June 14, 2007

Mary A. Colligan
Assistant Regional Administrator for Protected Resources
National Marine Fisheries Service
Northeast Region
One Blackburn Drive
Gloucester, MA 01930-2298

SUBJECT: HOPE CREEK EXTENDED POWER UPRATE ESSENTIAL FISH HABITAT ASSESSMENT

Dear Ms. Colligan:

The U.S. Nuclear Regulatory Commission (NRC) staff has prepared the enclosed essential fish habitat (EFH) assessment to determine if the proposed extended power uprate (EPU) of the Hope Creek Generating Station (HCGS) would adversely affect EFH. The proposed action would result in an increase in power output of up to 20% and would not entail major construction activity. HCGS is located on Artificial Island in Lower Alloways Creek Township, New Jersey, adjacent to the Delaware Estuary.

The NRC staff's assessment considers the impacts of HCGS operation on the EFH of species managed by the Mid-Atlantic Fishery Management Council. The assessment addresses potential adverse effects on EFH for the species and life stages that could potentially occur in the vicinity of the plant. The NRC staff concludes that the proposed EPU would have a minimal adverse effect on EFH. In preparing our assessment and reaching our conclusion, the NRC staff relied on information provided by the licensee, on other literature, and on information from the National Marine Fisheries Service's Northeast Regional Office. We look forward to your comments on the assessment. If you have any questions regarding this assessment or the staff's request, please contact Dr. Dennis Logan, Aquatic Biologist, at 301-415-0490 or by e-mail at dtl1@nrc.gov.

Sincerely,

/RA/

Eric Benner, Branch Chief
Environmental Branch A
Division of License Renewal
Office of Nuclear Reactor Regulation

Docket No. 50-354

Enclosure:
EFH Assessment

cc w/enclosure: See next page

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D. Logan H. Nash A. Luu E. Benner JShea

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NAME	D. Logan	I. King	H. Nash (w/ changes)	A. Luu	E. Benner
DATE	06/7/07	06/5/07	06/13/07	06/13/07	06/14/07

OFFICIAL RECORD COPY

cc:

Mr. Dennis Winchester
Vice President - Nuclear Assessments
PSEG Nuclear
P.O. Box 236
Hancocks Bridge, NJ 08038

Mr. George P. Barnes
Site Vice President - Hope Creek
PSEG Nuclear
P.O. Box 236
Hancocks Bridge, NJ 08038

Mr. George H. Gellrich
Plant Support Manager
PSEG Nuclear
P.O. Box 236
Hancocks Bridge, NJ 08038

Mr. Michael J. Massaro
Plant Manager - Hope Creek
PSEG Nuclear
P.O. Box 236
Hancocks Bridge, NJ 08038

Mr. James Mallon
Manager - Licensing
200 Exelon Way - KSA 3-E
Kennett Square, PA 19348

Mr. Jeffrie J. Keenan, Esquire
PSEG Nuclear - N21
P.O. Box 236
Hancocks Bridge, NJ 08038

Mr. Michael Jesse
Manager - Regulatory Assurance
P.O. Box 236
Hancocks Bridge, NJ 08038

Township Clerk
Lower Alloways Creek Township
Municipal Building, P.O. Box 157
Hancocks Bridge, NJ 08038

Mr. Paul Bauldauf, P.E., Asst. Director
Radiation Protection Programs
NJ Department of Environmental
Protection and Energy
CN 415
Trenton, NJ 08625-0415

Mr. Brian Beam
Board of Public Utilities
2 Gateway Center, Tenth Floor
Newark, NJ 07102

Regional Administrator, Region I
U.S. Nuclear Regulatory Commission
475 Allendale Road
King of Prussia, PA 19406

Senior Resident Inspector
Hope Creek Generating Station
U.S. Nuclear Regulatory Commission
Drawer 0509
Hancocks Bridge, NJ 08038

Stan Gorski
Habitat Conservation Division
James J. Howard Marine Sciences
Laboratory
74 Magruder Road
Highlands, NJ 07732

Essential Fish Habitat Assessment

Hope Creek Generating Station
Extended Power Uprate

2007

Enclosure

ESSENTIAL FISH HABITAT ASSESSMENT FOR AN EXTENDED POWER UPRATE AT HOPE CREEK GENERATING STATION

1.0 INTRODUCTION

The U.S. Nuclear Regulatory Commission (NRC) issues licenses for domestic power plants in accordance with the provisions of the Atomic Energy Act of 1954, as amended, and NRC implementing regulations. NRC is reviewing an application submitted by PSEG Nuclear LLC (PSEG or applicant) for an extended power uprate (EPU) for the Hope Creek Generating Station. The result of the uprate would be an increase in maximum thermal power of 20%.

