Logan, Dennis

From: Logan, Dennis
Sent: Thursday, August 19, 2010 11:33 AM
To: 'Dillard, Steve'
Cc: Imboden, Andy
Subject: RE: QUESTION: salem NJPDES permit status
Attachments: App D - EFH Assessment(2) - DTL.docx

Steve,

Thanks for sending the EFH assessment yesterday. The draft is attached with my comments and edits—a couple will be worked out as part of your normal editing.

One element is missing, I think: We need a short discussion of cumulative effects in which we talk about the application for a COL that has been submitted to NRC for a new unit on Artificial Island. Info should be available on our public website. We will need the same cumulative effects discussion in the BA as well (don't know if I had caught that earlier). Cut and paste from Chapter 4 cumulative impact as much as possible--short and concise is good. Other comments are in the attached document.

Perhaps we should also mention in the intro that we previously submitted an EFH analysis for the extended power uprate for Hope Creek and that NOAA Fisheries accepted that assessment. That info is in ADAMS. Just a sentence or two would do it.

One last thing. Since this has less cut-and-paste from the SEIS (more from the previous EFH for Hope Creek), please give it a lost check against the SEIS sections to see we didn't contradict ourselves or say something different. I did not see anything like that in my review, but a last check would not hurt.

Otherwise I think this is good for inclusion in the draft SEIS.

Be talking to you,
Dennis

From: Dillard, Steve [mailto:STEVE.DILLARD@aecom.com]
Sent: Wednesday, August 18, 2010 7:24 PM
To: Logan, Dennis
Subject: RE: QUESTION: salem NJPDES permit status

Dennis,

Sorry I'm just now responding – I was out of the office Mon and Tues and have been scrambling to catch up today. Nicole has been calling the State of NJ to try to get the answers to your questions, though I don't think she's succeeded yet.

I've attached the EFH assessment for your review. Most of it you've seen because it is modeled after the one for the HCGS EPU. I've also tried to incorporate all relevant comments you made on the BA into the sections that the EFH and BA have in common. It hasn't been through final tech editing and formatting, so don't worry about those types of issues.

D/141

I have a few questions related to finalizing Section 4.5 and the BA. I'll try to call you tomorrow to resolve them.

Regards,

Steve Dillard
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From: Logan, Dennis [mailto:Dennis.Logan@nrc.gov]
Sent: Tuesday, August 17, 2010 8:44 AM
To: Dillard, Steve; Duda, Steve
Subject: FW: QUESTION: salem NJPDES permit status

I put together this much from the ER to answer Bo's question, but still have a couple of questions (see attachment). Could you answer them? Your section 4 discussions do not answer these either. Thanks. -Dennis

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From: Pham, Bo
Sent: Monday, August 16, 2010 5:57 PM
To: Hurley, Bobbie; Logan, Dennis; Eccleston, Charles
Cc: Imboden, Andy; Susco, Jeremy; Nguyen, Nikki
Subject: QUESTION: salem NJPDES permit status

Bobbie & aquatic folks (I don't have Dillard's email):

What is the status of the NJPDES permit & associated 316b determination for Salem?

Charles fwded me a "Factsheet for a Draft NJPDES Permit Including Section 316(a) Variance Determination and Section 316(b) Decision," which is not dated and didn't seem official to me. I'm trying to respond to the cooling tower question in the scoping summary report and am hesitant to cite a fact sheet that may not be recognized by the state yet because it's in draft form. I would prefer to cite their current or last good 316b determination.

Thanks.

Bo Pham
Chief, Projects Branch 1
Division of License Renewal
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
301-415-8450

Essential Fish Habitat Assessment

Salem Nuclear Generating Station Units 1 and 2

Hope Creek Generating Station Unit 1

License Renewal

July 2010

Docket Numbers 50-272, 50-311, and 50-354

U.S. Nuclear Regulatory Commission

Rockville, Maryland

Assessment of the Potential Effects on Essential Fish Habitat from the Proposed License Renewal for Salem Nuclear Generating Station and Hope Creek Generating Station

1.0 Introduction

The U.S. Nuclear Regulatory Commission (NRC) prepared this essential fish habitat (EFH) assessment to support the draft supplemental environmental impact statement (SEIS) for renewal of the operating licenses for Salem Nuclear Generating Station Units 1 and 2 (Salem) and Hope Creek Generating Station (HCGS), which are located in New Jersey on the eastern shore of the Delaware Estuary. The current 40-year licenses expire on August 13, 2016 for Salem Unit 1, April 18, 2020 for Salem Unit 2, and April 11, 2026 for HCGS. The proposed license renewal for which this EFH assessment has been prepared would extend the operating licenses for 20 years.

PSEG Nuclear, LLC (PSEG), which operates Salem and HCGS, prepared Environmental Reports (PSEG 2009a; PSEG 2009b) as part of its application for renewal of the Salem and HCGS licenses. In the Environmental Reports, PSEG analyzed the environmental impacts associated with the proposed license renewal action, considered alternatives to the proposed action, and evaluated mitigation measures for reducing adverse environmental effects. The NRC is using the Environmental Reports and additional information as the basis for this EFH assessment and the SEIS, a facility-specific supplement to the *Generic Environmental Impact Statement for License Renewal of Nuclear Plants*, NUREG-1437 (NRC 1996).

The Magnuson-Stevens Fishery Conservation and Management Act (MSA) was reauthorized in 1996 and amended to focus on the importance of habitat protection for healthy fisheries (16 USC 1801 et seq.). The MSA amendments, known as the Sustainable Fisheries Act, required the eight regional fishery management councils to describe and identify EFH in their regions, to identify actions to conserve and enhance their EFH, and to minimize the adverse effects of fishing on EFH. The act strengthened the authorities of the governing agencies to protect and conserve the habitats of marine, estuarine, and anadromous fish, crustaceans, and mollusks (New England Fisheries Management Council [NEFMC], 1999). EFH was defined by Congress as those waters and substrates necessary for spawning, breeding, feeding, or growth to maturity (MSA, 16 USC 1801 et seq.). The National Marine Fisheries Service (NMFS) designates EFH. The consultation requirements of Section 305(b) of the MSA provide that Federal agencies consult with NMFS on all actions or proposed actions authorized, funded, or undertaken by the agency that may adversely affect EFH.

EFH is an essential component in the development of Fishery Management Plans to assess the effects of habitat loss or degradation on fishery stocks and to take actions to mitigate such damage. Many managed species are mobile and migrate seasonally, so some species are managed coast-wide, others are managed by more than one fishery management council, and still others are managed for the entire coast by a single council. In Delaware Bay, various fisheries species are managed by the Atlantic States Marine Fisheries Commission (ASMFC), the New England Fisheries Management Council (NWMFC), the Mid-Atlantic Fishery Management Council (MAFMC), and the South Atlantic Fishery Management Council (SAFMC). Several species are regulated by the states of New Jersey and Delaware as well, in some cases with more rigid restrictions than those of the regional councils.

2.0 Proposed Federal Action

The proposed Federal actions are NRC's decisions to either renew or not renew the operating licenses for Salem and HCGS for an additional 20 years beyond the original 40-year term of operation. PSEG initiated the proposed actions by submitting applications for license renewal for Salem Units 1 and 2, for which the existing licenses DPR-70 (Unit 1) and DPR-75 (Unit 2) expire on August 13, 2016 and April 18, 2020, respectively, and for HCGS, for which the existing license NPF-57 expires April 11, 2026. If NRC approves the license renewal applications, PSEG could continue to operate and maintain the units until the renewed licenses expire in 2036, 2040, and 2046. No major construction, refurbishment, or replacement activities are associated with the license renewals.

3.0 Environmental Setting

The Salem and HCGS facilities are at the south end of Artificial Island in Lower Alloways Creek Township, Salem County, New Jersey about 50 river miles (mi) north of the mouth of Delaware Bay. The estuary at this point is approximately 2.5 mi wide. The Salem and HCGS facilities are located near river mi 50, approximately 17 mi south of the Delaware Memorial Bridge. Salem, New Jersey is 8 mi northeast of the site, and Philadelphia is about 40 mi to the northeast (AEC, 1973). Figures 1 and 2 show the location of Salem and HCGS within a 6-mi radius and a 50-mi radius, respectively.

Artificial Island is a 1,500-acre (ac) island created by the U.S. Army Corps of Engineers (USACE) beginning in the early 20th century. USACE constructed the island by building up hydraulic dredge spoils within a progressively enlarged diked area established around a natural sandbar that projected into the estuary. The island currently has an average elevation of about 9 feet (ft) above mean sea level (MSL) and a maximum elevation of about 18 ft above MSL (AEC, 1973). Figure 3 is an aerial photograph of the site.

Comment [D1]: Please add the internationalunits of measure.

From the mouth of Delaware Bay upstream through the estuary to the river, aquatic habitats transition from saltwater to tidally influenced brackish water of variable salinities to tidal freshwater. Additional habitats occur along the margins of the estuary in brackish and freshwater marshes. The substrate of the estuary provides a range of benthic habitats with characteristics dictated by salinity, tides, water velocity, and sediment type. Sediments in the estuary zone that includes Artificial Island are primarily mud, muddy sand, and sandy mud (PSEG, 2006a).

Comment [D2]: "transition" is a transitive verb, so it is the wrong word here. Can you find a better one?

