State of New Jersey
Department of Environmental Protection
Division of Water Quality
401 East State Street, P.O. Box 29
Trenton, New Jersey 08625-029

FACT SHEET
FOR A DRAFT NJPDES PERMIT INCLUDING SECTION 316(a) VARIANCE DETERMINATION AND SECTION 316(b) DECISION

Permit No. NJ0005622 Date:

Name & Address of Applicant:	Public Service Energy Group Nuclear LLC Salem Generating Station P.O. Box 236, N33 Hancocks Bridge, NJ 08038
Name & Address of Facility where Discharge Occurs:	Salem Generating Station Artificial Island Lower Alloway Creek Township Salem County, NJ
Receiving Water & Method of Conveyance:	Delaware Estuary via pipes
Receiving Water Classification:	Zone 5

TABLE OF CONTENTS - FACT SHEET **Page No.**

I. Facility Overview 2
II. Regulatory Background 3
III. Overview of Existing July 20, 1994 Permit 4
IV. NJDEP's Review of the March 4, 1999 Renewal Application 6
V. Overview of Draft Permit Conditions and Section 316(a) Variance and Section 316(b) Determination 7
VI. NJDEP Procedures for Reaching a Final Decision on the Draft Permit and NJDEP Contact 7
VII. Description of Station Intakes, Wastewater Discharges and Components 7
VIII. Description of Limitations and Conditions Specific to this Permit 14
IX. Permit Summary Tables for DSN's 481-486, 48C, 487, 489 & FAC's A-C 20
X. Section 316(a) Variance and Section 316(b) Determination 30
A. Regulatory History for Section 316(a) Variance and Section 316(b) Determination 30
B. Compliance with Section 316 Special Conditions and/or Overview of Studies Performed

Special Condition 1: Intake Flow Limitation 30

TABLE OF CONTENTS - FACT SHEET (continued)

Special Condition 2: Intake Screen Improvements 31
Special Condition 3: Wetlands Restoration and Enhancement 33
Special Condition 4: Elimination of Impediments to Fish Migration 43
Special Condition 5: Sound Deterrent Studies 46
Special Condition 6: Biological Monitoring Program 50
Special Condition 7: Financial Assurance Requirements 58
Special Condition 8: Force Majeure 58
Special Condition 9: Termination of Section 316(a) Variance/ Penalties 58
Special Condition 10: Submission of all Documents 58
Special Condition 11 Section 316(a) Variance Request and Section 316(b) Demonstration 58
1. Section 316(a) Variance 59
2. Section 316(b) Determination 64
3. Special Studies Proposed in this Renewal Permit 73
A. Entrainment and Impingement 73
B. Estimated Productivity at the Wetland Restoration Sites 75
4. Minimization of Impacts Through Continued and Proposed Special Conditions 77
XI. Reference Table Itemizing the Section 316 Special Conditions included in the July 20, 1994 Permit as Compared to the Section 316 Special Conditions Proposed in the Renewal Permit 78
XII. Contents of the Administrative Record 79

Section including all Tables, Figures and Maps Referenced throughout the Fact Sheet follows item XII – all references to tables, figures or maps within the Fact Sheet are underlined.

I. FACILITY OVERVIEW

Public Service Energy Group ("PSEG" or the "Company" or "Permittee") is the operator of the Salem Generating Station ("Salem" or the "Station"). PSEG requested a name change to its NJPDES permit on April 24, 2000 where the previous name was "PSE&G". PSEG shares ownership of the Station with PECO Energy (formerly Philadelphia Electric Company), and Conectiv Energy (formerly Atlantic Electric and DELMARVA Power and Light). The owners are members of the PJM Interconnection, L.L.C. (PJM) and PSEG sells its electricity in the PJM power pool.

The Station is located in Lower Alloways Creek Township, Salem County, NJ at River Mile 50 on the Delaware Estuary ("river" or "estuary"), 18 miles south of the Delaware Memorial Bridge. The Station is located on a projection of land known as Artificial Island on the eastern shore of the Delaware Estuary. B Figure 1 and the USGS map depicts the location of the facility. The estuary in the area of the Station is approximately

2.5 miles wide. The tidal flow of the river past the Station is approximately 400,000 cubic feet per second (cfs) or 259,000 million gallons per day (MGD). The river in the vicinity of the Station is characterized by variable salinity, tidal currents and a high quantity of particulate material suspended in the water column.

Salem is a three unit electric generating facility. Units 1 and 2 are nuclear powered, pressurized water reactors, each rated at about 1100 MWe. Units 1 and 2 use a once-through cooling water system and are operated as baseload electrical generating units. Unit 3 is an air-cooled combustion turbine rated at approximately 40 MWe. Unit 3 is used as a peaking and emergency standby generator and has no discharge to surface water. The Salem units were proposed in 1966 and construction was started in 1968. Salem Unit 1 began operation in 1977 and has a license to operate through 2017. Unit 2 began operation in 1981 and has a license to operate through 2021.

Four basic steps are involved in the production of electricity at Salem (refer to Schematic of Simplified Steam Electric Cycle) Fission in the nuclear reactors heats high purity water in each unit's primary loop system. Heat is then transferred in a heat exchanger (steam generator) to a secondary loop system creating steam. The steam is used to drive turbines so that some of the energy in the steam is converted to mechanical energy. The turbines are connected to generators that convert the mechanical energy of the rotating turbines into electrical energy. River water is used to cool the steam exhausted from the turbines and condense the steam in the secondary loop system back into high purity water. This process is known as non-contact cooling because the river water does not mix with the Station's steam. The condensed high purity water is returned from the condensers to the steam generators to be converted again into steam to continue to drive the turbines The river water that passes through the condensers for non-contact cooling of the secondary steam loop is discharged back to the river.

In addition to the discharge of non-contact cooling water from the circulating water system, the Station discharges other wastewater as discussed in Section VII. All sanitary wastewater generated at the Station is routed to the adjacent Hope Creek Generating Station.

II. REGULATORY BACKGROUND

The Federal Water Pollution Control Act (the "Clean Water Act" or "CWA"), 33 U.S.C. 1251 et seq., authorizes federal and state agencies to regulate discharges of pollutants to surface waters through the National Pollutant Discharge Elimination System("NPDES") permit program. The United States Environmental Protection Agency ("USEPA"), which originally administered the NPDES program for New Jersey, delegated program authority to the New Jersey Department of Environmental Protection ("the Department") in 1982. The Department implements the NPDES program through the New Jersey Pollutant Discharge Elimination System (NJPDES) regulations (N.J.A.C. 7:14A-1 et seq.) which were promulgated pursuant to the authority of the New Jersey Water Pollution Control Act (N.J.S.A. 58:10A-1 et seq.).

In 1972, Congress enacted the Clean Water Act (CWA) requiring all point source dischargers of pollutants, including heat, to obtain a permit from USEPA or from a state with delegated permitting authority. Section 316 of the CWA contains parts (a) and (b). Section 316(a) addresses thermal aspects of the discharge. This section provides that a variance from thermal surface water quality standards can be granted if the permittee can demonstrate that a balanced indigenous population is being maintained in the receiving water, meaning less stringent thermal effluent limits may be imposed. Section 316(b) addresses impacts of the cooling water intake structure on aquatic life, namely impingement and entrainment effects. Impingement is when aquatic life is caught on screens entering the facility's intake structure. Entrainment is when aquatic life is withdrawn through the plant, subjected to thermal impacts, and then discharged. Section 316(b) requires that the location, design, construction and capacity of a cooling water intake structure reflect the best technology available (BTA) for minimizing adverse environmental impact. Although the plain language of the Act does not call for economic analysis when requiring BTA, legal precedent has provided that any BTA imposed may not be wholly disproportionate from the environmental benefits to be gained. The Department's Section 316(a) Variance and Section 316(b) determination for this renewal permit are discussed in further detail in Section X within this Fact Sheet.

III. OVERVIEW OF EXISTING JULY 20, 1994 NJPDES PERMIT

Salem's discharges to surface water are regulated pursuant to NJPDES Permit No. NJ0005622. The existing NJPDES permit for this facility was issued to PSE&G-Salem Generating Station on July 20, 1994 and expired on August 31, 1999. Because the permittee submitted a timely renewal application, this permit continues in full force and effect pursuant to N.J.A.C. 7:14A-2.8(a). The existing July 20, 1994 NJPDES permit authorizes the withdrawal of Delaware Estuary water for use in the Salem Station's cooling water processes as well as the discharge of this heated water back to the Delaware Estuary.

In its July 20, 1994 NJPDES permit, the Department granted PSE&G's request for a variance pursuant to Section 316(a) and proposed thermal limits which would allow the continued operation of the existing once-through cooling system. With regard to Section 316(b), the Department determined that "best technology available" consisted of the existing cooling water intake structure, in conjunction with modifications to the intake screens and an improved fish bucket design; a restriction on cooling water intake flow; and a sound deterrent study. The Department also required a variety of other "Special Conditions". To summarize the BTA requirements as well as the Special Conditions, these permit requirements can be grouped under three categories and can be described as follows:

- **Special Conditions Requiring Actions at the Station's Circulating Water Intake Structure Considered to be Best Technology Available** – an intake flow limitation; upgrading of the intake screens to state-of the art standards; and conduct of a study to

determine whether sound would be a feasible and an effective technology at Salem to deter fish from the plant's intake screens.

- **Special Conditions Requiring Actions in the Estuary to Produce Fish** – undertake a wetlands program to restore and/or preserve at least 8,000 acres of wetlands, plus 2,000 acres of additional wetlands or 6,000 acres of associated upland buffers, or a combination thereof based on a 1:3 wetlands/uplands buffer acreage ratio. The permit also required a Deed of Conservation Restriction to preserve up to 18,500 acres of lands, wetlands and uplands including the 4,500 acre Bayside Tract. The Permit further required PSE&G to install five fish ladders to eliminate barriers to migration, thus increasing the spawning habitat available to anadromous fish.