The 1996 amendments to the Magnuson-Stevens Fishery Conservation and Management Act (MSA) identify the importance of habitat protection to healthy fisheries. The amendments known as the Sustainable Fisheries Act strengthen the governing agencies' authorities to protect and conserve the habitat of marine, estuarine, and anadromous animals (NEFMC 1999). Essential Fish Habitat (EFH) is defined as those waters and substrata necessary for spawning, breeding, feeding, or growth to maturity (MSA, 16 USC 1801 *et seq.*). Designating 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. This responsibility was expanded to insure additional habitat protection (NMFS 1999). The consultation requirements of Section 305(b) of the MSA provide that Federal agencies consult with the Secretary of Commerce on all actions or proposed actions authorized, funded, or undertaken by the agency that may adversely affect EFH.

Hope Creek Generating Station is located on Artificial Island on the New Jersey shore of the Delaware Estuary, which serves as the plant's source of cooling water and the receiving water body for the effluent.

2.0 PROPOSED FEDERAL ACTION

The proposed action is to amend Hope Creek Generating Station's Operating License to increase the core thermal power level from 3,339 to 3,952 megawatts thermal (MWt), an increase great enough to be classified as an EPU. The original Operating License NPF-57 authorized operation up to a maximum power level of 3,293 MWt. NRC authorized a 1.4 % thermal power increase to 3,339 MWt in 2001. The increase in thermal power would be achieved by installing a turbine of higher efficiency, which would extract additional electrical power from the steam, and by increasing the heat output of the reactor. The intent is to raise the power level in increments that would not exceed the maximum level of 3,952 MWt. Under EPU conditions, the maximum power level would be 120% of the original licensed level or a 20% increase.

3.0 ENVIRONMENTAL SETTING IN RELATION TO EFH

Hope Creek Generating Station is located on Artificial Island, on the eastern bank (New Jersey) of the Delaware River Estuary and is about 50 miles north of the mouth of the Bay. At Artificial Island the estuary is tidal with a net flow south; it is roughly 5000 m (16,000 ft) wide, and turns to the left (looking south). The Army Corps of Engineers maintains a dredged navigation channel close to the center of the river, about 2011 m (6,600 ft) west of the Hope Creek Generating Station discharge. The channel is about 12 m (40 ft) deep and about 400 m (1300 ft) wide. On the New Jersey side of the channel, water depths (MLW) are fairly uniform at about 6 m (20 ft). Predominant tides in the area are semi-diurnal with a 12.42-hour period and a mean tidal range of 1.68 m (5.5 ft). The maximum tidal currents occur in the channel, and currents flow more slowly over the shallower areas. (NRC 1984, Najarian Associates 2004)

Maximum tidal currents in this area as reported in NRC 1984 are summarized in the table below:

Tide	Location in Relation to Hope Creek Generating Station	
	4710 m (15,450 ft) Upstream	1510 m (4950 ft) Downstream
Flood	1.23 m/sec (4.05 ft/sec)	0.77 m/sec (2.53 ft/sec)
Ebb	1.34 m/sec (4.39 ft/sec)	0.98 m/sec (3.21 ft/sec)

Salinity is an important determinant of biotic distribution in estuaries, and salinity near the plant site depends on river flow. NRC (1984) reported that during low-flow period average salinity in this reach ranged from 5 to 18 parts per thousand (ppt) and during other periods from 0 to 5 ppt. Najarian Associates (2004) and PSEG Services Corp. (2005) characterized salinity at the plant as ranging between 0 and 20 ppt and, in summer during periods of low flow, typically exceeding 6 ppt. Based on temperature and conductivity data collected by the U.S. Geological Survey (USGS) at Reedy Island, just north of Artificial Island, Najarian Associates (2004) calculated salinity from 1991 through 2002. Visual examination of their Figure B6 indicates that salinity appears to have a median of about 5 ppt, exceeded 12 ppt in only two years and 13 ppt in only one year, and never exceeded about 15 ppt during this entire 11-year period. Based on these observations, NRC staff assumes that salinity is typically from 0 to 5 ppt in periods of low flow (typically but not always summer) and 5 to 12 ppt in periods of high flow. Within these larger patterns, salinity at any location also varies with the tides.