At Artificial Island, the estuary is tidal with a net flow to the south (Figure 1). The USACE maintains a dredged navigation channel near the center of the estuary about 6,600 ft (2,011 meters [m]) west of the shoreline at Salem and HCGS. The navigation channel is about 40 ft (12 m) deep and 1,300 ft (396 m) wide. On the New Jersey side of the channel, water depths in the open estuary at mean low water are fairly uniform at about 20 ft (6 m). Predominant tides in the area are semi-diurnal with a period of 12.4-hours and a mean tidal range of 5.5 ft (1.68 m) (NRC, 1984; Najarian Associates, 2004).

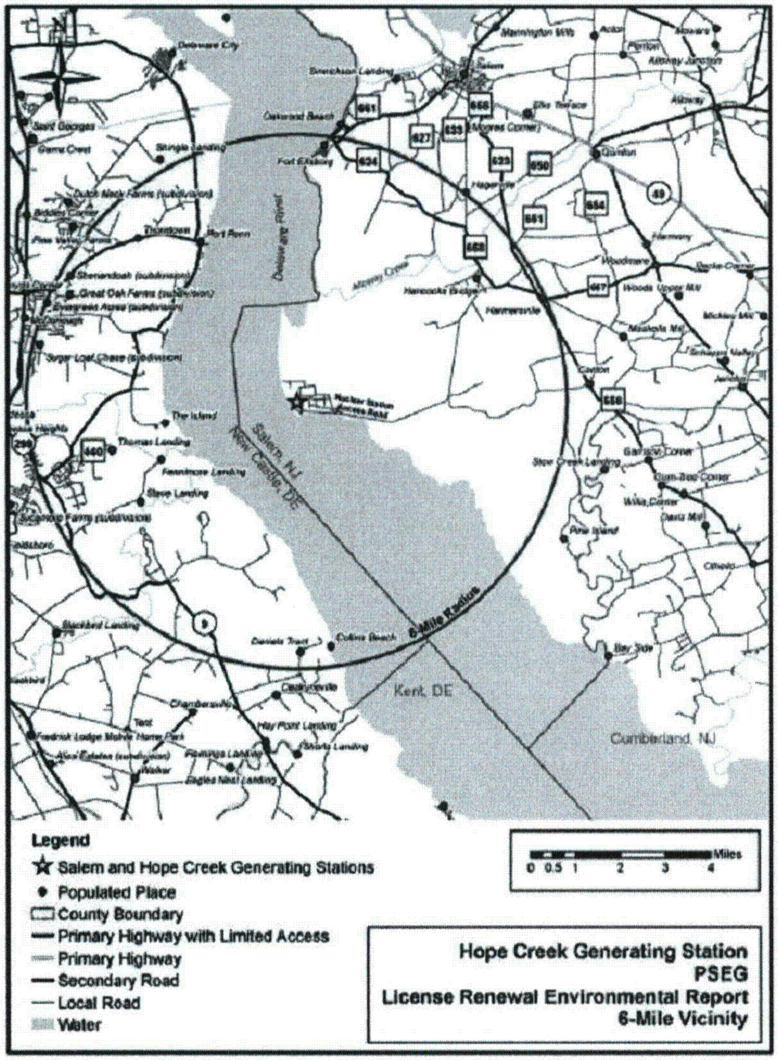

Figure 1. Location of Salem and HCGS Site, within a 6-Mile Radius (Source: PSEG, 2009a; PSEG, 2009b)

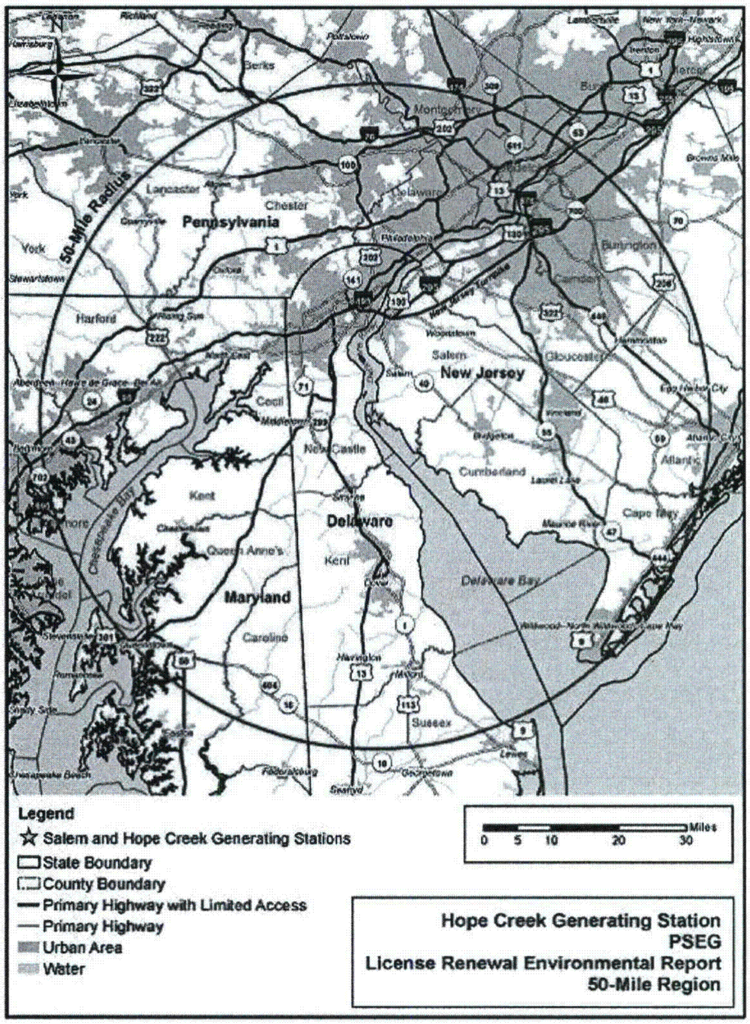

Figure 2. Location of Salem and HCGS Site, within a 50-Mile Radius (Source: PSEG, 2009a; PSEG, 2009b)

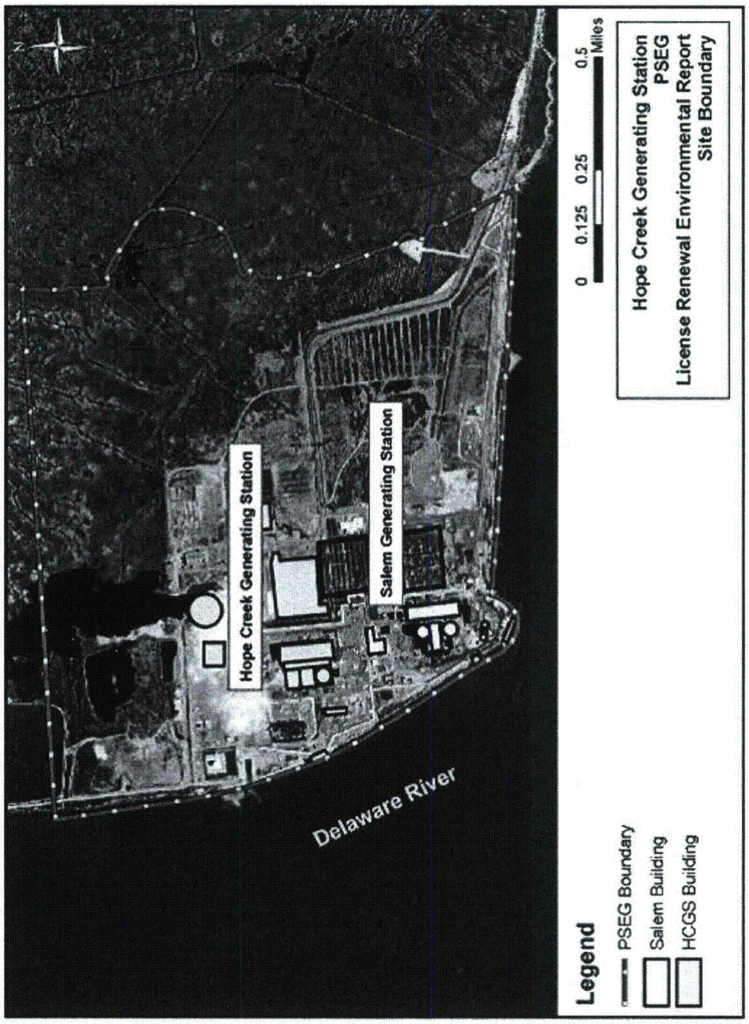

Figure 3. Aerial Photo of the Salem and HCGS Facilities (Source: PSEG, 2009a; PSEG, 2009b)

Salinity is an important determinant of the distribution of biota in estuaries. Salinity near the Salem and HCGS facilities depends on river flow. NRC (1984) reported that average salinity in this area during periods of low flow ranged from 5 to 18 parts per thousand (ppt) and during periods of higher flow ranged from 0 to 5 ppt. Najarian Associates (2004) and PSEG (2005) characterized salinity at HCGS as ranging from 0 and 20 ppt and typically exceeding 6 ppt in summer during periods of low flow. Najarian Associates (2004) calculated salinity from 1991 through 2002 based on temperature and conductivity data collected by the U.S. Geological Survey (USGS) at Reedy Island, located slightly north of Artificial Island on the Delaware side of the estuary. Their data indicate that salinity during the period had a median of about 5 ppt, exceeded 12 ppt in only 2 years and 13 ppt in only 1 year, and never exceeded about 15 ppt during the entire 11-year period. Based on these observations, NRC staff assumes that salinity in the vicinity of Salem and HCGS is typically from 0 to 5 ppt in periods of low flow (usually, but not always, summer) and 5 to 12 ppt in periods of high flow. Within these larger patterns, salinity at any specific location also varies with the tides (NRC, 2007).