- **Special Conditions Requiring Actions to Develop and Implement a Comprehensive Biological Monitoring Program** - requirement to perform baywide abundance monitoring; perform comprehensive monitoring of Salem's thermal plume and an updated assessment of its biological effects; impingement and entrainment monitoring, abundance monitoring for ichthyoplankton and juvenile blueback herring in connection with the fish ladder sites, detrital production and pesticide release monitoring at marsh restoration sites and data generated by sound deterrent studies. The permit also required PSE&G to establish a Monitoring Advisory Committee ("MAC") to provide technical advice to PSE&G concerning the design and implementation of the Company's biological monitoring program and a Management Plan Advisory Committee ("MPAC") to provide technical advice to PSE&G concerning the development and implementation of the wetlands restoration program. These two committees are composed of representatives of federal and state environmental and resource protection agencies, independent scientists and, in the case of MPAC, local governments.

The BTA conditions were incorporated in the July 20, 1994 permit to minimize adverse impacts. Likewise, the Special Conditions were incorporated to further minimize environmental impacts from the Station's cooling water intake structure which is the objective of Section 316(b). These permit conditions are described in further detail in Section X.B. within this Fact Sheet.

After the July 20, 1994 NJPDES permit was issued, the Delaware Natural Resource Environmental Commission (DNREC) and the Delaware Riverkeeper each requested an adjudicatory hearing before the New Jersey Office of Administrative Law to challenge the 1994 Permit. PSE&G thereafter entered into settlement agreements with DNREC and the Delaware Riverkeeper resolving their challenges, and as a result, both entities withdrew their hearing requests. Under the DNREC Settlement, PSE&G agreed, among other matters, to restore a minimum of 3,000 acres of degraded wetlands and acquire up to 2,000 acres of upland buffers in addition to the acreage required in the Permit, and to construct artificial reefs, all in Delaware. These measures were designed to benefit the aquatic populations of the Estuary and provide an expanded wetlands habitat.

Pursuant to the requirements of the NJPDES Regulations at N.J.A.C. 7:14A-1 et seq., PSE&G applied for renewal of its NJPDES permit in March 1999. In addition to the standard regulatory requirements for permit renewal, PSE&G's application specifically requests renewal of the Section 316(a) variance granted in the Station's existing permit. This application also includes a Demonstration pursuant to Section 316(b) relative to the Station's cooling water intake structure. The permittee also provided detailed information to demonstrate its compliance with the Special Conditions in its March 4, 1999 application. This subject draft NJPDES permit action is in response to the March 4, 1999 permit application and its supplemental addendums.

IV. NJDEP'S REVIEW OF THE MARCH 4, 1999 RENEWAL APPLICATION

The March 4, 1999 NJPDES application is voluminous consisting of 36 volumes of application material and 167 volumes of reference material. Numerous staff and management from different NJDEP divisions have come together as a team to review the PSE&G application and inspect the PSE&G wetland restoration sites as related to their progress. This includes Department representatives from the Division of Fish and Wildlife, Land Use Regulation Program, the Division of Water Quality, the Attorney General's office and the Southern Bureau of Water Compliance and Enforcement. Although the Department has the knowledge and expertise to review this application, the Department determined that it would be beneficial to hire an outside contractor to assist in its review of certain portions of the application. As a result, the Department contracted the services of ESSA Technologies, Ltd. of Richmond Hill, Ontario, Canada for those issues associated with Section 316(b) of the Clean Water Act including impingement and entrainment impacts, available intake protection technologies, cost/benefit analysis and the status of fish populations (e.g. predictive and retrospective assessments of power plant impacts to fisheries, biostatistics, fish population dynamics and fisheries economics) in the Delaware Estuary. Overall, the contractor has evaluated the accuracy, completeness and appropriateness of the conclusions reached in the application given the methodologies and data used. The contractor's findings have been documented in a final report (included in its entirety as Attachment A) for the Department where many of their recommendations have been incorporated in this draft permit renewal. Several of the contractor's findings are described in further detail in Section X.B. within this Fact Sheet. In accordance with N.J.A.C. 7:14A-3.1(c)2, PSE&G has reimbursed the Department for this expense as part of its NJPDES permit fee.

During the application review process, the Department has participated in many meetings to listen to the perspectives and technical information brought forth by many different groups and agencies including representatives from environmental groups (NJ Environmental Federation, Delaware Riverkeeper, EAGLE, Eastern Environmental Law Center, UNPLUG Salem, Clean Ocean Action, American Littoral Society), the State of Delaware, US Fish and Wildlife Service, the Delaware River Basin Commission, and USEPA as well as the MPAC and MAC members. Many of these groups have submitted comments on the application. The Department has considered all these comments prior to preparing this draft NJPDES permit renewal. As set forth in N.J.A.C. 7:14A-15.10, the

Department has published a public notice of this draft permit action and is seeking public comments on the draft permit action as described in the Public Notice. Therefore, although many parties have already submitted comments on the application, interested parties also have an opportunity to comment on this draft NJPDES permit.

This NJPDES permit is being issued by the Division of Water Quality; however, input and requirements of other Department divisions are referenced and represented throughout the NJPDES permit document. The facility has been classified as a **major** discharger by the Department of Environmental Protection in accordance with the U.S. EPA rating criteria.

V. OVERVIEW OF DRAFT PERMIT CONDITIONS AND SECTION 316(a) VARIANCE AND 316(b) DETERMINATION

The existing/proposed effluent limitations, effluent sampling analytical data, and other pertinent information are described in the Permit Summary Tables and basis noted herein. Also included is a summary of the basis for each effluent limitation and an evaluation of compliance for each of the Special Conditions set forth in the July 20, 1994 permit. These Special Conditions are required to minimize environmental impacts related to the Station's cooling water system pursuant to Section 316(b) of the Clean Water Act. This proposed draft NJPDES permit renewal carries over and/or revises many of the Special Conditions set forth in the existing July 20, 1994 NJPDES permit. This proposed draft permit action also provides a thermal variance for the discharge from DSN's 481 – 486 based on Section 316(a) of the Clean Water Act. Lastly, this draft permit action sets forth effluent limitations and/or monitoring conditions for several of the point source discharges.

VI. NJDEP PROCEDURES FOR REACHING A FINAL DECISION ON THE DRAFT PERMIT AND NJDEP CONTACT

These procedures are set forth in N.J.A.C. 7:14A-15.1 et seq. and are also described in the public notice. Included in the public notice are requirements for the submission of comments by a specified date, procedures for requesting a hearing and the nature of the hearing, and other procedures for participation in the final Department decision.

Additional information concerning the draft permit may be obtained between the hours of 8:00 A.M. and 5:00 P.M., Monday through Friday from Susan Rosenwinkel, Bureau of Point Source Permitting-Region 2 (609) 292-4860.

VII. DESCRIPTION OF STATION INTAKES, WASTEWATER DISCHARGES AND WASTEWATER COMPONENTS

A. Station Intakes

Circulating Water System Intake

The Circulating Water System Intake is located at the southwestern side of Artificial Island and supplies water to cool the condensers of Salem Units 1 and 2 (refer to B Figure 9). The intake structure includes 12 separate intake bays (six for each of the two Salem units) and is located at the shoreline. The Circulating Water System Intake is comprised of several parts as described below. A diagram of the circulating water intake structure as B Figure 10A.

Ice Barriers - In winter, removable ice barriers are installed on the face of each of the 12 intake bays to prevent damage during severe icing conditions. The barriers are constructed of pressure-treated lumber and structural steel. The ice barriers are removed in early spring and reinstalled in the late fall.

Trash Racks - River water enters the intake bays through fixed bar racks called trash racks that are designed to prevent large floating or submerged debris from entering the system. The trash racks are constructed of half inch wide steel bars on 3.5 inch centers; the size of the clear slot opening is 3 inches. PSEG employees inspect the trash racks and, if required, remove any debris using a mobile clamshell-type mechanical rake. There are two trash rakes which are self-contained and traverse the entire width of the intake. The trash rakes contain a hopper that transports the debris to basket-lined pits at each end of the intake. The removed debris is de-watered by gravity and disposed of off-site.

Traveling Screens – After passing through the trash racks, intake water flows through vertical traveling screens of a modified Ristroph design. The traveling screens have been extensively upgraded over time where there have been three distinct traveling screen designs at Salem. The most recent upgrades were required as a condition of the July 20, 1994 permit and took place in 1995. These upgrades were made to improve performance and reliability and increase the survival rates of impinged fish. The traveling screens are described further in Section X.B. under Compliance with Special Condition 2 in this document.

Fish Return System – Each screen panel has a 10-foot long composite material fish bucket attached to its bottom support member. As the bucket travels over the head sprocket of the traveling screen, organisms slide onto the screen face and are washed by the low-pressure spray system. One low-pressure (less than 10 psi) spray header is located outside the screen unit and two low-pressure (less than 15 psi) spray headers and nozzles are located inside the screen unit. The spray is washed into an upper fiberglass (18 by 30 inch) trough. This low-pressure wash is designed to minimize descaling and other injuries that could occur with conventional high-pressure spray headers. As the panel rotates to the fish removal position, the spray wash water helps to slide fish on the screen surface over a flap seal into a bi-directional fish trough. As the panels continue to travel, the remaining debris is removed into a bi-directional debris trough using two inside high-pressure (90 psi) spray headers with spray nozzles. The fish and debris troughs are joined after the troughs leave the building. Fish and debris washed from the screens are returned through bi-directional troughs to the Estuary on either the north or

south side of the intake, depending upon the direction of tidal flow. The troughs are bi-directional in that they are emptied in the direction of the tide, so that fish and debris will flow away from the circulating water intake structure, in an effort to minimize the likelihood of reimpingement. The troughs are also designed to allow diversion to the respective fish counting pool for impingement studies. A diagram of the vertical traveling screen is included as B Figure 11.