Monthly average surface water temperatures vary with season: between 1977 and 1982 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 meter of water depth. (NRC 1984)

The U.S. Environmental Protection Agency (EPA 1998) summarized conditions in the Delaware Estuary in a report on Mid-Atlantic estuaries and provided the following insights. Estuarine waters are categorized in three zones based on salinity: oligohaline (0 to 5 ppt), mesohaline (5 to 18 ppt), and polyhaline (greater than 18 ppt). The reach adjacent to Artificial Island is at the interface of the oligo- and mesohaline zones–oligohaline during high flow and mesohaline during low flow conditions. Water clarity here is generally fair (EPA classes are good, fair, and poor), which EPA explains as meaning that a wader in waist-deep water would not be able to see his feet. Directly above and below this reach EPA lists water clarity as poor, which they define 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. Lower water clarity is typically due to phytoplankton blooms, suspended sediments from runoff from land or wind over shallow water, and detritus from tributaries and the main stem of the river.

EPA (1989) classifies concentrations of nitrogen and phosphorus, which are plant nutrients that can cause eutrophication and algal blooms in rivers and estuaries, in this reach as poor in a rating system of good, fair, or 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 (1989) reports that dissolved oxygen and chlorophyll (a measure of phytoplankton density) levels in this reach of the Delaware Estuary were good in spite of high nutrient levels. EPA (1989) indicates that the typical pattern did not occur in this reach of the Delaware Estuary because "murky water inhibits persistent algal blooms." Algal blooms here are limited by light, not by nutrient levels.

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) and 2002 through 2004 (DRBC 2007) in terms of Designated Uses, among which is the use of "Supporting Aquatic Life." For its environmental sampling programs, DRBC divides the Delaware Estuary into 6 Zones, some with sub-Zones, and Zone 5 includes Artificial Island. Because of low concentrations of dissolved oxygen, the DRBC reports conclude that Zone 5 did not meet the use of supporting aquatic life between the years 2000 and 2004.

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, bivalves, some polychaetes and others). Some consume detritus, or dead plant material. While the benthic community contains within it many trophic levels, it also provides a trophic base for fish and shellfish (such as crabs) valued by humans. Besides these important ecological functions, benthic communities are sensitive indicators of pollution and the general condition of rivers and 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. And they are good indicators because they are relatively easy to sample and observe. EPA developed an index of benthic condition, with classes 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 increases from severely impacted to good moving south from Philadelphia to the mouth of the Bay. EPA (1998) classifies the benthic community in the reach adjacent to Hope Creek and Artificial Island as impacted and good south of the island. The sediment texture in the transition zone that includes Artificial Island are primarily mud, muddy sand, and sandy mud (PSEG 2006).

Many contaminants that enter the estuary bind to detritus and suspended sediment particles, which can settle to the bottom where contaminant concentrations may exceed concentrations in the water column. Aquatic organisms can then be directly exposed by living in, on, or near the sediments; by feeding on plants and animals that are directly exposed to sediment contaminants or are exposed though food-web transfer; and by being exposed to resuspended sediments. Sediments form a reservoir that can release persistent contaminants long after other sources have ceased. Typical contaminants in rivers and estuaries include metals (e.g., chromium, copper, lead, mercury, silver, arsenic, and zinc), polyaromatic hydrocarbons, polychlorinated biphenyls (PCBs), and pesticides. EPA (1998) categorized the sediment contamination as posing (1) no risk, (2) minimal risk, or (3) potential risk to aquatic life and found that found that 53% of sediments in Mid-Atlantic estuaries posed no risk. They reported that sediments in the Delaware Estuary off Artificial Island posed minimal risk to aquatic life. Sediment contaminant levels in Mid-Atlantic estuaries have generally improved due to increased regulation of point and non-point source pollution, and this trend may occur in the Delaware Estuary as well.