Monthly average surface water temperatures in the Delaware Estuary vary with season. Between 1977 and 1982, water temperatures ranged from -0.9 °C (30.4 °F) in February 1982 to 30.5 °C (86.9 °F) in August 1980. Although the estuary in this reach is generally well mixed, it can occasionally stratify, with surface temperatures 1 ° to 2 °C (2 ° to 4 °F) higher than bottom temperatures and salinity increasing as much as 2.0 ppt per m of water depth (NRC, 1984).

EPA (1998) categorizes estuarine waters in three categories based on salinity: oligohaline (0 to 5 ppt), mesohaline (5 to 18 ppt), and polyhaline (greater than 18 ppt). The estuary reach adjacent to Artificial Island is at the interface of the oligohaline and mesohaline zones; thus, it is oligohaline during high flow conditions and mesohaline during low flow. Based on water clarity categories of good, fair, or poor, EPA (1998) classified the water clarity in this area of the estuary as generally fair, which it described as meaning that a wader in waist-deep water would not be able to see his feet. It classified the water clarity directly upstream and downstream of this reach as poor, which it described as meaning that a diver would not be able to see his hand at arm's length. Most estuarine waters in the Mid-Atlantic have good water clarity, and lower water clarity typically is due to phytoplankton blooms and suspended sediments and detritus (EPA, 1998).

Nitrogen and phosphorus are plant nutrients that can cause eutrophication and algal blooms in rivers and estuaries. Based on a rating system of good, fair, or poor, the EPA (1998) classified nitrogen and phosphorus concentrations in the estuary reach adjacent to Artificial Island as poor. High loads of these two nutrients to the Delaware Estuary largely come from point sources (e.g., sewage treatment plants) in the highly urbanized upper estuary. While high nutrient levels can lead to algal blooms and subsequent low dissolved oxygen levels and odors, EPA (1998) reported that levels of dissolved oxygen and chlorophyll (a measure of phytoplankton density) in this reach of the Delaware Estuary were good in spite of high nutrient levels, possibly because the low water clarity reduces light penetration and inhibits algal blooms (EPA, 1998).

More recently, the Delaware River Basin Commission (DRBC) reported somewhat different conditions. DRBC assessed the water quality of the Delaware River and Estuary in years 2000 through 2002 (DRBC, 2004), 2002 through 2004 (DRBC, 2007), and 2004 through 2006 (DRBC, 2008) by evaluating the extent to which those waters were supporting designated uses. The designated use of concern to this EFH assessment is maintenance of aquatic life. For its environmental sampling programs, DRBC divides the Delaware Estuary into six zones, some with sub-zones; Zone 5 includes Artificial Island. The DRBC reports conclude that the "maintenance of aquatic life" designated use was not supported in Zone 5 between the years 2000 and 2006 because of low concentrations of dissolved oxygen.

The benthic, or bottom-dwelling, community of estuarine invertebrates performs many ecological functions. Some species or groups of species form habitat by building reefs (e.g., oysters and some polychaete worms) or by stabilizing or destabilizing of soft substrata (some bivalves, polychaetes, and amphipods). Some benthic organisms are filter feeders that clean the overlying water (e.g., oysters and other bivalves, some polychaetes), and some consume detritus, or dead plant material. The benthic community comprises many trophic levels and provides a trophic base for fish and shellfish (such as crabs) valued by humans. In addition to these important ecological functions, benthic communities serve as sensitive indicators of pollution and the general condition of estuaries. They are sensitive because they are relatively immobile and cannot avoid exposure to the overlying water or underlying sediments and because their diverse members have a variety of physiological sensitivities to environmental conditions. They also are good indicators because they are relatively easy to sample and observe. EPA developed an index of benthic condition, with categories of good, impacted, and severely impacted, and applied it to Mid-Atlantic estuaries (EPA, 1998). About a quarter of the Delaware Estuary has impacted conditions, and the benthic condition index generally improves from severely impacted to good moving south from Philadelphia to the mouth of the estuary. EPA (1998) classified the benthic community in the reach adjacent to Artificial Island (Salem and HCGS) as impacted and the community south of the island as good.

Many contaminants that enter the estuary bind to detritus and suspended sediment particles, which can settle to the bottom and accumulate in the substrate. Aquatic organisms then may be directly exposed by contact with the sediments; by feeding on plants and animals that are exposed to sediment contaminants directly or though the food web; and by being exposed to resuspended sediments. Sediments can act as a reservoir of contaminants, releasing persistent contaminants long after other sources have ceased. Typical contaminants in rivers and estuaries include metals (e.g., arsenic, chromium, copper, lead, mercury, silver, and zinc) and organic compounds such as polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), and pesticides. EPA (1998) categorized sediment contamination in mid-Atlantic estuaries and reported that sediments in the Delaware Estuary off Artificial Island posed minimal risk to aquatic life. Sediment contaminant levels in mid-Atlantic estuaries generally improved during the 1990s (EPA, 1998).

The properties of some contaminants (e.g., resistance to degradation, affinity for binding to organic matter and lipids) cause them to bioaccumulate in fish. Some fish species that occur in the vicinity of Artificial Island have body burdens of contaminants high enough to have warranted fish consumption advisories. The States of New Jersey (NJDEP and NJDHSS, 2010) and Delaware (DNREC, 2009) have issued fish consumption advisories for their respective waters of the Delaware Estuary. For the reach of the estuary between the mouth of Delaware Bay and the Chesapeake and Delaware Canal, which is just north of Salem and HCGS, the consumption advisories for both states are similar and are as follows:

(1) For all weakfish (*Cynoscion regalis*), the general adult population is advised to eat no more than one 8-ounce meal per month (Delaware) or per week (New Jersey), and high risk individuals are advised to eat no more than one meal per month (New Jersey), due to PCB contamination.

(2) For all striped bass (*Morone saxatilis*), white perch (*M. americana*), American eel (*Anguilla rostrata*), channel catfish (*Ictalurus punctatus*), and white catfish (*Ameiurus catus*), members of the general population are advised to eat no more than one 8-ounce meal per

year (two meals per year for striped bass as per Delaware) due to PCB and mercury contamination. High risk individuals (i.e., women of child-bearing age and children) are advised not eat any amount of these fish.

(3) For bluefish (*Pomatomus saltatrix*) 14 inches (in.) or less in length, the Delaware advisory recommends no more than one meal per month due to PCB contamination. For bluefish longer than 14 in., Delaware recommends no more than one meal per year for the general population and no consumption for high-risk individuals. For bluefish longer than 24-in., the general population and high-risk individuals are advised by New Jersey not to eat any amount of these fish.

While fish advisories per se do not show that contaminant exposure from water and sediments is adversely affecting fish populations or other natural populations that prey on these fish, they do show that environmental contaminants in aquatic habitats near Salem and HCGS are being bioaccumulated and passed through natural food webs.

4.0 Operation of the Facilities

The Delaware Estuary provides condenser cooling water and service water for both Salem and HCGS (PSEG, 2009a; PSEG, 2009b), and operation of the Salem and HCGS cooling water systems would be the principal source of potential impacts to fish habitat from the proposed actions. Each of the Salem units uses a once-through circulating water system (CWS) for condenser cooling that withdraws water from the estuary and returns the heated water to the estuary. In contrast, HCGS dissipates heat to the atmosphere through a closed-cycle system using a natural-draft cooling tower, which minimizes the withdrawal of water from the estuary and the release of heated effluent to the estuary (PSEG, 2009a; PSEG, 2009b). Because the Salem once-through systems withdraw significantly more water than the HCGS closed-cycle system, Salem has a greater potential to adversely affect EFH.

4.1 Salem

The CWS for each Salem unit withdraws brackish water from the Delaware Estuary through an intake structure located at the shoreline on the south end of the site. Salem also withdraws water from the estuary for its service water system (SWS) from an adjacent intake structure (PSEG, 2009a). The CWS provides water to condense steam from the turbines, and the heated water is returned to the estuary. The SWS supplies cooling water to the reactor safeguard and auxiliary systems (PSEG, 2009a).

The CWS intake structure has 12 bays for 12 circulating water pumps, and each bay is equipped with several features to prevent the intake of biota and debris into the pumps (NJDEP 2000):

- Ice Barriers. During the winter, removable ice barriers are installed in front of the intakes to prevent damage to the intake pumps from ice formed on the Delaware Estuary. These barriers consist of pressure-treated wood bars and underlying structural steel braces. The barriers are removed early in the spring and replaced in the late fall.
- Trash Racks. After intake water passes through the ice barriers (if installed), it flows through fixed trash racks. These racks prevent large organisms and debris from entering the pumps. The racks are made from 0.5 in. (1.3 cm) steel bars placed on 3.5-in. (8.9 cm) centers, creating a 3-in. (7.6 cm) clearance between each bar. The racks are inspected by PSEG employees, who remove any debris caught on them with mechanical, mobile, clamshell-type rakes. These trash rakes include a hopper that stores and transports removed debris to a pit at the end of each intake, where it is dewatered by gravity and disposed of off-site.