Service Water System Intake

The service water system is a safety-related cooling water system that supplies a dependable, continuous flow of cooling water (under normal and emergency conditions) to the nuclear and turbine area heat exchangers. Service water is withdrawn from the estuary through an intake located approximately 400 feet north of the CWS intake. The service water system intake has trash racks and traveling screens, where debris is collected to prevent interference with pump or heat exchanger operation. To dislodge collected debris, the traveling screens are backwashed with service water. The backwash water and debris are discharged into a trough and directed through trash baskets back to the estuary. The intake water then passes through the service water pumps to the service water strainers which are designed to remove small particles from the intake water to prevent clogging and damage to the heat exchangers in the service water system. Service water is discharged to the estuary via connections to the CWS pipes. The traveling screens on the service water intake do not have a modified Ristroph design or a fish return system as do the traveling screens on the CWS. During normal Station operations, the four service water pumps nominally provide 41,200 gallons per minute. The service water intake flow is approximately 4% of Salem's circulating water system intake flow.

B. Station Outfalls and Discharge Components

Discharge and Thermal Monitoring Points – A schematic is included as B Figure 31. A tabular summary of each outfall and its components is included below followed by a description.

DSN	Latitude	Longitude	Name of Operation or Process	Monthly Avg. Flow in MGD (Appl.)
481	39º 27' 38"	75º 32' 16"	Primarily non-contact cooling water	502
482	39º 27' 38"	75º 32' 16"	Primarily non-contact cooling water	476
483	39º 27' 38"	75º 32' 16"	Non-contact cooling water	466
484	39º 27' 38"	75º 32' 16"	Primarily non-contact cooling water	467
485	39º 27' 38"	75º 32' 16"	Primarily non-contact cooling water	426
486	39º 27' 38"	75º 32' 16"	Non-contact cooling water	456
FAC A	N/A – Thermal Monitoring	N/A – Thermal Monitoring	Thermal Loading for Unit 1, namely DSN's 481, 482 and 483.	N/A
FAC B	N/A – Thermal Monitoring	N/A – Thermal Monitoring	Thermal Loading for Unit 2, namely DSN's 484, 485 and 486.	N/A
FAC C	N/A – Thermal Monitoring	N/A – Thermal Monitoring	Intake Flow Limit and Thermal Loading for Units 1 and 2.	N/A
48C	N/A – Internal Point	N/A – Internal Point	Intermittent batch type discharge to DSN's 481, 482, 484, or 485.	0.0155

487	39º 27' 46"	75º 32' 17"	North Yard Drain	0.013
DSN	Latitude	Longitude	Name of Operation or Process	Monthly Avg. Flow in MGD (Appl.)
487B	N/A – Internal Point	N/A – Internal Point	#3 Skim Tank: discharge to DSN 487 on an emergency basis.	Emergency Only
488	39º 27' 41"	75º 32' 12"	West Yard Drain	2.3
489	39º 27' 40"	75º 32' 00"	South Yard Drain	0.09
490	39º 27' 40"	75º 31' 52"	Yard Drain	None
491	39º 27' 40"	75º 31' 50"	East Yard Drain	0.014

DSN's 481 – 486

Outfalls for DSN's 481 - 486 - The Station is designed to discharge, at a maximum, approximately 3200 MGD of once-through, non-contact condenser cooling water through six submerged pipes or outfalls designated as Discharge Serial Numbers (DSN's) 481 – 486. The pumps and piping are designed to discharge water to the Estuary at a velocity of 10.5 feet per second at a depth of 31 feet below the surface at mean low tide. The six 120 inch discharge pipes (three from each unit) designated as DSN's 481 – 486 run along the riverbed from the shoreline toward the middle of the Estuary, and are buried for most of their length. The pipes run for a distance of approximately 500 feet from the Station bulkhead, nearly directly westward beneath the Estuary. At their western end, the pipes discharge nearly horizontally into the Estuary, perpendicular to the dominant flow. At the discharge point, the pipes are located at a depth of about 30 feet.

Discharge Components of DSN's 481 – 486 - The discharge flow from DSN's 481-486 is composed primarily of wastewater used as once-through condenser cooling water from the circulating water system as well as the service water system; however, DSN's 481, 482, 484 and 485 periodically include a limited contribution of flow from the radioactive liquid waste system and non-radioactive liquid waste system (which is monitored internally as DSN 48C).

Circulating Water System - As described previously under the section entitled **Facility Overview**, intake water from the river passes through the condensers for non-contact cooling of the secondary steam loop and is discharged back to the river through DSN's 481 - 486. This once-through cooling water from the circulating water system comprises the majority of the flow through DSN's 481 – 486. Treatment chemicals are not added to this once-through condenser cooling water.

Service Water System - As described previously, the service water system is a nuclear safety-related system where its discharge is classified as a low volume waste stream pursuant to 40 CFR 423. Past history has demonstrated that macroinvertebrate fouling does occur in the system. Sodium hypochlorite is continuously added at the suction of the service water pumps (at a target concentration of 500 ug/L), so residual

chlorine may be present in the eventual discharge through DSN's 481, 482, 484 and/or 485. As described in Appendix B of the March 4, 1999 NJPDES/DSW permit application, the service water system is designed to allow the addition of liquid sodium hypochlorite at the suction of each operating service water pump by the variable displacement pumps. The circulating water system effluent residual chlorine monitor provides an electronic signal to the sodium hypochlorite injection pumps to shut down the addition of sodium hypochlorite prior to exceeding the residual chlorine effluent limitations for DSN's 481 – 486.

Radioactive Liquid Waste System – Effluent from the radioactive liquid waste system (also known as monitor tank effluent) discharges through DSN's 481, 482, 484 and/or 485. The radioactive liquid waste system collects system leakage, floor drains, equipment leakage, decontamination liquids, wash waters, system drains, ventilation system drains, laboratory drains and sample wastes from areas of the Station which contain or may contain radioactive materials. These waste streams may also contain trace quantities of organics, analytical laboratory chemicals, decontamination solutions, or normal housekeeping and cleaning products. The typical chemicals used within the system potentially draining to this system include low concentrations of chromates, hydrazine and boron.

The radioactive liquid waste system segregates, collects, processes, provides monitoring capability, recycles, and discharges waste streams that potentially contain radioactivity from various Station processes within the power generation area during normal operations, maintenance evolutions and transient conditions. PSE&G states in its application that the effluent from the radioactive liquid waste system is normally discharged in a batch mode only after being collected in waste tanks, sampled for radioactivity, sampled for potential chemical contaminants, and the calculations are performed to ensure effluent limitations are met. PSE&G is responsible to the United States Nuclear Regulatory Commission (USNRC) for compliance with radiological effluent limitations, associated monitoring requirements and other licensing requirements. The radioactive liquid waste system flow is a minimal component of the total effluent volume at DSN's 481, 482, 484 and/or 485. Solids created by the treatment of these liquid waste streams in the radioactive liquid waste system are radioactive waste and are transported to a facility licensed by the USNRC for disposal in accordance with USNRC requirements.

DSN 48C – Non-Radioactive Liquid Waste Disposal System (NRLWDS)

DSN 48C is an internal low volume waste stream that discharges on a batch-type basis into DSN's 481, 482, 484 and/or 485. The purpose of the NRLWDS is the collection and treatment of secondary plant waste water which may contain chemicals, especially acidic and caustic wastewater before discharge. The NRLWDS processes and treats the non-radioactive low volume wastes from various Station processes including:

- Regenerant waste from demineralizers used to produce ultrapure water at Salem and at the adjacent Hope Creek Generating Station. These waste streams contain dilute acid and caustic regenerants as well as the impurities removed from the Station's well water (i.e. groundwater is also a source of water for the Station).

- Waste from chemical unloading area drains; chemical feed tank drains and floor drains; the demineralizer area sump; the number 3 oil water skimmer; and drains from the acid and caustic area and ammonium hydroxide filling connections. The chemical unloading area drains can contain residuals due to leakage or spillage during acid or caustic truck transfers as well as precipitation. The chemical feed tanks are utilized for handling and adding feedwater treatment chemicals, primarily ammonium hydroxide, hydrazine, and ethanolamine. The tank drains, tank overflows and floor drains may contain residual treatment chemicals or wash water containing dilute cleaning agents. Effluent from the number 3 oil skimmer may contain house heating boiler treatment chemicals. The demineralizer sumps collect leakage; spillage; overflows; floor drains; service water sampling; venting and leakage; analytical laboratory drains from the demineralizer plant; and tank drainage from the acid and caustic storage areas. The waste from floor drains may also contain small amounts of cleaning solutions and lubricants.

- Waste from secondary analytical laboratory drains and in-line instrumentation that measures the purity of process water in the feedwater cycle. This small volume waste stream consists primarily of pure water with analytical reagents and treatment chemicals.

- Steam generator blowdown can be an influent to the NRLWDS, but is normally directed to the condensers for reuse in the system. Steam generator blowdown and drainage contains ammonium hydroxide, hydrazine (most of which is converted to ammonia at operating temperatures), ethanolamine, trace minerals and metals.

- Recycled water and discharge from NRLWDS vents, drains, analytical laboratory, and floor drains. This influent is essentially NRLWDS wastewater and has the potential to contain the same constituents as the other influents to the NRLWDS as well as NRLWDS treatment chemicals.

- Regenerant wastes from the condensate polishers where the condensate polishers remove impurities by demineralization from the steam cycle condensate water. Because these polishers are regenerated using dilute acid and caustic, the regenerant wastes contain dilute acids and caustics, impurities removed by demineralization, and residual treatment chemicals.