The properties that cause some contaminants that accumulate in sediments (e.g., persistence, affinity for organic material) also 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 result in fish consumption advisories. The States of New Jersey (New Jersey Department of Environmental Protection and New Jersey Department of Health and Senior Services 2006) and Delaware (DNREC 2007) have issued Fish Consumption Advisories for their respective Delaware Estuary waters. For the reach of the Estuary between the Chesapeake and Delaware Canal, which is just north of Hope Creek Generating Station, to the mouth of the Bay, the consumption advisories for both states are similar and are as follows:

(1) For all weakfish (*Cynoscion regalis*) and for bluefish (*Pomatomus saltatrix*) 14-in. long or less, the general population and high risk individuals are advised to eat no more than one 8-oz meal per month or less due to PCB contamination.

(2) For all striped bass (*Morone saxatilis*), white perch (*M. americana*), American eel *(Anguilla rostrata*), channel catfish (*Ictalurus punctatus*), white catfish (*Ameiurus catus*), bluefish greater than 14-in. long, members of the general population are advised to eat no more than one 8-oz meal per year due to PCB and mercury contamination. High risk individuals, i.e., women of child-bearing age and children, should not 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 are being bioaccumulated and passed through natural food webs in aquatic habitats near Hope Creek Generating Station.

4.0 PLANT COOLING WATER SYSTEM AND THERMAL EFFLUENT LIMITATIONS

The potential impacts to fish habitat from the proposed action would primarily be due to operation of the cooling water system. Hope Creek Generating Station dissipates heat to the atmosphere through a closed-cycle system with a natural-draft cooling tower, which minimizes water withdrawn from and heated effluent released to the Delaware Estuary. The description of the cooling water system below is based on the Final Environmental Statement (NRC 1984), the Environmental Report for the proposed EPU (PSEG Services Corp. 2005), and the recent hydrothermal modeling report prepared for the EPU application (Najarian Associates 2004).

The west face of the cooling water intake structure is parallel to and flush with the shoreline and 34 m (112 ft) long. Water flows into the structure at a maximum velocity of 10.7 cm/s (0.35 ft/sec). Coated carbon-steel trash racks, 3 in. deep and 3/4 in. wide, located on 3-in. centers, are located in front of the intake structure. After passing through the trash racks, the intake water flows through modified Ristroph-design traveling screens at about 11.9 m/sec (0.39 ft/sec). The mesh size of the vertical screens is 1.27 cm x 0.32 cm (½ in. X 1/8 in.). Each basket of the screen has a trough or fish bucket on the lower lip. Low pressure (less than 20 pounds per square inch [psi]) sprays wash impinged organisms into a fish return trough. Then high pressure sprays (about 90 psi) wash the remaining debris into a debris trough. The fish and debris troughs combine and return the fish to the Delaware Estuary. The screens do not operate continuously.

From the intake structure, water flows to four circulating water pumps, two or three of which normally operate at any time, and on to the condenser. In the condenser, heat from the hot steam exhausting from the turbine generator is transferred to the cooling water, although the steam and cooling water never come into direct contact. The heated cooling water then flows to the station's single natural-draft cooling tower, where it is released in the tower and forms small droplets that fall like rainfall in the tower and release heat through evaporation. The warm, moist air in the tower rises and pulls ambient air into the tower. Evaporation leaves solids behind in the cooling water, which is collected at the bottom of the tower. Some of the warmed cooling water, now with elevated concentrations of dissolved solids and called "blowdown," is recycled within the cooling tower and the rest is released into the estuary through a gravity-fed 48-in discharge pipe. Cooling water to replace the blowdown, the "makeup water," is withdrawn from the estuary through the intake structure and service water pumps.

The volume makeup cooling water withdrawn from the estuary is the sum of the blowdown released and the evaporative loss from the cooling tower. The evaporative loss is a function of several factors including air temperature and humidity, circulating water flow, and cooling water temperature. Evaporative loss from the cooling tower would increase about 20% over original conditions during EPU conditions. The concentration of solids in the blowdown is now about 30% higher than in the makeup water, and this difference would increase about 9% from the original conditions under EPU conditions. After the EPU, the plant would tend to produce less effluent (blowdown), but the total dissolved solids (TDS) content of that effluent would be higher. Because the density of the effluent is determined by both temperature and TDS, the effluent may be either less (and tend to float) or more dense (and tend to sink) than the receiving water, depending on conditions at the time.