- Traveling Screens. After the course-grid trash racks, the intake water passes through vertical travelling screens that have a finer mesh with openings 0.25 in. (0.64 cm) wide x 0.5 in. (1.3 cm) high. The screens remove debris and biota small enough to have passed through the trash racks and large enough to be impinged on the screens. The Salem screens are a modified Ristroph design constructed to minimize injuries to impinged organisms. The velocity through the Salem intake screens is approximately 1 foot per second (fps) (0.3 meters per second [mps]) at mean low tide.
- Fish Return System. Each panel of the travelling screen has a 10-ft (3-m) long fish bucket attached across the bottom support member. As the travelling screen reaches the top of each rotation, fish and other organisms caught in the fish bucket slide along a horizontal catch screen. As the travelling screen continues to rotate, the bucket is inverted. A low-pressure water sprays wash fish off the screen, and the fish slide through a flap into a two-way fish trough. Debris is then washed off the screen by a high-pressure water spray into a separate debris trough. The contents of both troughs – fish, debris, and backwash water – return to the estuary. The troughs are designed so that when the fish and debris are released, the tidal flow tends to carry them away from the intake, reducing the likelihood of re-impingement. Thus, the troughs empty on either the north or south side of the intake structure depending on the direction of tidal flow.

The CWS provides approximately 1,050,000 gallons per minute (gpm) (3,975,000 liters per minute [lpm]) to each of Salem's two reactor units. The total design flow is 1,110,000 gpm (4,202,000 lpm) through each unit. No biocides are required in the CWS (PSEG, 2009a).

The SWS intake structure is located approximately 400 ft (122 m) north of the CWS intake. The SWS intake has four bays, each containing three pumps. The 12 service-water pumps have a total design rating of 130,500 gpm (494,000 lpm). The SWS intake structure is equipped with trash racks, conventional vertical traveling screens, and filters to remove debris and biota from the intake water stream, but the screens do not have a modified Ristroph design or fish return system. The screen openings are 3/8-in. (0.95 cm) square. The average velocity through the Salem SWS intake screens is less than 1 fps (0.3 mps) at the pump design flow of 10,875 gpm (41,160 lpm). Fish and debris impinged on the screens are washed off by a high-pressure spray into a trough. The contents of the trough pass through trash baskets that collect debris and biota while allowing backwash water to return to the estuary. Debris and biota collected from the trash racks is removed and transported to a landfill for disposal (NJDEP, 2006a; PSEG, 2009a).

The withdrawal of Delaware Estuary water for the Salem CWS and SWS systems is regulated under the terms of the Salem New Jersey Pollutant Discharge Elimination System (NJPDES) permit, Number NJ005622, and also is authorized by the Delaware River Basin Commission (DRBC). Both the Salem CWS and SWS discharge water back to the Delaware Estuary through a single return that serves both systems and is located between the Salem CWS and SWS intakes. Cooling water from Salem is discharged through six adjacent pipes 7 ft (2 m) in diameter and spaced 15 ft (4.6 m) apart on center that merge into three pipes 10 ft (3 m) in diameter (PSEG, 2006a). The discharge piping extends approximately 500 ft (150 m) from the shore (PSEG, 1999). The discharge pipes are buried for most of their length until they discharge horizontally into the water of the estuary at a depth at mean tidal level of about 31 ft (9.5 m). The discharge is approximately perpendicular to the prevailing currents. At full power, Salem is designed to discharge approximately 3,200 mgd (140 cubic meters per second [cms]) at a velocity of about 10 ft/s (3 m/s) (PSEG, 1999). To prevent biofouling in the heat exchangers and piping of the SWS, sodium hypochlorite is injected into the system. SWS water is discharged via the discharge pipe shared with the CWS. Residual chlorine levels are maintained in accordance with the facility's New Jersey Pollutant Discharge Elimination System (NJPDES) Permit (PSEG, 2009a).

The Section 316(a) variance for Salem limits the temperature of the discharge, the difference in temperature between the thermal plume and the ambient water, and the rate of water withdrawal from the Delaware Estuary (NJDEP, 2001). During the summer period the maximum permissible discharge temperature is 115°F (46.1°C). In non-summer months, the maximum permissible discharge temperature is 110°F (43.3°C). The maximum permissible temperature differential year round between the thermal plume and ambient water is 27.5°F (13°C). The permit also limits the amount of water that Salem withdraws to a monthly average of 3,024 million gallons per day (132 cubic meters per second) (NJDEP, 2001).

The Salem thermal plume approximately follows the contour of the shoreline at the discharge. The width of the plume varies from about 4,000 ft (1,200 m) on the flood tide to about 10,000 ft (3,000 m) on the ebb tide. The maximum plume length extends to approximately 43,000 ft (13,000 m) upstream and 36,000 ft (11,000 m) downstream (PSEG, 1999). The thermal plume consists of a near-field region, a transition region, and a far-field region. The near-field region, also referred to as the zone of initial mixing, is the region closest to the outlet of the discharge pipes where the mixing of the discharge with the waters of the Delaware Estuary is induced by the velocity of the discharge itself. The length of the near-field region is approximately 300 ft (90 m) during ebb and flood tides and 1,000 ft (300 m) during slack tide. The transition region is the area where the plume spreads horizontally and stratifies vertically due to the buoyancy of the warmer waters. The length of the transition region is approximately 700 ft (200 m). In the far-field region, mixing is controlled by the ambient currents induced mainly by the tidal nature of the receiving water. The ebb tide draws the discharge downstream, and the flood tide draws it upstream (PSEG, 1999).

4.2 HCGS

A single intake structure supplies water from the Delaware Estuary to the SWS at HCGS. The intake structure consists of four active bays that are equipped with pumps and associated equipment (trash racks, Ristroph traveling screens, and a fish-return system) similar to the equipment described above for Salem. (The structure also contains four empty bays originally intended to service a second reactor that was never built.) Water is drawn into the SWS through trash racks and passes through the traveling screens at a maximum velocity of 0.35 fps (0.11 m/s). The openings in the wire mesh of the screens are 0.375 in. (0.95 cm) square. As described above, a low-pressure spray washes impinged fish into the fish-return trough and a high-pressure spray washes debris into the debris trough as the screens continuously rotate. These troughs merge and return fish, debris, and backwash water to the estuary south of the SWS intake structure (PSEG, 2009b).

After passing through the traveling screens, the estuary water enters the service water pumps. Depending on the temperature of the estuary water, two or three pumps are normally needed to supply service water. Each pump is rated at 16,500 gpm (62,400 lpm). Water is then pumped into the stilling basin in the pump house. The stilling basin supplies water to the general SWS and the fire protection system for back-up residual heat removal service water and for emergency service water. To prevent organic buildup and biofouling in the heat exchangers and piping of the SWS, sodium hypochlorite is continuously injected into the system (PSEG, 2009b).

The SWS intake also provides makeup water for the CWS by supplying water to the cooling tower basin. The HCGS cooling tower is a 512-ft-high, counterflow, hyperbolic, natural draft cooling tower (PSEG, 2008). The cooling tower basin contains approximately 9 million gallons of water and provides approximately 612,000 gpm (2,316,000 lpm) of water to the CWS via four pumps. The CWS is a closed-cycle system that provides water to the main condenser to condense steam from the turbine and then passes the heated water through the cooling tower. The HCGS CWS loses water through evaporation and drift from the cooling tower and blowdown water removed from the system to control the buildup of suspended solids. This water is made up by water from the SWS (PSEG, 2009b). Monthly water losses average from 9,600 gpm (36,300 lpm) in January to 13,000 gpm (49,200 lpm) in July. Blowdown effluent returns to the Delaware Estuary (NJDEP, 2002).

Comment [D3]: SI units too.

The cooling tower blowdown and other facility effluents are discharged to the estuary through an underwater conduit located 1,500 ft (450 m) upstream of the HCGS SWS intake. The HCGS discharge pipe extends 10 ft (3.0 m) offshore and is situated at mean tide level. The discharge from HCGS is regulated under the terms of NJPDES permit number NJ0025411 (NJDEP, 2001).

Thermal effluent limitations for HCGS are imposed though NJPDES permits. The plant has a designated heat dissipation area no larger than 2,500 ft (762 m) upstream or downstream and 1,500 ft (457 m) offshore from the discharge point. Outside of the designated area, water temperature increases attributable to the plant cannot exceed ambient water temperature by more than 4 °F (2.2 °C) in the non-summer months of September through May or 1.5 °F (0.8 °C) in the summer months of June through August. In addition, the maximum water temperature attributable to the plant outside of the designated area cannot exceed 86 °F (30 °C). In addition to the other requirements, the 1-hr average temperature of the effluent on any day cannot exceed 97.1 °F (36.2 °C) (PSEG, 2005a; Najarian Associates, 2004).

Sodium hypochlorite is injected into the CWS to control biological growth, and the dosage is controlled to maintain measurable free available chlorine in the cooling tower basin and the outlet of the main condensers. Chlorine-produced oxidants are reduced in the effluent by a dechorination system that employs ammonium bisulfite. Acute and chronic toxicity test results of the effluent from 1998 through 2001 indicate that the discharge is not toxic.