Influents to the NRLWDS are collected in the equalization mixing basin where some self-neutralization of the dilute acid and caustic waste occurs. If necessary, the wastestream may be treated with sodium hypochlorite or hydrogen peroxide to reduce the concentrations of ammonia and hydrazine. The wastestream is then normally routed

through the No. 2 clarifier for solids removal by settling; the mix tank for pH adjustment to induce precipitation of any remaining metals; the No. 1 clarifier for final clarification and metals precipitation; and is then discharged through DSN 48C which is routed to DSN's 481, 482, 484 and/or 485. Sodium hypochlorite or hydrogen peroxide can be added in the equalization basin or other points within the system to facilitate the reduction of treatment chemical concentrations prior to discharge. Either or both clarifiers can be bypassed, depending on wastestream quality. The mix tank normally is used for the addition of caustic to facilitate precipitation of metals and the capability has been installed, although it is not normally used, for the addition of a coagulant aid. The mixed media filter skid is installed but not normally used. A schematic of the non-radioactive cooling water system is shown as B Figure 25.

Although the NRLWDS is designed for treatment of non-radioactive wastes, very low levels of radioactive materials can enter the system. The primary source of radioactive materials in the system is from regeneration of the condensate polisher resins. DSN 48C is a USNRC monitored pathway.

Solids generated in the NRLWDS are collected in the sludge pit, the clarifiers, or the equalization basin and are analyzed prior to disposal to determine the appropriate disposition of the residual wastes. Historically, the wastes have been classified as radioactive (due to low levels of radioactivity which enter the system and concentration in the residual) requiring disposal in a USNRC approved facility.

DSN 487

DSN 487 is the North Yard Drain where the discharge components consist of river water influx, precipitation runoff, building roof drains, floor drains (from the fire pump and fresh water tank), sump pumps, No. 2 turbine building flood pump, and the emergency discharge from DSN 487B. The primary contributor to the effluent flow is the river water influx due to the low elevation of the Station. The No. 3 skim tank (formerly DSN 487B) has been rerouted to discharge to the influent of the NRLWDS as required in the existing July 20, 1994 NJPDES permit. However, a discharge point has been retained for the No. 3 skim tank to discharge through DSN 487 in the event of an emergency where this emergency path is identified as DSN 487B. Although it is not anticipated that routine discharge through this emergency path will occur, the provision is necessary to ensure the oils on the top of the No. 3 skim tank are not released overland in the event of a pump failure. The No. 3 skim tank is a gravity separator designed to remove oils prior to discharge to the NRLWDS.

DSN 489

DSN 489 is the South Yard Drain where the discharge components consist of precipitation runoff, building roof drains, #1 and #2 skim tanks, power transformer sumps, auxiliary power transformer sumps, turbine building floor drains and turbine building sump pumps. These components are routed through one of the two 40,000

gallon Highland Oil Water Separators that are installed in parallel. Only one oil water separator is normally in service. The oil/water separator system was installed in accordance with the requirements of the July 20, 1994 permit, specifically section G.2, Part IV.

DSN's 488, 490 and 491

DSN 488 is the West Yard Drain which is located within the secure perimeter of the Station. Yard drains are the term used for the systems designed to collect and transport precipitation runoff and consist primarily of grated inlets and piping. Due to the low elevation of the Station, the primary contributor to flow through DSN 488 is the tidal river water influx with the service water strainer backwash being the next major contributor. Other discharge components include precipitation runoff, building roof drains, building floor drains, sump pumps, #1 turbine building floor pump, the service water sump pumps, residual chlorine analytical wastewater, and circulating water system vents.

DSN 490 and 491 are external storm drainage systems that are located outside the secure perimeter of the Station. Discharges through these outfalls consist solely of precipitation runoff from areas of the property not associated with an industrial process area. DSN 490 discharges precipitation runoff from the area of the helicopter landing pad. DSN 491, the East Yard Drain, discharge precipitation runoff from the employee parking lot and an adjacent access road.

FAC A, B and C

FAC A, B and C are not physical outfalls but instead enable regulation of specific parameters as a sum. Specifically, FAC A designates the discharge from Unit 1 (namely DSN's 481, 482, and 483) whereas FAC B designates the discharge from Unit 2 (namely DSN's 484, 485 and 486). FAC C designates the discharge from the "facility" namely the discharges from Units 1 and 2 (DSN's 481 – 486). These designators are used to enable regulation of intake, effluent and differential temperature for FAC A and FAC B and intake flow and heat for FAC C.

VIII. DESCRIPTION OF LIMITATIONS AND CONDITIONS SPECIFIC TO THIS PERMIT

DSN's 481 – 486

Effluent Flow: The monitoring conditions for **Effluent Flow** are applied pursuant to N.J.A.C. 7:14A-13.13 and 13.14 and are consistent with the existing permit. Effluent flow shall be calculated on a daily basis for DSN's 481 – 486. The calculation procedures for the purposes of DMR reporting are described in further detail in Part IV.

Effluent Temperature: Monitoring for **Effluent Temperature** is consistent with the existing permit and is required pursuant to N.J.A.C. 7:14A-13.19. Monitoring for effluent temperature for each individual outfall shall occur on a continuous basis. Monitoring and reporting of effluent temperature is necessary to calculate compliance with limitations and conditions imposed for FAC A, B, and C as described later.

Chlorine Produced Oxidants: Effluent limitations and monitoring conditions **Chlorine Produced Oxidants** are consistent with the existing permit and are required pursuant to N.J.A.C. 7:14A-13.19. The existing permit specifies effluent limitations and monitoring conditions for Total Residual Chlorine; however, Chlorine Produced Oxidants is simply a more appropriate name for the compounds which the total residual chlorine analytical method measures. Therefore, the total residual chlorine analytical method can be used for compliance purposes for chlorine produced oxidants limitations and monitoring requirements. As described previously, the circulating water system flow, which comprises the most significant portion of the flow through DSN's 481 – 486, is not continuously chlorinated. However, the service water system component of the flow, that is also discharged through DSN's 481 – 486, is continuously chlorinated. Under normal operating conditions, service water system non-contact cooling water is discharged.

When service water system non-contact cooling water is discharged, an effluent limitation of 0.5 mg/L shall apply as a daily maximum and an effluent limitation of 0.3 mg/L shall apply as a monthly average. These limitations are applied at DSN's 481 – 486. Monitoring is required three times per week when service water system water is discharged. **At all other times (i.e. the discharge of circulating water system water non-contact cooling water along with service water system non-contact cooling water)**, a daily maximum effluent limitation of 0.2 mg/L is applied in accordance with N.J.A.C. 7:14A-13.19 where this limit is consistent with the existing permit. A monthly average reporting requirement is also applied when service water system non-contact cooling water is not being discharged. Monitoring is required three times per week.

Should the permittee determine in the future that it is necessary to chlorinate the circulating water system, the Department shall be notified as described in Part IV. As part of this notification, the permittee shall provide the Department with a methodology for sodium hypochlorite addition. Upon approval by the Department in writing, chlorine produced oxidants may not be discharged from any single generating unit for more than two hours per day. Also, chlorine produced oxidants at the permitted outfalls DSN's 481 – 486 shall not exceed a daily maximum of 0.2 mg/L during the chlorination of the main condensers. The permittee shall maintain a log, noting the time and duration of chlorination of the main condensers.

pH: Monitoring for **pH** is consistent with the existing permit and is required pursuant to N.J.A.C. 7:14A-13.19. Monitoring for pH shall be performed three times per week using a grab sample. The daily minimum pH of the effluent shall not be less than 6.0 standard units (S.U.) and the daily maximum pH shall not be greater than 9.0 S.U.. Monitoring for intake pH is also required. If the intake pH is less than 6.0 S.U. the daily minimum pH limitation shall be equivalent to the measured intake pH. If the intake pH is greater than 9.0 S.U., the daily maximum pH limitation shall be equivalent to the measured intake pH.

Whole Effluent Toxicity (WET): Section 101(a) of the Clean Water Act (CWA) establishes a national policy of restoring and maintaining the chemical, physical and

biological integrity of the Nation's waters. In addition, section 101(a)(3)of the CWA and the State's Surface Water Quality Standards (SWQS) at N.J.A.C. 7:9B-1.5(a)3 state that the discharge of toxic pollutants in toxic amounts is prohibited. Further, 40 CFR 122.44(d) and N.J.A.C. 7:14A-13.6(a) require that where the Department determines that a discharge causes, shows a reasonable potential to cause, or contributes to an excursion above the SWQS, the permitting authority must establish effluent limits for WET. In order to satisfy the requirements of the CWA, the State's SWQS and the NJPDES Regulations, the need for a water quality based effluent limitation (WQBEL) for WET was evaluated for this discharge.

In order to assess the toxicity effects of the circulating water system as well as the effects of DSN 48C and the other wastewater components, the permittee is required to perform acute toxicity testing on a minimum of one representative circulating water system outfall, namely DSN's 481, 482, 484 and/or 485, while DSN 48C effluent is routed to this outfall during sample collection.

The test species to be used for determining permit compliance with the acute WET limit of an LC50$\geq$ 50% effluent shall be the sheepshead minnow (*Cyprinodon variegatus*). The monitoring frequency for acute toxicity has been reduced from quarterly to twice each year in accordance with 7:14A-14.2(c) based on consistent compliance with the applicable WET limit.

The **Toxicity Reduction Implementation Requirements** (TRIR) are included in accordance with N.J.A.C. 7:14A-13.17(a), 7:14A-6.2(a)5 and recommendations in Section 5.8 of the TSD. The requirements are necessary to expedite compliance with the acute WET toxicity limitation should exceedances of the acute WET limitation occur. As included in section B.1 of the TRIR requirements, the initial step of the TRIR is to identify the variability of the effluent toxicity and to verify that a consistent toxicity problem does in fact exist.