The four circulating water pumps have a design capacity of 138,000 gallons per minute (gpm) each, or 552,000 gpm total. Normally only two or three pumps are required to provide the total service water flow, which includes the makeup water and any auxiliary cooling water. The volume required depends on temperature. When the ambient water temperature is greater than 70 °F, typically June through September, three pumps operate to supply about 52,000 gpm of total service water. At temperatures below 70 °F, typically November through April, two pumps operate to supply about 37,000 gpm of total service water.

Sodium hypochlorite is injected into the cooling water system 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.

Thermal effluent limitations for Hope Creek Generating Station are imposed though New Jersey Pollutant Discharge Elimination System (NJPDES) permits. The plant has a designated heat dissipation area no larger than 2500 ft (762 m) upstream or downstream and 1500 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 2.2 °C (4 °F) in non-summer months of September through May or 0.8 °C (1.5 °F) in summer months of June through August. In addition, the maximum water temperature attributable to the plant outside of the designated area cannot exceed 30 °C (86 °F). Temperature records from USGS monitoring station at Reedy Point, about 3 km (2 mi) upriver from HCGS, has been used to determine ambient water temperature. In addition to the other requirements, the one-hour average temperature of the effluent on any day cannot exceed 36.2 °C (97.1 °F). (PSEG Services Corp. 2005, Najarian Associates 2004)

Cooling water withdrawal affects aquatic populations through impingement of larger individuals (e.g., fish, some crustaceans, turtles, etc.) on the trash racks and intake debris screens and through entrainment of smaller organisms that pass through the screens into the cooling water system. The proposed action would not change the volume or rate of cooling water withdrawn. Most of the additional heat generating under the EPU would be dissipated by the cooling tower, and PSEG proposes no changes to the cooling water system.

Discharge of heated effluent alters natural thermal and current regimes and can induce thermal shock. The HCGS effluent would change under the EPU. Because the volume of makeup water withdrawn from the estuary would remain unchanged and the volume of evaporative loss from the cooling tower would increase, the volume of the blowdown released, which is the difference of the two, would decrease. The increase evaporation would leave behind more solids in the blowdown, so the concentration of TDS in the effluent would be about 9% higher on average (Najarian Associates 2004). The effluent would also be somewhat warmer, but modeling predicts that all present NJPDES permit conditions for the effluent would still be met (Najarian Associates 2004).

5.0 POTENTIAL IMPACTS OF THE PROPOSED ACTION ON DESIGNATED ESSENTIAL FISH HABITAT OF FEDERALLY MANAGED SPECIES IN THE VICINITY HOPE CREEK GENERATING STATION

Under present conditions, the plant affects fish habitat primarily through its cooling water system 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 thermal and current regimes in fish habitat. The proposed action has the potential to alter at least some aspects of EFH.

Hope Creek Generating Station lies close to the interface of the NMFS's tidal freshwater and mixing salinity zones. The reach of the Delaware Estuary adjacent to Hope Creek Generating Station is designated EFH for several fish species and life stages. NRC staff considered all the designated EFH that could occur in the vicinity of HCGS based on geographic coordinates and eliminated EFH for some species and life stages with EFH requirements outside of the normal conditions recorded locally.

The NMFS identifies EFH on their website in terms of both the estuary as a whole and 10 minutes (') by 10 ' squares of latitude and longitude and presents tables of species and life stages with EFH within the squares. In terms of the estuary as a whole, NMFS identifies 16 fish species with EFH in the Delaware Estuary and summarizes their salinity requirements by life stage (Table 1). On a finer scale, the 10 ' by 10 ' square that includes Hope Creek Generating Station is defined by the following coordinates:

North: 39 ° 30.0 'N
East: 75 ° 30.0 'W
South: 39 ° 20.0 'N
West: 75 ° 40.0 'W

The description of the general location and New Jersey shoreline in the square shows that it includes Artificial Island and HCGS:

> "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."

The NRC staff compared salinity in the vicinity of the plant described earlier with EFH salinity requirements of each species and life stage in Table 1 to further refine the EFH species list. The salinity requirements of several of the fish species and life stages are higher than have been reported or occur only during periods of low flow (Table 2). Where EFH salinity requirements were not met in the vicinity of the plant, the species and life stages were dropped from further consideration. This assessment analyzes effects of the proposed EPU for the four remaining species (Table 3).

