODERATE since new operations workers would likely reside in the same counties and in the same pattern as the current Salem and HCGS workforce. Many of the operations workers would be expected to settle in Salem County where nearly 40 percent of the current workforce reside.

Because New Castle, Gloucester, and Cumberland Counties each has a larger available housing supply than Salem County, and the current number of Salem and HCGS workers residing in these three counties combined (43 percent) is the same as those residing in Salem County (40 percent), the cumulative construction- and operations-related socioeconomic impacts are likely to be SMALL in these three counties. If PSEG decides to construct a new nuclear power plant unit at the Salem and HCGS site, the cumulative impacts of this action would likely be SMALL on the four-county socioeconomic region of influence.

The specific impact of this action would ultimately depend on the actual design, characteristics, and construction practices proposed by the applicant. Such details are not available at this time, but if the combined license application is submitted to NRC, the detailed socioeconomic

impacts of this action at the Salem and HCGS site would be analyzed and addressed in a separate NEPA document that would be prepared by NRC.

4.11.7 Summary of Cummulative Impacts

The Staff considered the potential impacts resulting from operation of Salem and HCGS during the period of extended operation and other past, present, and reasonably foreseeable future actions in the vicinity of Salem and HCGS. The preliminary determination is that the potential cumulative impacts resulting from Salem and HCGS operation during the period of extended operation would range from SMALL to MODERATE. Table 4-XX summarizes the cumulative impact by resource area.

Table 4-24. Summary of Cumulative Impacts on Resource Areas

Resource Area	Impact	Summary
Land Use	SMALL	With respect to the Salem and HCGS facilities, no measureable changes in land use would occur over the proposed license renewal term. When combined with other past, present, and reasonable foreseeable future activities, impacts from continued operation of Salem and HCGS would constitute a SMALL cumulative impact on land use.
Air Quality	SMALL	Impacts of air emissions over the proposed license renewal term would be SMALL. When combined with other past, present, and reasonably foreseeable future activities, impacts to air resources from the Salem and HCGS facilities would constitute a SMALL cumulative impact on air quality. In comparison with the alternative of constructing and operating a comparable gas or coal-fired power plant, license renewal would result in a new cumulative deferral in both GHG and other toxic air emissions, which would otherwise be produced by a fossil-fueled plant.
Ground Water	SMALL	Groundwater consumption constitutes a SMALL cumulative impact on the resource. When this consumption is added to other past, present, and reasonably foreseeable future withdrawals, cumulative impact on groundwater resources is SMALL.
Surface Water	SMALL	Impacts on surface water over the proposed license term would be SMALL. When combined with other past, present, and reasonably foreseeable future activities, impacts to surface water from the Salem and HCGS facilities would constitute a SMALL cumulative impact.
Aquatic Resources	SMALL	Past and present operations have impacted aquatic resources in the vicinity of Salem and HCGS and would likely continue to in the future. Such impacts would continue to be SMALL. When combined with other past, present, and reasonable foreseeable future activities, impacts from continued operation of Salem and HCGS would constitute a SMALL cumulative impact on aquatic resources.
Terrestrial Resources	SMALL to MODERATE	Past and present operations constituted a MODERATE impacted terrestrial habitat and species in the vicinity of Salem and HCGS. Continued impacts associated with the proposed license renewal term would be SMALL. When combined with other past, present, and reasonable foreseeable future activities, impacts from continued operation of Salem and HCGS would constitute a SMALL cumulative impact on terrestrial resources.

Threatened or Endangered Species	SMALL	Past and present operations have impacted threatened or endangered species in the vicinity of Salem and HCGS and would likely continue to in the future. Such impacts would continue to be SMALL. When combined with other past, present, and reasonable foreseeable future activities, impacts from continued operation of Salem and HCGS would constitute a SMALL cumulative impact on threatened or endangered species.
Human Health	SMALL	When combined with the other past, present, and reasonably foreseeable future activities, the cumulative human health impacts of continued operation of Salem and NCGS from radiation exposure to the public, microbiological organisms from thermal discharges to the Delaware Estuary, and electric-field-induced currents from the Salem and HCGS transmission lines would all be negligible to SMALL.
Socioeconomics	SMALL to LARGE	Impacts on socioeconomics over the proposed license term would be SMALL depending on the alternative selected. When combined with other past, present, and reasonably foreseeable future activities, impacts to socioeconomics from the Salem and HCGS facilities would constitute a SMALL to LARGE cumulative impact.

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