Effluent samples for conducting WET testing for acute testing are to be collected after the last treatment step, consistent with collection location for other parameters. The permittee is required to collect samples for the purpose of acute toxicity testing at a minimum of one representative circulating water system outfall, namely DSN's 481, 482, 484 and/or 485. During sample collection, for the purposes of acute toxicity testing, DSN 48C effluent shall be routed to this representative outfall.

The permittee has recently completed a comprehensive site-specific **chronic toxicity characterization test**. The test species methods used for this chronic toxicity testing was the Sheepshead Minnow (*Cyprinodon variegatus*) and the *Mysidopsis bahia.* All tests conducted for this study were >100% for both growth and survival.

Other Parameters: Effluent limitations have not been imposed for **total organic carbon, total suspended solids, ammonia and petroleum hydrocarbons**. These parameters were included as part of the effluent characterization study (as described

below). Based on the results of this study, the Department has determined that they are not present in quantities substantially different from the influent. In addition, given that the primary component of DSN's 481 – 486 is once-through cooling water, it is not expected that these parameters would be present in significant quantities in the effluent.

DSN's FAC A and FAC B

As described previously, FAC A designates the discharge from Unit 1 (DSN's 481, 482, and 483) whereas FAC B designates the discharge from Unit 2 (DSN's 484, 485 and 486).

The effluent temperature values measured continuously at the individual outfalls for DSN's 481 – 486 shall be utilized in calculating flow-weighted **Effluent Temperature values for FAC A and FAC B** as described in Part IV. Effluent flow is required to be monitored at outfalls 481 – 486 where these values shall be used in any flow-weighted calculation procedure. Monitoring for effluent temperature shall be calculated as the flow-weighted average for FAC A and FAC B as described in the effluent limitations tables for FAC A and FAC B in Part IV. A daily maximum effluent temperature limitation of 46.1 degrees Celsius (115 degrees Fahrenheit) is imposed for FAC A and FAC B based on the Section 316(a) Determination which is described and justified in further detail in Section V.B. later in this Fact Sheet. Monthly average reporting is also required for effluent temperature for FAC A and FAC B. These limitations and monitoring conditions are consistent with the existing permit pursuant to N.J.A.C. 7:14A-13.19.

A continuous monitoring condition for **Intake Temperature** is carried forward from the existing permit pursuant to N.J.A.C. 7:14A-13.19. Intake temperature shall be measured at the intake to the main circulating water system for Units 1 and 2 on a continuous basis and shall be averaged daily to obtain the intake temperature for FAC A and for FAC B. The calculated intake temperature values shall be reported as both a daily maximum and a monthly average. In the event that one of the temperature monitoring devices is out of service (such as for calibration and maintenance) the other temperature monitoring device will be used for reporting intake temperature for FAC A and FAC B.

DSN FAC C

As described previously, FAC C represents the "facility" namely the discharges from Unit 1 and Unit 2 which are designated as DSN's 481 – 486. **Intake flow** is limited to a monthly average of 3024 million gallons per day total intake for DSN's 481 – 486 as specified in Part IV. This limit is consistent with the existing July 20, 1994 NJPDES permit where it was imposed as part of the Section 316(b) Demonstration Special Conditions. Intake flow shall be measured as the sum of the twelve individual intakes to the circulating water system and reported as a monthly average in million gallons per day. The flow of each individual circulating water pump shall be calculated as the product of the number of operating hours for that pump for the reporting period and the flow rate for

that pump as indicated in item G.1. of Part IV. The flow rate for each respective pump shall be calculated in accordance with **annual tracer evaluation studies** as described in Part IV.

The total thermal discharge or **"Heat"** for the facility is limited as 30,600 million BTU's per hour as a monthly average. This limit is consistent with the existing permit. The calculation procedure is provided in Part IV.

DSN 48C

The effluent limitations and/or monitoring requirements for **Flow**, **Petroleum Hydrocarbons**, **Total Organic Carbon**, **Total Suspended Solids** and **Ammonia** have been retained from the existing permit in accordance with N.J.A.C. 7:14A-13.19. The monitoring frequency of "daily" for flow and "twice per month" for petroleum hydrocarbons, total organic carbon, total suspended solids and ammonia have also been retained from the existing permit. Although the permittee has demonstrated consistent compliance with the effluent limitations, the Department has determined that it is appropriate to retain the "twice/month" monitoring frequency given the potential contaminants and level of treatment for this wastestream.

DSN 487B

The effluent limitations and/or monitoring requirements for **Flow**, **Effluent Temperature**, **Petroleum Hydrocarbons**, **Total Organic Carbon**, **Total Suspended Solids** and **pH** have been retained from the existing permit in accordance with N.J.A.C. 7:14A-13.19. The monitoring frequency of "once/batch" is still appropriate and has therefore also been retained.

DSN 489

The effluent limitations and/or monitoring requirements for **Flow**, **Petroleum Hydrocarbons**, **Total Organic Carbon**, **Total Suspended Solids** and **pH** have been retained from the existing permit in accordance with N.J.A.C. 7:14A-13.19. The monitoring frequency of "monthly" is still appropriate and has therefore also been retained from the existing permit. The Department has eliminated the weekly average effluent limitation of 45 mg/L for this outfall based on the types of discharge components routed to this outfall, the continued imposition of a monthly monitoring frequency (as opposed to weekly), and consistent compliance with the daily maximum and monthly average limits.

DSN's 481-486, 48C, 487 and 489 - Monitoring Requirements

Monitoring frequencies and sample types are in accordance with N.J.A.C. 7:14A-14, unless specified otherwise above. The permittee may submit a written request for a modification of the permit to decrease monitoring frequencies for any parameters listed in Part III-B/C for DSNs 481-486, 48C, 487B and 489 if site specific conditions indicate the

applicability of such a modification. Conditions governing requests for a reduction in monitoring frequency are provided in N.J.A.C. 7:14A-14.2.

DSN's 481-486, 48C and 489 - Effluent Characterization Study

As required in the July 20, 1994 NJPDES permit, the permittee was required to complete an effluent characterization study. This study was completed in two phases and a summary of the data from both phases has been included as Table 1. Based on the results of this study, the Department has determined that additional effluent limitations and/or monitoring requirements are not necessary at this time.

DSN's 488, 490, 491 - Stormwater Pollution Prevention Plan

The Department has determined that chemical-specific effluent limitations and/or monitoring requirements are not necessary for DSN's 488, 490 and 491 at this time. This determination is based on the fact that stormwater discharged through these outfalls does not typically come into contact with industrial processes.

IX. PERMIT SUMMARY TABLES

Facility: PSEG - Salem **Latitude: 39° 27' 38"** **Classification: Zone 5**
Receiving Stream: Delaware Estuary **Longitude: 75° 32' 16"** **WQMP Basin 17/Delaware River Basin**
Wastewater Type: DSN's 483 and 486: once-through cooling water only
DSN's 481-482, 484-485: once-through cooling water, non-radioactive liquid waste disposal system effluent and radioactive liquid waste effluent

Application data for DSN's 481 – 483: analytical results for effluent flow, residual chlorine and pH are specific to this outfall. Flow is representative of average flow during power operations of at least one unit to ensure that flow rate is representative of normal plant operations. Analytical results for effluent temperature are representative of the flow weighted effluent temperature for Unit 1, DSN's 481 – 483. Analytical results for conventional pollutants are a composite of the results for DSN 484-486. All other analytical results are a composite of the results for DSN 484 and 486.

Application data for DSN's 484 – 486: analytical results for effluent flow, residual chlorine and pH are specific to this outfall. Flow is representative of average flow during power operations of at least one unit to ensure that flow rate is representative of normal plant operations. Analytical results for effluent temperature are representative of the flow weighted effluent temperature for Unit 2, DSN's 484 – 486. Analytical results for conventional pollutants are a composite of the results for DSN 484-486. All other analytical results are a composite of the results for DSN 484 and 486.

Parameter All units in mg/l (kg/day) unless otherwise noted		*Appli-cation: DSN 481*	*Appli-cation: DSN 482*	*Appli-cation: DSN 483*	*Appli-cation: DSN 484*	*Appli-cation DSN 485*	*Appli-cation: DSN 486*	Existing NJPDES/DSW Permit limits for **DSN's 481-486**	NJPDES/ DSW DMR 1/99 – 6/00	Other	Draft Permit Limits for **DSN's 481-486 applied at each outfall**
Effluent Flow, MGD	avg. max. data pts	*502* *542* *425*	*476* *492* *425*	*466* *560* *425*	*467* *558* *547*	*426* *505* *547*	*456* *543* *547*	NL NL	450 554 108	NL NL	NL* NL*
Intake Flow, MGD	'avg. 'max.	- -	- -	- -	- -	- -	- -	See FAC C	- -	- -	See FAC C
Summer Temperature – INTAKE, °C, (°F)	avg. data pts	*24.3* *106*	*24.3* *106*	*24.3* *106*	*24.3* *137*	*24.3* *137*	*24.3* *137*	NL NL	See FAC A and B	- -	See FAC A and B
Summer Temperature – EFFLUENT, °C, (°F)	avg. max. data pts	*25.3* *36.8* *106*	*25.3* *36.8* *106*	*25.3* *36.8* *106*	*26.2* *37.6* *137*	*26.2* *37.6* *137*	*26.2* *37.6* *137*	See FAC A and B	See FAC A and B	- -	NL* NL*
Winter Temperature – INTAKE, °C, (°F)	avg. data pts	*9.4* *319*	*9.4* *319*	*9.4* *319*	*9.4* *410*	*9.4* *410*	*9.4* *410*	NL NL	See FAC A and B	- -	See FAC A and B
Winter Temperature – EFFLUENT, °C, (°F)	avg. max. data pts	*12.6* *32.8* *319*	*12.6* *32.8* *319*	*12.6* *32.8* *319*	*12.2* *33.4* *410*	*12.0* *33.3* *410*	*12.0* *33.4* *410*	See FAC A and B	See FAC A and B	- -	NL* NL*