Table 1. Designated EFH by species and life stage in NMFS's 10' x 10' square of latitude and longitude of the Delaware Estuary that includes Hope Creek Generating Station.

Species	Eggs	Larvae	Juveniles	Adults
Red Hake (*Urophycis chuss*)				
Winter Flounder (*Pleuronectes americanus*)	X	X	X	X
Windowpane (*Scophthalmus aquosus*)	X	X	X	X
American Plaice (*Hippoglossoides americanus*)				
Bluefish (*Pomotomus saltatrix*)			X	X
Atlantic Sea Herring (*Clupea harengus*)				
Atlantic Butterfish (*Peprilus triacanthus*)			X	
Summer Flounder (*Paralichthys dentatus*)			X	X
Scup (*Stenotomus chrysops*)	n/a	n/a	X	
Black Sea Bass (*Centropristes striatus*)	n/a		X	
King Mackerel (*Scomberomorus cavalla*)	X	X	X	X
Spanish Mackerel (*Scomberomorus maculatus*)	X	X	X	X
Cobia (*Rachycentron canadum*)	X	X	X	X
Clearnose Skate (*Leucoraja eglantaria*)			X	X
Little Skate (*Leucoraja erinacea*)			X	X
Winter Skate (*Leucoraja ocellata*)			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 2007a, 2007b

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

Habitat Salinity in Delaware Estuary Adjacent to Hope Creek Generating Station		
Condition	Salinity Range (ppt)	
High Flow	0 - 5	
Low Flow	5 - 12	
EFH Salinity Requirement[(a)]		
Species, Life Stage	Salinity Requirement (ppt)	Salinity Fits Habitat
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 otherwise noted.
(b) Packer et al. (2003) NOAA Technical Memorandum NMFS-NE-174
(c) Packer et al. (2003) NOAA Technical Memorandum NMFS-NE-175
(d) NOAA (2003) NOAA Technical Memorandum NMFS-NE-179

Table 3. Fish species and life stages retained for EFH analysis for Hope Creek Generating Station Extended Power Uprate.

Species	Eggs	Larvae	Juveniles	Adults
Winter Flounder	X	X	X	X
Windowpane	X	X	X	X
Atlantic Butterfish			X	
Summer Flounder			X	X

Winter Flounder (*Pseudopleuronectes americanus*)

EFH for winter flounder egg, larval, juvenile, and adult life stages may occur in the vicinity of Hope Creek Generating Station. EFH for eggs includes bottom habitats with substrates of sand, muddy sand, and gravel on the Georges Bank, the inshore areas of the Gulf of Maine, southern New England, and the mid-Atlantic region south to Delaware Bay. Eggs are typically found in water at depths less than 5 m (16 ft), and in water with temperatures less than 10 °C. Larval EFH occurs in pelagic and bottom waters of Georges Bank, inshore areas of the Gulf of Maine, southern New England, and the mid-Atlantic region south to Delaware Bay. Larval EFH includes water less than 6 m (20 ft) deep and with temperatures below 15 °C. EFH for juvenile winter flounder includes bottom habitats with substrates of mud or fine-grained sand on Georges Bank, inshore areas of the Gulf of Maine, southern New England, and the mid-Atlantic region south to Delaware Bay. 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. Age 1+ juveniles are found at water depths ranging from 1 to 50 m (3 to 164 ft) and at temperatures below 25 °C. EFH for both adults and spawning adults includes bottom habitats, including estuaries, with substrata of mud, muddy sand, sand, and gravel on Georges Bank, inshore areas of the Gulf of Maine, southern New England, and the mid-Atlantic region south to the Delaware Bay. Adult winter flounder live in water at depths ranging from 1 to 100 m (3 to 328 ft) with temperatures below 25 °C. Spawning adults are found at water depths less than 6 m (262 ft), except for on Georges Bank, where they spawn as deep as 80 m. Water temperatures for spawning adults are typically below 15 °C (NMFS 2006). Spawning takes place at night over sandy bottoms in shallow estuaries starting in mid December and ending in May, with a peak in the February to March time frame.