The withdrawal of Delaware River water for the HCGS CWS and SWS systems is regulated under the terms of the HCGS NJPDES permit, Number NJ0025411, and also is authorized by the DRBC. Although it requires measurement and reporting, the NJPDES permit does not specify limits on the total withdrawal volume of estuary water for HCGS operations (NJDEP, 2003). Actual withdrawals average 66.8 mgd (253 million liters per day), of which 13 mgd evaporate (49 million liters per day), 6.7 mgd (25 million liters per day) are returned as screen backwash, and the remainder (approximately 47 mgd [179 million liters per day]) is discharged back to the estuary (PSEG, 2009b). To compensate for evaporative losses in the system, the DRBC authorization requires releases from storage reservoirs, or reductions in withdrawal, during periods of low-flow conditions at Trenton, New Jersey (DRBC 2001). To accomplish this, PSEG is one of several utilities that own and operate the Merrill Creek Reservoir in Washington, New Jersey. This reservoir is used to release water during low-flow conditions as required by the DRBC authorization (PSEG 2009b).

5.0 Potential Impacts of the Proposed Action on Designated Essential Fish Habitat of Federally Managed Species in the Vicinity of Salem and HCGS

Under present conditions, Salem and HCGS affect fish habitat primarily through their cooling water systems as described above. Water withdrawn for cooling is no longer available as habitat, and fish and their food can be lost due to impingement and entrainment. Water returned to the estuary as thermal effluent changes the natural temperature and current regimes in localized areas of habitat. Thus, the proposed action has the potential to alter at least some aspects of EFH.

Salem and HCGS are located near the interface of the salinity zones classified by NMFS as tidal freshwater and mixing salinity zones. The area of the Delaware Estuary adjacent to Artificial Island is designated by NMFS as EFH for various life stages of several species of fish. NRC staff considered all the designated EFH that could occur in the vicinity of Salem and HCGS based on geographic coordinates and eliminated EFH for some species and life stages with EFH requirements that are outside of the conditions that normally occur in the local area.

NMFS identifies EFH on their website for the overall Delaware Bay (NOAA, 2010a) and for smaller squares within the estuary defined by 10 minutes (') of latitude by 10 ' of longitude. NMFS provides tables of species and life stages that have designated EFH within the 10' by 10' squares. The 10 ' by 10 ' square that includes Salem and HCGS is defined by the following coordinates:

North: 39 ° 30.0 'N　　South: 39 ° 20.0 'N

East: 75 ° 30.0 'W　　West: 75 ° 40.0 'W

The description of the general location and New Jersey shoreline within this square confirm that it includes Artificial Island and the Salem and HCGS facilities (NOAA, 2010a):

> "Atlantic Ocean waters within the square within the Delaware River, within the mixing water salinity zone of the Delaware Bay affecting both the New Jersey and Delaware coasts. On the New Jersey side, these waters affect: from Hope Creek on the south, north past Stoney Point, and Salem Nuclear Power Plant on Artificial Island, to the tip of Artificial Island as well as affecting Baker Shoal."

NMFS (2010a) identified 14 fish species with EFH in the Delaware Estuary in the vicinity of Salem and HCGS. These species and their life stages with EFH in this area are identified in Table 1. The salinity requirements of these species and life stages are provided in Table 2. Salinities in the vicinity of Artificial Island are described above in Section 3.0. For each of these EFH species, the NRC staff compared the range of salinities in the vicinity of Salem and HCGS with the salinity requirements of the potentially affected life stages. The salinity requirements of many of these EFH species and life stages were found to be higher than salinity ranges in the vicinity of Salem and HCGS or to overlap these salinity ranges only during periods of low flow (Table 2).

Table 1. Designated EFH by species and life stage in NMFS' 10' x 10' square of latitude and longitude in the Delaware Estuary that includes Salem and HCGS

Scientific Name	Common Name	Eggs	Larvae	Juveniles	Adults
Urophycis chuss	Red hake				
Pseudopleuronectes americanus	Winter flounder	X	X	X	X
Scophthalmus aquosus	Windowpane flounder	X	X	X	X
Pomotomus saltatrix	Bluefish			X	X
Paralichthys dentatus	Summer flounder			X	X

Peprilus triacanthus	Atlantic butterfish			X	
Stenotomus chrysops	Scup	n/a	n/a	X	
Centropristes striatus	Black sea bass	n/a		X	
Scomberomorus cavalla	King mackerel	X	X	X	X
Scomberomorus maculatus	Spanish mackerel	X	X	X	X
Rachycentron canadum	Cobia	X	X	X	X
Leucoraja eglantaria	Clearnose skate			X	X
Leucoraja erinacea	Little skate			X	X
Leucoraja ocellata	Winter skate			X	X

X indicates designated EFH within this area. Blank indicates no designated EFH in this area. n/a indicates that the species does not have this life stage or has no EFH designation for this life stage. Sources: NOAA, 2010a; NOAA, 2010b.

Table 2. Potential EFH species eliminated from further consideration due to salinity requirements

Species, Life Stage	EFH Salinity Requirement (ppt) [a]	Site Salinity[e] Matches Requirement?
Windowpane, juvenile	5.5-36	low flow only
Windowpane, adult	5.5-36	low flow only
Windowpane, spawner	5.5-36	low flow only
Bluefish, juvenile	23-36	no
Bluefish, adult	>25	no
Scup, juvenile	>15	no
Black sea bass, juvenile	>18	no
King mackerel	>30	no
Spanish mackerel	>30	no
Cobia	>25	no
Clearnose skate, juvenile	probably >22 [b]	no
Clearnose skate, adult	probably >22 [b]	no
Little skate, juvenile	mostly 25-30 [c]	no
Little skate, adult	probably >20 [c]	no
Winter skate, juvenile	probably >20 [d]	no
Winter skate, adult	probably >20[d]	no

[a] Salinity data from NOAA table "Summary of Essential Fish Habitat (EFH) and General Habitat Parameters for Federally Managed Species" unless noted otherwise.
[b] Packer et al. (2003a) NOAA Technical Memorandum NMFS-NE-174.
[c] Packer et al. (2003b) NOAA Technical Memorandum NMFS-NE-175.
[d] NOAA (2003) NOAA Technical Memorandum NMFS-NE-179.
[e] Salinities in Delaware Estuary in vicinity of Salem/HCGS: high flow 0-5 ppt, low flow 5-12 ppt.

This comparison allowed the list of species with EFH that potentially could be affected by Salem or HCGS to be further refined. If the salinity requirements of a life stage of an EFH species were not met in the vicinity of the Salem and HCGS facilities, the EFH for that species and life stage was eliminated from further consideration because its potential to be affected by the proposed action would be negligible. As a result, four species were identified that have potentially affected EFH for one or more life stages in the vicinity (Table 3): winter flounder (*Pseudopleuronectes americanus*), windowpane flounder (*Scophthalmus aquosus*), summer flounder (*Paralichthys dentatus*), and Atlantic butterfish (*Peprilus triacanthus*). Descriptions of these four species are provided below.

Table 3. Fish Species and Life Stages with Potentially Affected EFH in the Vicinity of Salem and HCGS

Species	Eggs	Larvae	Juveniles	Adults
Winter flounder	X	X	X	X
Windowpane flounder	X	X	X	X
Summer flounder			X	X
Atlantic butterfish			X	

Source: NRC, 2007.

Winter Flounder

The geographic area encompassing winter flounder EFH includes Georges Bank, the inshore areas of the Gulf of Maine, southern New England, and the mid-Atlantic region south to Delaware Bay. EFH for egg, larval, juvenile, and adult life stages may exist in the Delaware Estuary in the vicinity of Salem and HCGS. EFH for eggs includes bottom habitats with substrates of sand, muddy sand, and gravel. Eggs typically are found in water at depths less than 5 m (16 ft), temperatures less than 10 °C (50 °F), and salinities of 10 to 30 ppt (NMFS, 2010b). Larval EFH includes pelagic and bottom waters less than 6 m (20 ft) deep with temperatures below 15 °C (59 °F)and salinities of 4 to 30 ppt. EFH for juvenile winter flounder includes bottom habitats with substrates of mud or fine-grained sand. Young-of-the-year juveniles are found at water depths from 0.1 to 10 m (0.3 to 33 ft) and temperatures below 28 °C (82 °F). Age 1+ juveniles are found at water depths ranging from 1 to 50 m (3 to 164 ft) and at temperatures below 25 °C (77 °F). EFH for both adults and spawning adults includes bottom habitats with substrates of mud, muddy sand, sand, and gravel, including such habitats within estuaries. Adult winter flounder live in waters with depths from 1 to 100 m (3 to 328 ft) with temperatures below 25 °C (77 °F). Spawning adults usually are found at water depths less than 6 m (20 ft). Water temperatures for spawning adults are typically below 15 °C (59 °F) (NMFS, 2010b). Spawning takes place over sandy bottoms in shallow estuaries mainly from February to June (NMFS, 2010b). In Delaware Bay, winter flounder spawn from January through March, and early life stages are present in April and May (USACE, 2009).

Comment [D4]: Space missing.