Parameter All units in mg/l (kg/day) unless otherwise noted		*Application DSN 481*	*Application: DSN 482*	*Application: DSN 483*	*Application: DSN 484*	*Application: DSN 485*	*Application: DSN 486*	Existing NJPDES/DSW Permit limits for **DSN's 481-486**	NJPDES/ DSW DMR 1/99 – 12/99	Other	Draft Permit Limits for **DSN's 481-486 applied at each outfall**
Temperature – Difference, ^{o}C (^{o}F)	avg. max.	- -	- -	- -	- -	- -	- -	See FAC A and B	See FAC A and B	- -	See FAC C
Heat, Facility MBTU/hour	avg. max.	- -	- -	- -	- -	- -	- -	See FAC C	See FAC C	- -	See FAC C
Chlorine Produced Oxidants, mg/L – During discharge of service water	avg. max. data pts	*<0.1* *0.3* *639*	*<0.1* *0.3* *639*	*<0.1* *0.3* *639*	*<0.1* *0.4* *639*	*<0.1* *0.3* *639*	*<0.1* *0.3* *639*	0.3 0.5	0.1 0.4 7 det./4 ND	- -	0.3 0.5
Chlorine Produced Oxidants, mg/L – During discharge of circulating water	avg. max. data pts	*<0.1* *0.3* *639*	*<0.1* *0.3* *639*	*<0.1* *0.3* *639*	*<0.1* *0.4* *639*	*<0.1* *0.3* *639*	*<0.1* *0.3* *639*	NL 0.2	<0.1 0.1 89	- -	NL 0.2
Intake pH, standard units	Min. Max. data pts	*6.4* *8.4* *213*	*6.4* *8.4* *213*	*6.4* *8.4* *213*	*6.4* *8.4* *213*	*6.4* *8.4* *213*	*6.4* *8.4* *213*	NL NL	7 8.3 108	- -	NL NL
Effluent pH, standard units	min. max. data pts	*6.2* *8.3* *213*	*6.2* *8.2* *213*	*6.2* *8.3* *213*	*6.2* *8.2* *213*	*6.2* *8.3* *213*	*6.2* *8.2* *213*	6.0 9.0	6.6 9.4 143	6.0[2] 9.0[2]	6.0 9.0
Acute Toxicity, LC50 (% effluent)	min max. data pts	-- --	-- --	-- --	-- --	-- --	-- --	50 --	>100 >100 6	- -	50 – Daily Min. for DSN's 481, 482, 484 and/or 485
Total Organic Carbon, mg/L	avg. max. data pts	*4.1* *8.7* *15*	*4.1* *8.7* *15*	*4.1* *8.7* *15*	*4.1* *8.7* *15*	*4.1* *8.7* *15*	*4.1* *8.7* *15*	- -	- -	- -	- -
Effluent Total Suspended Solids, mg/L	avg. max. data pts	*116* *202* *15*	*116* *202* *15*	*116* *202* *15*	*116* *202* *15*	*116* *202* *15*	*116* *202* *15*	- -	- -	- -	- -
Influent Total Suspended Solids, mg/L	avg. data pts	*222* *15*	*222* *15*	*222* *15*	*222* *15*	*222* *15*	*222* *15*	- -	- -	- -	- -
Ammonia, mg/L	avg. max. data pts	*0.1* *0.3* *10*	*0.1* *0.3* *10*	*0.1* *0.3* *10*	*0.1* *0.3* *10*	*0.1* *0.3* *10*	*0.1* *0.3* *10*	- -	- -	35 [2] -	- -
Petroleum Hydrocarbons, mg/L	avg. max. data pts	*<1.3* *<1.3* *15*	*<1.3* *<1.3* *15*	*<1.3* *<1.3* *15*	*<1.3* *<1.3* *15*	*<1.3* *<1.3* *15*	*<1.3* *<1.3* *15*	- -	- -	10[3] 15[3]	- -

Footnotes for Permit Summary Tables for DSN's 481-486

A comprehensive effluent characterization study was performed, as required in the July 20, 1994 permit, for conventional, non-conventional and toxic parameters including intake samples. The results of this study were described previously in this Fact Sheet.

DMR data is a summary of DSN's 481-486.

The abbreviation "N/A" denotes "Not Applicable"; "NL" denotes "Not Limited" with monitoring and reporting required
MGD denotes million gallons per day

* Effluent flow and effluent temperature shall be monitored continuously. For the purposes of reporting this data on discharge monitoring reports as well as for any calculation procedure, the permittee shall summarize the values measured during the course of a calendar day consistent with the definition of daily discharge at N.J.A.C. 7:14A-1.2. The daily discharge values that are tracked over a period of a calendar month shall be averaged for the purposes of DMR reporting of a monthly average. The maximum of these daily discharge values shall be reported on the monthly DMR as the daily maximum.

[1] Data from NJPDES Permit renewal application dated 3-4-99.
[2] Water Quality Regulations of the Delaware River Basin Commission.
[3] N.J.A.C. 7:14A-12.

Facility: PSEG – Salem **Discharge Serial Number (DSN): FAC A (DSN's 481 – 483)**
Wastewater Type: Heat Limitations for Unit 1

Parameter All units in mg/l (kg/day) unless otherwise noted		Existing NJPDES/DSW Permit limits for **FAC A**	NJPDES/DSW DMR 1/99-6/00	Draft Permit Limits for **FAC A**
Temperature – Intake*, ^{o}F (^{o}C)	avg. max. data pts	NL NL	(15.8) (30.2) 12	NL NL
Temperature – Effluent**, ^{o}F (^{o}C) June 1 – Sept. 30	avg. max. data pts	NL 115 (46.1)	(32.4) (37.3) 4	NL 115 (46.1)
Temperature – Effluent**, ^{o}F (^{o}C) October 1 – May 31	avg. max. data pts	NL 110 (43.3)	(17.9) (30.6) 8	NL 110 (43.3)
Differential Temperature***, ^{o}F (^{o}C)	avg. max. data pts	NL NL	(6.9) (10.1) 12	NL 27.5 (15.3)

Facility: PSEG – Salem **Discharge Serial Number (DSN): FAC B (DSN's 484 – 486)**
Wastewater Type: Heat Limitations for Unit 2

Parameter All units in mg/l (kg/day) unless otherwise noted		Existing NJPDES/DSW Permit limits for **FAC B**	NJPDES/DSW DMR 7/99-6/00	Draft Permit Limits for **FAC B**
Temperature – Intake*, ^{o}F (^{o}C)	avg. max. data pts	NL NL	(15.8) (30.2) 12	NL NL
Temperature – Effluent**, ^{o}F (^{o}C) June 1 – Sept. 30	avg. max. data pts	NL 115 (46.1)	(34.1) (38.5) 4	NL 115 (46.1)
Temperature – Effluent**, ^{o}F (^{o}C) October 1 – May 31	avg. max. data pts	NL 110 (43.3)	(19.3) (30.8) 8	NL 110 (43.3)
Differential Temperature***, ^{o}F (^{o}C)	avg. max. data pts	NL NL	(8.5) (10.8) 12	NL 27.5 (15.3)

Footnotes for FAC A and FAC B – Requirements are described in Part IV.

* The intake temperatures from Units 1 and 2 shall be averaged to obtain the intake temperature for FAC A. For the purposes of reporting this data on discharge monitoring reports as well as for any calculation procedure, the permittee shall summarize the intake temperature values measured during the course of a calendar day consistent with the definition of daily discharge at N.J.A.C. 7:14A-1.2. The daily discharge values that are tracked over a period of a calendar month shall be averaged for the purposes of DMR reporting of a monthly average. The maximum of these daily discharge values shall be reported on the monthly DMR as the daily maximum.

** Effluent temperature shall be measured at DSN's 481 - 486 on a continuous basis where effluent temperature for FAC A and FAC B shall be calculated as follows:

Effluent Temperature for FAC A = $[(\text{Eff. Temperature}_{\text{DSN 481}} \times \text{Eff. Flow}_{\text{DSN 481}}) + (\text{Eff. Temperature}_{\text{DSN 482}} \times \text{Eff. Flow}_{\text{DSN 482}}) + (\text{Eff. Temperature}_{\text{DSN 483}} \times \text{Eff. Flow}_{\text{DSN 483}})] / (\text{Eff. Flow}_{\text{DSN 481}} + \text{Eff. Flow}_{\text{DSN 482}} + \text{Eff. Flow}_{\text{DSN 483}})$

Effluent Temperature for FAC B = $[(\text{Eff. Temperature}_{\text{DSN 484}} \times \text{Eff. Flow}_{\text{DSN 484}}) + (\text{Eff. Temperature}_{\text{DSN 485}} \times \text{Eff. Flow}_{\text{DSN 485}}) + (\text{Eff. Temperature}_{\text{DSN 486}} \times \text{Eff. Flow}_{\text{DSN 486}})] / (\text{Eff. Flow}_{\text{DSN 484}} + \text{Eff. Flow}_{\text{DSN 485}} + \text{Eff. Flow}_{\text{DSN 486}})$

*** The permittee shall calculate differential temperature on an hourly basis where the daily differential temperature is an arithmetic average of the hourly values obtained during the course of the day for daily intake temperature and daily effluent temperature. The calculations for daily intake temperature and daily effluent temperature are explained above in footnotes "*" and "**".