The various life stages of winter flounder can generally be found in areas where the bottom habitat has a substrate of mud, sand, or gravel (NEFMC 1998b). Winter flounder eggs are demersal, adhesive, and stick together in clusters, and hatching may occur in 2 to 3 weeks, depending upon the water temperature (Bulloch 1986; Pereira et al.1999). Larvae are initially planktonic, but, as metamorphosis continues, they settle to the bottom. After yolk-sac absorption, they feed on diatoms. 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 or 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, although exceptions may occur due to water temperature and food availability (Pereira 1999). 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).

Table 5-7 in PSEG (1999) indicates that winter flounder have been found in pre-operational and operational collections from the vicinity of Hope Creek Generating Station, although no information on life stage, methods of capture and identification, abundance, or location of capture are provided. NRC staff would not anticipate that larval and juvenile life stages would use this reach of the estuary as habitat because this reach tends not to stratify and lacks the deep salinity wedge with a net upstream flow that many species use to move up or maintain their position in the estuary. Due to the small area and relatively small temperature increase in the thermal effluent, the lack of change in water withdrawal, and the expectation of low habitat utilization, the EPU is expected to have only a minimal adverse effect on winter flounder EFH.

Windowpane (*Scopthalmus aquosus*)

The initial analysis suggests that EFH for windowpane egg, larval, juvenile, and adult life stages may occur in the vicinity of Hope Creek Generating Station. EFH for eggs includes surface waters on the perimeter of the Gulf of Maine, Georges Bank, southern New England, and the mid-Atlantic region south to Cape Hatteras. EFH for larvae includes pelagic waters, with water depths between 50 to 150 m (164 to 492 ft) and temperatures below 20 °C. For larvae, the EFH consists of surface waters on the perimeter of the Gulf of Maine, Georges Bank, southern New England, and the mid-Atlantic region south to Cape Hatteras. Both eggs and larvae are found in water depths less than 70 m (230 ft), and in water temperatures below 20 °C. Juvenile, adult, and spawning adult EFH includes bottom habitats with substrates of mud or fine-grained sand on the perimeter of the Gulf of Maine, Georges Bank, southern New England, and the mid-Atlantic region south to Cape Hatteras. These areas are generally 1 to 100 m (3 to 328 ft) deep and have water temperatures below 26 °C (NMFS 2006). The windowpane prefers a soft bottom substrate for spawning, and generally spawns between April and December, with peak spawning activity in July and August on Georges Bank and in May in the mid-Atlantic region (NEFMC 1998a, Hendrickson 1998 in ENSR 2000).

Both the eggs and larvae are pelagic, and exist in surface waters cooler than 20 °C (NEFMC 1998a in ENSR 2000). The prey for the windowpane is small benthic invertebrates, including polychaete worms and amphipods. The species may also prey on small forage bony fish species (Langston and Bowman 1981 in ENSR 2000). Juveniles living in shallow waters tend to move to deeper waters as they mature (Chang et al. 1999b). In studies in Massachusetts, juveniles were most abundant in inshore waters at depths of less than 20 m (66 ft) and at water temperatures between 5 °C and 12 °C in the spring and between 12 °C and 19 °C in the fall (Chang et al. 1999b).

Table 5-7 in PSEG (1999) indicates that windowpane have been found in pre-operational and operational collections from the vicinity of Hope Creek Generating Station, although no information on life stage, methods of capture and identification, abundance, or location of capture are provided. NRC staff would not anticipate that larval and juvenile life stages would use this reach of the estuary as habitat because this reach tends not to stratify and lacks the deep salinity wedge with a net upstream flow that many species use to move up or maintain their position in the estuary. Due to the small area and relatively small temperature increase in the thermal effluent, the lack of change in water withdrawal, and the expectation of low habitat utilization, the EPU is expected to have only a minimal adverse effect on windowpane EFH.

Atlantic butterfish (*Peprilus triacanthus*)

EFH for Atlantic butterfish juveniles may occur in the vicinity of Hope Creek Generating Station. 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, Maine to James River, Virginia (NMFS 2006). Butterfish eggs and larvae are found in water with depths ranging from the shore to 6000 ft, and temperatures between 48 °F and 66 °F. Juvenile and adult butterfish are found in waters from 33 to 1,200 ft deep, and with temperatures ranging from 37 °F to 82 °F (NMFS 2006). Spawning occurs offshore, at temperatures above 59 °F (Colton 1972 in Cross et al. 1999). Juvenile butterfish are found in association with jellyfish in the summer for protection.