The various life stages of winter flounder generally can be found in areas where the bottom habitat includes a substrate of mud, sand, or gravel (NEFMC, 1998). Winter flounder eggs are demersal, adhesive, and stick together in clusters. Eggs may hatch in 2 to 3 weeks, depending on water temperature (Pereira et al.,1999). Larvae initially are planktonic but settle to the bottom as metamorphosis continues. After yolk-sac absorption, the larvae feed initially on diatoms, and as they grow, they switch to rotifers, tintinnids, and invertebrate eggs and later to bivalve and polychaete larvae, copepod nauplii, and copepodites. Newly metamorphosed young-of-the-year fish take up residence in shallow water and eat small isopods, amphipods, other crustaceans, annelids, and mollusks. As they grow, they eat larger prey. Pereira et al. (1999) describes winter flounder as omnivorous, opportunistic feeders, consuming a wide variety of prey, with polychaetes and amphipods making up the majority of their diet. Typically, adult winter flounder migrate inshore in the fall and early winter and spawn in later winter and early spring. Then they may leave inshore areas if the water temperature exceeds 15 °C (59 °F), although exceptions may occur due to water temperature and food availability. Winter flounder may move significant distances (Pereira et al., 1999); however, they also can exhibit a high degree of fidelity and, in general, their movement patterns are localized (Nitschke et al., 2000).

The Salem and HCGS intakes and discharges have the potential to adversely affect EFH for winter flounder eggs, larvae, juveniles, and adults in the Delaware Estuary in the vicinity of the facilities. Because Salem uses much greater quantities of water than HCGS, Salem has a greater potential to adversely affect EFH species through the operation of its intake and discharge. Winter flounder eggs are demersal and adhesive and larvae also tend to be demersal and remain in the shallow coves and inlets where spawning typically occurs (Pereira et al., 1999). As a result, eggs and larvae are not likely to be adversely affected by operation of the Salem and HCGS intakes and discharges. In addition, juvenile and adult winter flounder have not been commonly entrained or impinged at Salem. NRC staff used monitoring data for the Salem intake from 1995 through 2008 to calculate an average of annual mean densities of winter flounder and other fish entrained and impinged over the 14-yr period (Tables 4 and 5). The density of winter flounder juveniles or smaller life stages entrained was only 0.01 per 100 m^3 of cooling water withdrawn. The density of winter flounder juveniles or adults impinged was only 2.6 juveniles or adults per 1 million m^3 of cooling water withdrawn. The area of the estuary affected by the thermal plume from the discharge is relatively very small and, due to the buoyancy of the plume, its extent tends to be greatest near the surface. Winter flounder would be unlikely to encounter the plume due to their demersal habits, and their mobility would allow them to avoid water temperatures that are not within their preference range. Therefore, continued operation of the Salem and HCGS intakes and discharges during the relicensing period would have minimal adverse effects on EFH for winter flounder eggs, larvae, juveniles, or adults.

Windowpane Flounder

The geographic area encompassing windowpane flounder EFH includes the perimeter of the Gulf of Maine, Georges Bank, southern New England, and the mid-Atlantic region south to Cape Hatteras. EFH for egg, larval, juvenile, and adult life stages may exist in the vicinity of Salem and HCGS. EFH for eggs, which are buoyant (Chang et al., 1999), includes surface waters within this range (NMFS, 2010b). EFH for larvae includes pelagic waters, with water depths from 50 to 150 m (164 to 492 ft) and temperatures below 20 °C (68 °F). For larvae, EFH consists of surface waters (NMFS, 2010b). Larvae are 2 mm (0.08 in.) long at hatching and settle to the bottom at about 10 mm (0.4 in.) in length (Chang et al., 1999). Eggs and larvae are found in water depths less than 70 m (230 ft), and in water temperatures below 20 °C (68 °F). Juvenile, adult, and spawning adult EFH includes bottom habitats with substrates of mud or fine-grained sand. These areas are generally 1 to 100 m (3 to 328 ft) deep and have water temperatures below 26 °C (79 °F) (NMFS, 2010b). Windowpane flounder prefer a soft bottom of mud or fine sand for spawning and generally spawn from February to December, with peak spawning activity in May in the mid-Atlantic region (Hendrickson, 1998). Windowpane flounder prey mostly on small crustaceans, such as mysids and decapod shrimp, and fish larvae. Juveniles living in shallow waters tend to move to deeper waters as they mature (Chang et al., 1999).

The Salem and HCGS intakes and discharges have the potential to adversely affect EFH for windowpane flounder eggs, larvae, juveniles, and adults in the Delaware Estuary in the vicinity of the facilities. Because Salem uses much greater quantities of water than HCGS, Salem has a greater potential to adversely affect EFH species through the operation of its intake and discharge. Juvenile and adult windowpane flounder have not been commonly entrained or impinged at Salem. NRC staff used monitoring data for the Salem intake from 1995 through

2008 to calculate an average of annual mean densities of windowpane flounder and other fish entrained and impinged over the 14-yr period (Tables 4 and 5). The density of windowpane flounder eggs, larvae, or juveniles entrained was only 0.004 per 100 m^3 of cooling water withdrawn. The density of windowpane flounder juveniles or adults impinged was only 2.4 juveniles or adults per 1 million m^3 of cooling water withdrawn. The area of the estuary affected by the thermal plume from the discharge is relatively very small and, due to the buoyancy of the plume, its extent tends to be greatest near the surface. Juvenile and adult windowpane flounder would be unlikely to encounter the plume due to their demersal habits, and their mobility would allow them to avoid water temperatures that are not within their preference range. Therefore, continued operation of the Salem and HCGS intakes and discharges during the relicensing period would have minimal adverse effects on EFH for windowpane flounder eggs, larvae, juveniles, or adults.

Summer flounder

EFH for summer flounder includes inshore estuaries and offshore demersal waters of the continental shelf from the Gulf of Maine to Cape Hatteras. EFH for juvenile and adult life stages may exist in the vicinity of Salem and HCGS. Summer flounder adults typically live in water depths shallower than 500 ft (NMFS 2010b). In southern New England and the mid-Atlantic region, spawning occurs primarily in September (Berrien and Sibunka 1999 in Packer et al. 1999) at temperatures of 12 to 19 °C (54 to 66 °F) (Able et al., 1990). Spawning takes place in open ocean areas of the continental shelf (Packer et al. 1999), and eggs are most often found in waters ranging from 30 to 360 ft (9 to 110 m) deep (NMFS 2010b). The timing of spawning coincides with maximum production of autumn plankton, which is the primary food source for larvae (Packer et al. 1999).

Eggs and larvae of the summer flounder are buoyant and pelagic. Eggs are most abundant in the northwest Atlantic in October and November, and larvae are most abundant from October to December. Larvae migrate inshore, and development of post-larvae and juveniles occurs primarily within bays and estuarine areas. Juvenile summer flounder feed on crustaceans and polychaetes, and as they grow larger they begin to feed on fish; adults are opportunistic feeders that prey mostly on fish and crustaceans (Packer et al. 1999).

The Salem and HCGS intakes and discharges have the potential to adversely affect adult and juvenile summer flounder EFH in the Delaware Estuary in the vicinity of the facilities. Because Salem uses much greater quantities of water than HCGS, Salem has a greater potential to adversely affect EFH species through the operation of its intake and discharge. Juvenile and adult summer flounder have not been commonly entrained or impinged at Salem. NRC staff used monitoring data for the Salem intake from 1995 through 2008 to calculate an average of annual mean densities of summer flounder and other fish entrained and impinged over the 14-yr period (Tables 4 and 5). The density of summer flounder juveniles or smaller life stages entrained was only 0.12 per 100 m^3 of cooling water withdrawn. The density of summer flounder juveniles or adults impinged was only 4.5 juveniles or adults per 1 million m^3 of cooling water withdrawn. The area of the estuary affected by the thermal plume from the discharge is relatively very small and, due to the buoyancy of the plume, its extent tends to be greatest near the surface. Summer flounder would be unlikely to encounter the plume due to their demersal habits, and their mobility would allow them to avoid water temperatures that are not within their preference range. Therefore, continued operation of the Salem and HCGS intakes and discharges during the relicensing period would have minimal adverse effects on EFH for summer flounder juveniles and adults.

Table 4. Species Entrained at Salem During Annual Entrainment Monitoring, 1995-2008

Common Name	Scientific Name	Average Density (n/100 m^3)
Bay anchovy	*Anchoa mitchilli*	72.35
Naked goby	*Gobiosoma bosc*	27.58
Striped bass	*Morone saxatilis*	7.07
Atlantic croaker	*Micropogonias undulatus*	7.04
Atlantic menhaden	*Brevoortia tyrannus*	6.91
Weakfish	*Cynoscion regalis*	2.81
Goby	Gobiidae	2.61
White perch/striped bass	*Morone* spp.	1.57
White perch	*Morone americana*	1.15
Atlantic silverside	*Menidia menidia*	0.66
Unidentifiable silverside	Antherinidae	0.47
Blueback herring/alewife	*Alosa spp.*	0.37
Silversides	*Menidia* spp.	0.22
Northern pipefish	*Syngnathus fuscus*	0.18
American eel	*Anguilla rostrata*	0.13
Unidentifiable fish		0.13
Summer flounder	***Paralichthys dentatus***	**0.12**
Hogchoker	*Trinectes maculatus*	0.10
Spot	*Leiostomus xanthurus*	0.09
Inland silverside	*Menidia beryllina*	0.08
Herrings	Clupeidae	0.08
Black drum	*Pogonias cromis*	0.07
Carps and minnows	Cyprinidae	0.06
Gizzard shad	*Dorosoma cepedianum*	0.06
Unidentifiable larvae		0.06
Atlantic herring	*Clupea harengus*	0.06
Alewife	*Alosa pseudoharengus*	0.05
Smallmouth flounder	*Etropus microstomus*	0.04
Rough silverside	*Membras martinica*	0.03
Blueback herring	*Alosa aestivalis*	0.03
Yellow perch	*Perca flavescens*	0.03
Spotted hake	*Urophycis regia*	0.02
Killifishes	*Fundulus* spp.	0.02
Mummichog	*Fundulus heteroclitus*	0.01
Northern searobin	*Prionotus carolinus*	0.01
Quillback	*Carpiodes cyprinus*	0.01
Unidentifiable eggs		0.01
Silver perch	*Bairdiella chrysoura*	0.01
Winter flounder	***Pseudopleuronectes americanus***	**0.01**
Threespine stickleback	*Gasterosteus aculeatus*	0.01
Atlantic needlefish	*Strongylura marina*	0.01
Unidentifiable		0.01
Blackcheek tonguefish	*Symphurus plagiusa*	0.01

Comment [D5]: No italics in spp.