"NL" denotes "Not Limited" with monitoring and reporting required

Facility: **PSEG – Salem** **Discharge Serial Number (DSN): FAC C (DSN's 481 – 486)**
Latitude: **39° 27' 38"** **Wastewater Type: Intake flow limitations and heat limitations for the facility**
Longitude: **75° 32' 16"**

Parameter All units in mg/l (kg/day) unless otherwise noted		Existing NJPDES/DSW Permit limits for **FAC C**	NJPDES/ DSW DMR 7/99-6/00	Draft Permit Limits for **FAC C**
Intake Flow, MGD	avg. max. data pts	3024 NL	2698 2955 12	3024 NL
Thermal Discharge, Million BTU's per Hour	avg. max. data pts	30600 NL	12033 18502 12	30600 NL

* Intake flow for the circulating water system shall be measured as the sum of the twelve individual intakes to the circulating water system. The intake flow values calculated over the course of a calendar day shall be averaged on a daily basis consistent with the definition of daily discharge pursuant to N.J.A.C. 7:14A-1.2. These daily discharge values shall be utilized for any calculation procedures necessary for the purposes of discharge monitoring report form completion.

** Thermal discharge in MTBU/Hr is the total heat released from Unit 1 (FAC A) and Unit 2 (FAC B) where it shall be calculated as follows (as described in Part IV):

Thermal Discharge $_{FAC\ C} = [M_1C_p(T_{eff}-T_{int})]_{Unit\ 1} + [M_2C_p(T_{eff}-T_{int})]_{Unit\ 2} / 1{,}000{,}000$

Where: **M_1 = Mass flow rate of water from Unit 1 in lbs/hour (includes circulating water flow as well as service water flow)**
M_2 = Mass flow rate of water from Unit 2 in lbs/hour (includes circulating water flow as well as service water flow)
Mass flow rate is equal to flow in gal/hour x 8.34 lb/gallon
T_{eff} = effluent temperature from Unit (e.g. Unit 1)
T_{int} = effluent temperature from Unit
C_p is the specific heat capacity of water in 1 BTU/lb F

The abbreviation "N/A" denotes "Not Applicable"; "NL" denotes "Not Limited" with monitoring and reporting required
MGD denotes million gallons per day

Facility: PSEG – Salem **Discharge Serial Number (DSN): 48C – Internal Monitoring Point**
Latitude: 39° 27' 38"
Longitude: 75° 32' 16"
Wastewater Type: Total regenerant wastewater, chemical drains, analytical equipment wastewater, steam generator drains and floor drains.
DSN 48C discharges to DSN's 481, 482, 484, and/or 485 on a batch-type basis.

Parameter All units in mg/l (kg/day) unless otherwise noted		NJPDES/DSW Permit Application	Existing NJPDES/DSW Permit limits for **DSN 48C**	NJPDES/ DSW DMR 1/99-6/00	Draft Permit Limits for **DSN 48C**
Flow, Effluent, MGD	avg. max. data pts	0.155 0.561 1491	NL NL	0.140 0.448 18	NL NL
Total Petroleum Hydrocarbons, mg/L	avg. max. data pts	<1 1 98	10 15	0.71 3 7 det./ 11 ND	10 15
Total Organic Carbon, mg/L	avg. max. data pts	5.4 50 98	NL 50	16 33 18	NL 50
Total Suspended Solids, mg/L	avg. 7day avg max. data pts	5.6 20 98	30 45 100	8.5 -- 18 18	30 45 100
Ammonia (as N), mg/L	avg. max. data pts	9.9 42 98	35 70	16.5 46 6 det./ 2 ND	35 70

The abbreviation "N/A" denotes "Not Applicable"; "NL" denotes "Not Limited" with monitoring and reporting required.
MGD denotes million gallons per day
"Det." denotes detected value whereas "ND" denotes non-detected value. Non-detectable values are not included in any average calculations.

Facility: PSEG - Salem **Latitude: 39° 27' 38"** **Receiving Stream: Delaware Estuary**
Discharge Serial Number (DSN): 487B **Longitude: 75° 32' 16"** **Classification: Zone 5**
WQMP Basin 17/Delaware River Basin

Wastewater Type: Treated stormwater, house heating boiler drains, floor drains

DSN 487B only discharges in an emergency on a batch-type basis. Normal discharge is to the influent of DSN 48C.

Parameter All units in mg/l (kg/day) unless otherwise noted		NJPDES/DSW Permit Application	Existing NJPDES/DSW Permit limits for **DSN 487B**	NJPDES/ DSW DMR 1/99-6/00*	Draft Permit limits for **DSN 487B**
Flow, Effluent, MGD	avg. max. data pts	0.013 0.013 1	NL NL	0.024 0.012 3	NL NL
Temperature – Effluent, ^{o}F (^{o}C)	avg. max. data pts	20.5 25 2	NL 110 (43.3)	19.2 22 4	NL 110 (43.3)
Total Petroleum Hydrocarbons, mg/L	avg. max. data pts	<1.0 <1.0 1	NL 15	<0.5 <0.1 3 ND	NL 15
Total Organic Carbon, mg/L	avg. max. data pts	<1.0 <1.0 1	NL 50	6.3 15 3	NL 50
Total Suspended Solids, mg/L	avg. max. data pts	<10 <10 1	NL 100	10.7 16 3	NL 100
PH, standard units	avg. max. data pts	7.45 7.45 1	6.0 9.0	6.6 8 4	6.0 9.0

The abbreviation "N/A" denotes "Not Applicable"; "NL" denotes "Not Limited" with monitoring and reporting required.
MGD denotes million gallons per day.
"Det." denotes detected value whereas "ND" denotes non-detected value.

*This outfall discharges on an emergency basis only – DMR data is available for all limited parameters for 3 months during this period.

Facility: PSEG - Salem **Latitude: 39° 27' 40"** **Receiving Stream: Delaware Estuary**
Discharge Serial Number (DSN): 489 **Longitude: 75° 32' 00"** **Classification: Zone 5**
WQMP Basin 17/Delaware River Basin

Wastewater Type: precipitation runoff, roof drains, #1 and #2 skim tanks, power transformer sumps, auxiliary power transformer sumps, floor drains and turbine building sump pumps. All components are routed through an Oil Water Separator.

Parameter All units in mg/l (kg/day) unless otherwise noted		NJPDES/DSW Permit Application	Existing NJPDES/DSW Permit limits for **DSN 489**	NJPDES/ DSW DMR 1/99-6/00	Draft Permit limits for **DSN 489**
Flow, Effluent, MGD	avg. max. data pts	0.088 0.183 49	NL NL	0.083 0.2432 18	NL NL
Temperature – Effluent, ^{o}F (^{o}C)	avg. max. data pts	20.5 22.5 2	- -	- -	- -
Total Petroleum Hydrocarbons, mg/L	avg. max. data pts	1.0 4.4 49	10 15	1.5 2 8 det./ 9 ND	10 15
Total Organic Carbon, mg/L	avg. max. data pts	6.7 28 49	NL 50	7.9 26 18	NL 50
Total Suspended Solids, mg/L	avg. 7day avg. max. data pts	7.5 55 49	30 45 100	8.25 - 20 16 det./2 ND	30 -- 100
PH, standard units	min. max. data pts	6.6 8.1 49	6.0 9.0	6.6 8.3 18	6.0 9.0

The abbreviation "N/A" denotes "Not Applicable"; "NL" denotes "Not Limited" with monitoring and reporting required
MGD denotes million gallons per day

“Det.” denotes detected value whereas “ND” denotes non-detected value. Non-detectable values are not included in any average calculations.

Facility: PSEG - Salem | **Latitude: 39° 27' 41"** | **Receiving Stream: Delaware Estuary**
Discharge Serial Number (DSN): 488 | **Longitude: 75° 32' 12"** | **Classification: Zone 5**
WQMP Basin 17/Delaware River Basin

Wastewater Type: Tidal river water influx, service water strainer backwash, precipitation runoff, roof drains, floor drains, sump pumps, #1 turbine building floor pump, the service water sump pumps, residual chlorine analytical wastewater, and circulating water system vents.

Discharge Serial Number (DSN): 490 | **Latitude: 39° 27' 40"** | **Receiving Stream: Delaware Estuary**
Longitude: 75° 31' 52" | **Classification: Zone 5**
WQMP Basin 17/Delaware River Basin

Wastewater Type: precipitation runoff from the helicopter landing pad area.

Discharge Serial Number (DSN): 491 | **Latitude: 39° 27' 40"** | **Receiving Stream: Delaware Estuary**
Longitude: 75° 31' 50" | **Classification: Zone 5**
WQMP Basin 17/Delaware River Basin

Wastewater Type: precipitation runoff from the employee parking lot and an adjacent access road

Chemical-specific effluent limitations and/or monitoring requirements are not applied to DSN's 488, 490 and 491 at this time. The stormwater from all three of these outfalls does not typically come into contact with industrial processes.

X. SECTION 316(a) VARIANCE AND SECTION 316(b) DETERMINATION

A. Regulatory History for Section 316 (a) Variance and Section 316 (b) Determination

Section 316(a) of the Clean Water Act (CWA) provides that a variance from thermal surface water quality standards can be granted, meaning less stringent thermal effluent limits may be imposed, if the permittee can demonstrate that a balanced indigenous population is being maintained in the receiving water. Section 316(b) of the CWA provides the mechanism for a regulatory agency determination as to whether the location, design, construction and capacity of the cooling water intake structure reflect the best technology available for minimizing adverse environmental impact. A detailed regulatory history for Sections 316 (a) and (b) prior to 1993 is provided in the Fact Sheet of the June 24, 1993 draft permit beginning on page 102.

In the July 20, 1994 final permit, the Department granted a Section 316(a) Variance and also determined that the permittee was in compliance with Section 316(b) of the Clean Water Act provided it complied with the conditions of the July 20, 1994 permit. In this permit, the Department determined that "best technology available"(BTA) consisted of the Station's once-through cooling water system in conjunction with an intake flow limitation; modifications to the intake traveling screens; and the conduct of a sound deterrent study. The July 20, 1994 permit also sets forth a variety of Section 316 Special Conditions to minimize and to increase understanding of the effects of the Station due to impingement/entrainment losses, which include the BTA components. Because the Department is making a determination regarding compliance with these permit conditions, a brief discussion of the original technical justification for each of these Special Conditions, as described in the July 20, 1994 permit, is included below. In addition, the rationale for the Department's current compliance determination is also included below.