All life stages are pelagic (Cross et al. 1999). Adult butterfish prey on small fish, squid, and crustaceans, and in turn are preyed upon by many species, including silver hake (*Merluccius bilinearis*), bluefish, swordfish (*Xiphias gladuis*), and longfinned squid (*Loligo pealei*) (ENSR 2000). In summer, the butterfish can be found over the entire continental shelf from sheltered bays and estuaries, over substrates of sand, rock, or mud, to a depth of 200 m (Cross et al. 1999). The butterfish migrates 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).

Table 5-7 in PSEG (1999) indicates that Atlantic butterfish are not among the 200 species of fish that have been found in the vicinity of Hope Creek Generating Station in either pre-operational or operational collections. NRC staff would not anticipate that juveniles would use this reach of the estuary as habitat because this reach tends not to stratify and lacks the deep salinity wedge with a net upstream flow that many species use to move up or maintain their position in the estuary. Due to the small area and relatively small temperature increase in the thermal effluent, the lack of change in water withdrawal, and the expectation of low habitat utilization, the EPU is expected to have only a minimal adverse effect on Atlantic butterfish EFH.

Summer flounder (*Paralicthys dentatus*)

EFH for summer flounder juvenile and adult life stages may occur in the vicinity of Hope Creek Generating Station. Offshore EFH includes demersal waters of the continental shelf from the Gulf of Maine to Cape Hatteras, and inshore EFH includes estuaries where summer flounder are identified as being common or abundant. Summer flounder adults typically live in water depths shallower than 500 ft (NMFS 2006). In southern New England and the Mid-Atlantic, spawning occurs primarily in September (Berrien and Sibunka 1999 in Packer et al. 1999). Spawning occurs in open ocean areas of the shelf (Packer et al. 1999), in waters ranging from 30 to 200 m (98 to 656 ft) deep (ENSR 2000). The timing of spawning coincides with maximum production of autumn plankton, which is the primary food source for larvae (Morse 1981 in Packer et al. 1999).

Both eggs and larvae of the species 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 (Able et al. 1990 in Packer et al. 1999). The larvae are transported toward coastal areas by the prevailing water currents, and development of post-larvae and juveniles occurs primarily within bays and estuarine areas (ENSR 2000). Juvenile summer flounder feed upon crustaceans and polychaetes, and as they grow larger they begin to feed more on fish, and adults are opportunistic feeders, preying mostly on fish and crustaceans (Packer et al. 1999). Species preyed upon include windowpane, winter flounder, Atlantic menhaden (*Brevoortia tyrannus*), red hake (*Urphycis chuss*), silver hake, scup (*Stenotomus chrysops*), Atlantic silverside (*Menidia menidia*), and bluefish, among others (Packer et al. 1999).

Table 5-7 in PSEG (1999) indicates that summer flounder have been found in pre-operational and operational collections from the vicinity of Hope Creek Generating Station during, although no information on life stage, methods of capture and identification, abundance, or location of capture are provided. Due to the small area and relatively small temperature increase in the thermal effluent and the lack of change in water withdrawal, the EPU is expected to have only a minimal adverse effect on summer flounder EFH.

6.0 MITIGATION MEASURES

Closed-cycle cooling systems, such as the one already operating at HCGS, are the most reasonable way to mitigate the number of aquatic organisms entrained and impinged. Continuous operation of the traveling screens may reduce the mortality of those organisms that are impinged. Because the proposed EPU is not expected to have more than minimal adverse effects on EFH, NRC proposes no additional mitigation measures.

7.0 CONCLUSION

The potential for adverse effects on EFH from the proposed EPU for Hope Creek Generating Station is related to water withdrawal and discharge of heated effluent. Water withdrawal is minimized through the use of closed-cycle cooling with a cooling tower, and no additional water withdrawal is proposed in association with the EPU. Most of the heat that would be produced by the EPU would be transferred to the atmosphere by the cooling tower. Under EPU conditions compared to present conditions, the volume of heated effluent would be less, the temperature would be slightly higher, the concentration of dissolved solids would increase, and the effluent would still meet all present NJPDES permit conditions. NRC staff concludes that the proposed EPU would have a minimal adverse effect on EFH.

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