Common Name	Scientific Name	Average Density (n/100 m³)
Oyster toadfish	*Opsanus tau*	0.01
Common carp	*Cyprinus carpio*	0.01
American shad	*Alosa sapidissima*	0.01
Striped cusk-eel	*Ophidion marginatum*	0.01
Windowpane flounder	***Scophthalmus aquosus***	**0.004**
Green goby	*Microgobius thalassinus*	0.004
Northern puffer	*Sphoeroides maculatus*	0.004
Feather blenny	*Hypsoblennius hentz*	0.004
American sand lance	*Ammodytes americanus*	0.004
Bluefish	*Pomatomus salatrix*	0.003
Unidentifiable juvenile		0.003
Striped searobin	*Prionotus evolans*	0.003
Conger eel	*Conger oceanicus*	0.003
Inshore lizardfish	*Synodus foetens*	0.003
Unidentifiable drum	Sciaenidae	0.003
Eastern silvery minnow	*Hybognathus regius*	0.003
Perches	Percidae	0.003
Northern kingfish	*Menticirrhus saxatilis*	0.003
Bluegill	*Lepomis macrochirus*	0.002
Banded killifish	*Fundulus diaphanus*	0.002
Unidentifiable sucker	Catostomidae	0.002
Striped anchovy	*Anchoa hepsetus*	0.002
Northern stargazer	*Astroscopus guttatus*	0.002
White crappie	*Pomoxis annularis*	0.002
Tautog	*Tautoga onitis*	0.002
Unidentifiable porgy	Sparidae	0.001
Spanish mackerel	*Scomberomorus maculatus*	0.001
Black sea bass	*Centropristis striata*	0.001
Sheepshead minnow	*Cyprinodon variegauts*	0.001
Striped killifish	*Fundulus majalis*	0.001
Unidentifiable sunfish	Centrarchidae	0.001
White sucker	*Catostomus commersoni*	0.001
Channel catfish	*Ictalurus punctatus*	0.001

(1) Species in **bold** have potentially affected EFH for one or more life stages in the vicinity of Salem and HCGS.

(2) Average density expressed as number of organisms entrained (n) per 100 cubic meters (m³) of water withdrawn through the intake screens.

Source: Biological Monitoring Program Annual Reports (PSEG, 1996; PSEG, 1997; PSEG, 1998; PSEG, 1999b; PSEG, 2000; PSEG, 2001; PSEG, 2002; PSEG, 2003; PSEG, 2004a; PSEG, 2005b; PSEG, 2006b; PSEG, 2007; PSEG, 2008; PSEG, 2009c)

Table 5. Species Impinged at Salem and Average Impingement Densities, Based on Annual Impingement Monitoring for 1995-2007

Common Name(1)	Scientific Name(1)	Average Density (n/10⁶ m³) (2)

Common Name[1]	Scientific Name[1]	Average Density ($n/10^6 m^3$) [2]
Atlantic croaker	*Micropogonias undulatus*	917.94
Blue crab	*Callinectes sapidus*	842.50
White perch	*Morone americana*	783.12
Weakfish	*Cynoscion regalis*	565.97
Hogchoker	*Trinectes maculatus*	231.95
Spotted hake	*Urophycis regia*	135.03
Bay anchovy	*Anchoa mitchilli*	132.01
Striped bass	*Morone saxatilis*	61.40
Blueback herring	*Alosa aestivalis*	58.56
Atlantic silverside	*Menidia menidia*	46.84
Gizzard shad	*Dorosoma cepedianum*	42.11
Atlantic menhaden	*Brevoortia tyrannus*	32.51
Threespine stickleback	*Gasterosteus aculeatus*	27.64
Striped cusk-eel	*Ophidion marginatum*	20.78
Spot	*Leiostomus xanthurus*	14.88
Alewife	*Alosa pseudoharengus*	11.35
Northern searobin	*Prionotus carolinus*	10.53
American shad	*Alosa sapidissima*	8.02
Yellow perch	*Perca flavescens*	7.71
Black drum	*Pogonias cromis*	6.29
Atlantic herring	*Clupea harengus*	6.05
Eastern silvery minnow	*Hybognathus regius*	5.60
Bluefish	*Pomatomus saltatrix*	5.59
American eel	*Anguilla rostrata*	5.32
Channel catfish	*Ictalurus punctatus*	4.90
Silver perch	*Bairdiella chrysoura*	4.62
Summer flounder	***Paralichthys dentatus***	**4.48**
Northern kingfish	*Menticirrhus saxatilis*	4.29
Oyster toadfish	*Opsanus tau*	3.68
Northern pipefish	*Syngnathus fuscus*	3.59
Red hake	*Urophycis chuss*	3.26
Naked goby	*Gobiosoma bosc*	3.25
Winter flounder	***Pseudopleuronectes americanus***	**2.59**
Windowpane flounder	***Scophthalmus aquosus***	**2.41**
Mummichog	*Fundulus heteroclitus*	2.13
Smallmouth flounder	*Etropus microstomus*	2.00
Bluegill	*Lepomis macrochirus*	1.89
Striped searobin	*Prionotus evolans*	1.81
Scup	*Stenotomus chrysops*	1.38
Harvestfish	*Peprilus alepidotus*	1.01
Striped killifish	*Fundulus majalis*	1.00
Butterfish	***Peprilus triacanthus***	**0.87**
Black sea bass	*Centropristis striata*	0.83
Brown bullhead	*Ameiurus nebulosus*	0.76
River herring	*Alosa* spp.	0.75

Common Name[1]	Scientific Name[1]	Average Density ($n/10^6\ m^3$) [2]
Unknown spp.	Unknown spp.	0.52
Sea lamprey	*Petromyzon marinus*	0.52
Skilletfish	*Gobiesox strumosus*	0.51
Rainbow smelt	*Osmerus punctatus*	0.48
Northern stargazer	*Astroscopus guttatus*	0.45
Fourspine stickleback	*Apeltes quadracus*	0.44
Conger eel	*Conger oceanicus*	0.43
Striped mullet	*Mugil cephalus*	0.43
Temperate bass	*Morone* sp.	0.38
Rough silverside	*Membras martinica*	0.36
Striped anchovy	*Anchoa hepsetus*	0.36
Inland silverside	*Menidia beryllina*	0.33
White mullet	*Mugil curema*	0.32
Spotfin butterflyfish	*Chaetodon ocellatus*	0.28
Atlantic needlefish	*Strongylura marina*	0.27
Yellow bullhead	*Ameiurus natalis*	0.26
Crevalle jack	*Caranx hippos*	0.25
Black crappie	*Pomoxis nigromaculatus*	0.24
Banded killifish	*Fundulus diaphanus*	0.24
Silver hake	*Merluccius bilinearis*	0.23
Lookdown	*Selene vomer*	0.20
Blackcheek tonguefish	*Symphurus plagiusa*	0.20
Permit	*Trachinotus falcatus*	0.16
Common carp	*Cyprinus carpio*	0.14
Sheepshead minnow	*Cyprinodon variegatus*	0.14
Pumpkinseed	*Lepomis gibbosus*	0.14
Northern puffer	*Sphoeroides maculatus*	0.14
Sheepshead	*Archosargus probatocephalus*	0.13
Florida pompano	*Trachinotus carolinus*	0.13
Fourspot flounder	*Paralichthys oblongus*	0.12
Smooth dogfish	*Mustelus canis*	0.12
Tessellated darter	*Etheostoma olmstedi*	0.12
Lined seahorse	*Hippocampus erectus*	0.11
Inshore lizardfish	*Synodus foetens*	0.11
Pinfish	*Lagodon rhomboides*	0.11
Golden shiner	*Notemigonus crysoleucas*	0.11
Atlantic spadefish	*Chaetodipterus faber*	0.10
White crappie	*Pomoxis annularis*	0.10
Unidentifiable Fish	Unidentifiable fish	0.10
White catfish	*Ameiurus catus*	0.10
White sucker	*Catostomus commersoni*	0.09
Spotfin killifish	*Fundulus luciae*	0.09
Pigfish	*Orthopristis chrysoptera*	0.09
Feather blenny	*Hypsoblennius hentz*	0.09
Spanish mackerel	*Scomberomorus maculatus*	0.09

Common Name[1]	Scientific Name[1]	Average Density ($n/10^6$ m^3) [2]
Bluespotted cornetfish	*Fistularia tabacaria*	0.09
Spottail shiner	*Notropis hudsonius*	0.08
Goosefish	*Lophius americanus*	0.08
Atlantic thread herring	*Opisthonema oglinum*	0.07
Green sunfish	*Lepomis cyanellus*	0.07
Redfin pickerel	*Esox americanus*	0.07
Spotfin mojarra	*Eucinostomus argenteus*	0.07
Redeared sunfish	*Lepomis microlophus*	0.07
Tautog	*Tautoga onitis*	0.06
Fat sleeper	*Dormitator maculatus*	0.06
Largemouth bass	*Micropterus salmoides*	0.06
Cownose	*Rhinoptera bonasus*	0.06
Satinfin shiner	*Cyprinella analostana*	0.06
Rainbow trout	*Oncorhynchus mykiss*	0.06
Redbreast sunfish	*Lepomis auritus*	0.06
Green goby	*Microgobius thalassinus*	0.06
Eastern mudminnow	*Umbra pygmaea*	0.06
Mud sunfish	*Acantharchus pomotis*	0.05
Atlantc sturgeon	*Acipenser oxyrhynchus*	0.05
Atlantic cutlassfish	*Trichiurus lepturus*	0.05
Southern kingfish	*Menticirrhus americanus*	0.05

(1) Species in **bold** have potentially affected EFH for one or more life stages in the vicinity of Salem and HCGS.

(2) Average density expressed as number of fish impinged (n) per million (10^6) cubic meters (m^3) of water withdrawn through the intake screens.

Source: Biological Monitoring Program Annual Reports (PSEG, 1996; PSEG, 1997; PSEG, 1998; PSEG, 1999b; PSEG, 2000; PSEG, 2001; PSEG, 2002; PSEG, 2003; PSEG, 2004a; PSEG, 2005b; PSEG, 2006b; PSEG, 2007; PSEG, 2008; PSEG, 2009c)

Atlantic butterfish

EFH for Atlantic butterfish juveniles may exist in the vicinity of Salem and HCGS. Inshore EFH for the butterfish includes the mixing or saline zones of estuaries where butterfish eggs, larvae, juveniles, and adults are common or abundant on the Atlantic coast, from Passamaquoddy Bay in Maine to the James River in Virginia (NMFS 2010b). Butterfish eggs and larvae are found in water with depths ranging from the shore to 6,000 ft and temperatures between 9 °C (48 °F) and 19 °C (66 °F). Juvenile and adult butterfish are found in waters from 33 to 1,200 ft deep and at temperatures ranging from 3 °C (37 °F) to 28 °C (82 °F) (NMFS 2010b). Spawning occurs offshore at temperatures above 15 °C (59 °F) (Colton 1972).

All butterfish life stages are pelagic. Adult butterfish prey on small fish, squid, crustaceans, and other invertebrates and in turn are preyed upon by many species of fish and squid. In summer, butterfish can be found over the entire continental shelf, including sheltered bays and estuaries, to a depth of 200 m over substrates of sand, rock, or mud. Butterfish migrate annually in response to seasonal changes in water temperature. During the summer, they migrate inshore into southern New England and Gulf of Maine waters, and in winter they migrate to the edge of the continental shelf in the Mid-Atlantic Bight (Cross et al., 1999).

The Salem and HCGS intakes and discharges have the potential to adversely affect EFH for Atlantic butterfish juveniles in the Delaware Estuary in the vicinity of the facilities. Because Salem uses much greater quantities of water than HCGS, Salem has a greater potential to adversely affect EFH through the operation of its intake and discharge. Butterfish juveniles have not been commonly entrained or impinged at Salem. NRC staff used monitoring data for the Salem intake from 1995 through 2008 to calculate an average of annual mean densities of butterfish and other fish entrained and impinged over the 14-yr period (Tables 4 and 5). Butterfish were not found in the entrainment sampling, and the density of butterfish impinged was only 0.87 juveniles or adults per 1 million m^3 of cooling water withdrawn. The area of the estuary affected by the thermal plume from the discharge is relatively very small and, due to the buoyancy of the plume, its extent tends to be greatest near the surface. Juvenile butterfish would be unlikely to encounter the plume due to its limited area, and their mobility would allow them to avoid water temperatures that are not within their preference range. Therefore, continued operation of the Salem and HCGS intakes and discharges during the relicensing period would have minimal adverse effects on EFH for Atlantic butterfish juveniles.

6.0 Mitigation Measures

In compliance with Salem's 1994 and 2001 NJPDES permits, PSEG implemented an Estuary Enhancement Program (EEP), which has preserved and/or restored more than 20,000 ac of wetland and adjoining upland buffers to enhance fish and shellfish populations in the Delaware Estuary (PSEG, 2009a). In particular, 4,400 acres of formerly diked salt hay farms were restored to reestablish conditions suitable for the growth of low marsh vegetation such as saltmarsh cord grass (*Spartina alterniflora*) and provide for tidal exchange with the estuary. These restored wetlands increase the production of fish and shellfish by increasing primary production in the detrital based food web of the Delaware Estuary. Both primary and secondary consumers benefit from this increase in production, including the four EFH species discussed above. PSEG estimated the increase in production of secondary consumers due to this restoration to be at least 18.6 million lbs/yr (PSEG, 2006a). These secondary consumers include species of fish and shellfish affected by impingement and entrainment at Salem, as well as other species.

~~Because the continued operation of Salem and HCGS for the 20-yr relicensing period is not expected to have more than minimal adverse effects on EFH, NRC proposes no additional mitigation measures beyond the ongoing activities of the EEP.~~

Comment [D6]: We no longer make statements about the need for mitigation. Mitigation is regulated by EPA and its delegated states: NJ is one. Therefore, NRC has no jurisdiction to propose or to implement mitigation—we leave such judgements to the regulating authority.

Here you should list mitigation measures already in place: cooling tower for Hope Creek, traveling screens, Ristroph design, fish return systems, etc.

Remember that the EEP is not a mitigation according to the supreme court court decision, even though it was originally proposed as one. It is a supplemental program (check ER for specific term for this) that has a positive impact on many estuarine species. It is OK to mention it here, but be clear that the EEP is not mitigation but a supplemental program. Also talk about the fish ladders that affect EFH species (once again, not a mitigation).

7.0 Conclusion

~~The principal means by which the~~ Salem and HCGS facilities ~~may~~ affect aquatic resources of the Delaware Estuary primarily through ~~are~~ the processes of entrainment and impingement of organisms at the cooling water intake and the discharge of thermal effluent. Water withdrawn for cooling is no longer available as habitat, and fish and their food can be lost due to impingement and entrainment. Water returned to the estuary as thermal effluent changes the natural temperature and current regimes in localized areas of habitat. These processes simultaneously and cumulatively affect the aquatic community of the estuary. Because the Salem facility has been operating for more than 30 years and HCGS for about 24 years, the total impacts of their operation are integrated and reflected in the condition of the ecosystem of the estuary. By evaluating total impacts from the historical, long-term operation of these facilities and the beneficial effects of ongoing restoration activities, total impacts on the estuary from future operation of both Salem and HCGS during the relicensing period can be assessed. As part of its 2006 NJPDES application for Salem, PSEG prepared an assessment of Adverse Environmental Impact for the Salem facility that analyzed the composition of the fish community in the vicinity, trends in the relative abundance of 12 representative species of fish and invertebrates, and the long-term sustainability of fish stocks in the estuary. The assessment demonstrated that the Salem and HCGS cooling water intake systems have not caused and are unlikely to cause in the future substantial harm to the sustainability of populations of important aquatic species or to the structure and function of the ecosystem in the Delaware Estuary (PSEG 2006a). Accordingly, the NRC staff concludes that the proposed action would have minimal adverse effects on EFH.

Comment [D7]: We have to independently assess affects, not just accepted PSEG's opinion. I think we also need to compare the amount of habitat and trophic support lost (measured as water withdrawn) in comparison to the available habitat for these species. That ration is vanishingly small, which supports the icea that the effects are minimal.

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NJDEP administers Clean Water Act sections 316(a) and 316(b) through its NJPDES permits.

Salem

NJDEP renewed the NDPDES permit for Salem in 2001 and accepted the results of Salem's 316(b) demonstration that the CWS and SWS intakes represented Best Technology Available (BTA) for reducing adverse impact. The application addressed Salem's compliance with the special conditions of the previous 1994 permit. The 2001 NJPDES permit contained some special conditions of its own.

In 2004, EPA promulgated its Phase II Rule for regulating cooling water intake structures at Clean Water Act section 316(b) large existing electric generating facilities such as Salem. PSEG submitted an application for renewal of the 2001 NJPDES permit in 2006, including information required under the Phase II rule. The 2001 permit was administratively continued in July 2006. EPA suspended the Phase II rule in July 2007 after the Riverkeeper, Inc. v EVA decision. At this point NJDEP has no scheduled action on Salem's administratively continued 2001 NJPDES permit.

Hope Creek

NJDEP renewed the NDPDES permit for Salem in 2003 and accepted the results of Salem's 316(b) demonstration that the Hope Creek's closed-cycle cooling water system represented Best Technology Available (BTA) for reducing adverse impact. The permit expired in 2008.

Questions:

I assume that the New Jersey Administrative Procedure Act automatically renewed Salem's 2001 permit without a judgment by NJDEP on 316(b). Is that true?

What happened to Hope Creek in 2008—did the NJAPA automatically extend its NJPDES permit?