B. Compliance with Section 316 Special Conditions and/or Overview of Studies performed

Special Condition 1: Limitation of the circulating water system (CWS) intake flow to a monthly average rate not to exceed 3024 MGD. This rate is 5 percent below design specifications. This condition is a component of the July 20, 1994 BTA determination.

Original Technical Justification for Special Condition 1: Limitation of the circulating water system intake flow to this rate allows consistency with the calculated cooling water intake volume that the impingement/entrainment loss estimates presented in the March 4, 1993 PSE&G Renewal Application Supplement were based upon.

Compliance with Special Condition 1: As indicated by the Discharge Monitoring Report (DMR) data summary included for FAC C in the Permit Summary Tables in Section IX, PSE&G is in compliance with the intake flow limit. Considering the average of DMR data from 1/99 through 6/00 the average intake flow amount is 2698 million gallons per day.

Proposed Permit Condition for Intake Flow Limitation: This intake flow limitation has been retained in the proposed permit as discussed previously under Section VIII of this Fact Sheet for FAC C. The calculation procedure for reporting this parameter on discharge monitoring reports has been defined in Part IV.

Special Condition 2: Implement modifications to the circulating water system intake traveling screens to incorporate a new fish bucket design including, without limitation: an extended lip which bends inward toward the screen face at the top to prevent fish escape; smooth woven mesh screen having rectangular pore openings; and a 30 inch wide fish sluice providing an approximate 3 inch depth of water. In addition, the permittee shall study best placement of inside and outside high pressure and low pressure fish sprays as well as a study of whether to combine or separate fish return and debris water system high pressure.

Original Technical Justification for Special Condition 2: The goal of these improvements was to reduce the overall rate of impingement mortality and improve performance and reliability. Improvements to the fish bucket design are required specifically to reduce the vortex current and create a somewhat sheltered region allowing the fish to maintain a stable, upright position. This condition is a component of the July 20, 1994 BTA determination.

Compliance with Special Condition 2

Intake Screen Improvements

In 1995, PSE&G made alterations to its Ristroph traveling water screens (Ristroph traveling screens were installed in 1979) to improve performance and reliability as well as to increase the survival rates of impinged fish. The new traveling water screens are a modified Ristroph design as illustrated in B Figure 11. Each screen unit is a vertical, chain-link, four-post type machine on which the screen rotates continuously to collect fish and debris as the water passes through the screen. Each traveling screen panel is 10 feet wide by 21 inches high and contains sixty-two (62) screen panels. The wire mesh on each screen panel has been changed to 14 gauge (0.100 in) "Smooth Tex®" screening material with 1/4" wide by 1/2" high mesh screen openings. At the bottom of each screen panel there is a composite material fish bucket with a reinforcing bar across the center.

The water spray system was modified to improve water flow to the circulating water traveling screens. A total of eighty spray nozzles were added to the spray headers of each traveling screen. Two low-pressure spray nozzles were added to the source pipe of each of the two inside fish spray headers (a total of 4 nozzles) to provide better spray coverage and improved fish handling. In addition, two high-pressure spray nozzles were added to each of the two main debris spray headers (a total of 4 nozzles) to provide better spray coverage and improve debris removal.

The modifications to the traveling screens incorporated newly designed screen baskets with hydrodynamically improved fish buckets. The modified Ristroph fish screens are made of composite material that are integral to the bottom support member of the screen panel. The fish

bucket redesign includes an integral, curved lip or leading edge. This lip efficiently redirects inlet water flow through the entire lower portion of the basket's screen surface area. Additionally, the curved lip eliminates the turbulent flow pattern that existed in previous fish bucket designs (refer to B Figure 12). Each newly designed bucket is configured to form an interlocking seal with the basket frame below it during ascending and descending travel. As the screen bucket travels over the head sprocket of the traveling screen, organisms slide onto the screen face and are washed off by the low-pressure spray system.

The mounting and structural hardware for the baskets is located behind the screen mesh weave. This, in conjunction with the smooth weave pattern, has resulted in a smooth surface to eliminate obstacles that might cause damage to fish when they contract these parts during the spray wash assisted removal cycle.

Additional advantages of using composite materials over steel are corrosion resistance and weight reduction, which allow for increased traveling screen speeds and enhanced debris removal. Use of this material has also resulted in reduced maintenance and operating costs of increased service life. This enhances fish handling because the pressure differential is reduced across screens due to less debris collected on the screen faces. Additionally, flow velocities are kept to a minimum, corresponding to the actual debris loading on the screen. The screen assembly now automatically changes speed in response to the differential pressure across the screens. The screens can rotate at 6,12, 17.5, or 35 feet per minute.

PSE&G completed the modification of the intake screens within the time allowed by the Permit.

Department's Contractor Review regarding Intake Screen Improvements

The Department's contractor, ESSA, reviewed the sections in the March 4, 1999 application pertaining to intake screen modifications, specifically "Attachment 1 – Intake Screen Modifications"; "Exhibit G-1-1 "Traveling Water Intake Screen Modifications"; and "Exhibit G-1-2 – Biological Efficacy of Intake Structure Modifications". The Department specified that these sections were to be reviewed to determine the extent to which the existing intake protection technology (being modified Ristroph traveling screens) has reduced impingement mortality and whether PSE&G's claim that the modified Ristroph traveling screens is best technology available is accurate.

In its June 14, 2000 report, ESSA states that "The Ristroph screen modifications are innovative, and represent BTA at the screens for reducing fish mortalities. However, effectiveness of the Ristroph Screens for improving fish survival will vary with species. Frail species will likely have a higher mortality than more robust ones." ESSA also states that "Because the Ristroph Screen alone cannot fully address fish impingement losses at the Salem station, further studies are recommended at the Salem station for a "fish defense system" which employs multi-sensory or hybrid technologies that focus more on behavioral deterrents."

ESSA also raised concerns regarding the fish return system. Specifically ESSA states that "The modified Ristroph screen is good, but improvements to the design and operation of the fish return system would likely increase the survival of fish coming off the screens."

Department's Determination Regarding Intake Screen Improvements and Proposed Permit Conditions

Based on ESSA's Report, the Department is hereby proposing the following Special Conditions to further understand and enhance the effectiveness of the existing Ristroph Screens:

(1) Fish mortality of the fish return system should be evaluated independently from the mortality of the Ristroph screens to determine mortality rates as fish re-enter the estuary. Emphasis should be placed on reducing potential mortality of susceptible species. PSEG shall submit a ranking of best to worst (i.e. most vulnerable or frail) RIS for which the Ristroph traveling screens are most effective at minimizing mortality.

(2) The permittee shall submit the findings of (1) along with proposed redesign of the fish return sluice where a biologist with expertise in the area of fish behavior shall specify flows, velocities, and depth profiles to minimize mortalities.

The due dates for these required studies and associated workplans are specified in Part IV.

Special Condition 3: Special Condition 3 pertains to the implementation of wetlands restoration and enhancement program which was developed to increase detrital production in the Delaware Estuary. More details are provided on pages 19-24 of Part IV of the July 20, 1994 permit. An overview of these requirements is as follows:

a. Restoration, enhancement and/or preservation of wetlands within the region of the Delaware Estuary (primarily within New Jersey; not more than 20% of the acres restored or enhanced under the program to be located within Delaware and/or Pennsylvania.) as follows:

(i) restore an aggregate of no less than 8000 acres of (1) diked wetlands (including salt hay farms, muskrat impoundments and/or agricultural impoundments) to normal daily tidal inundation so as to become functional salt marsh; and/or (2) wetlands dominated by common reed (*Phragmites australis*) to primarily Spartina species with other naturally occurring marsh grasses (i.e. *Distichilis spicata*, *Juncus spp*.). No less than 4000 of the 8000 acres required to be restored above must have been diked wetlands. The permittee shall secure access to or control such lands such that said lands will have title ownership or deed restriction as may be necessary to assure the continued protection of said lands from development;

(ii) restore an additional 2000 acres of wetlands as set forth above and/or preserve in a state that precludes development through appropriate title ownership or Conservation Restriction of no less than 6000 acres of uplands adjacent to Delaware Estuary tidal wetlands ("Upland Buffer"). An Upland Buffer shall mean an area of land adjacent to wetlands which minimizes adverse impacts on the wetlands and serves as an integral component of the wetland ecosystem;

(iii) the acreage restored, enhanced and/or preserved pursuant to (i) and (ii) above will comprise an aggregate of no less than 10,000 acres; provided, however, the permittee only will be credited one acre toward the 10,000 acre aggregate for every three acres of Upland Buffer acquired or restricted pursuant to (ii) above.

b. The permittee shall impose a Conservation Restriction on the approximately 4500 acres of land in Greenwich Township, Cumberland County, commonly known as the Bayside Tract. The approximate 1900 acres of Upland Buffer on the Bayside Tract shall be applied on a 3:1 basis toward satisfying the acreage requirement in (iii) above.

c. In addition to the above requirements, the permittee is required to design, file and implement Management Plans for the lands described in "a".

d. The permittee is also required to establish a **Management Plan Advisory Committee** (MPAC) to serve as a body to provide technical advice to the permittee concerning the required development and implementation of Management Plans for the sites described above in "a". The MPAC shall consist of representatives from at least three agencies that have jurisdiction over wetland restoration activities; a coastal geologist; two scientists with appropriate expertise; and representatives from Cape May, Cumberland and Salem Counties. The Department shall designate representatives from its Division of Fish, Game and Wildlife and its Mosquito Control Commission. The MPAC shall be chaired by the permittee's representative.

Original Technical Justification for Special Condition 3: The wetlands restoration program is a very important component in minimizing entrainment and impingement effects, especially as it relates to restoration of fish populations. Temperate zone tidal saltmarshes, such as those fringing the Delaware Bay and Estuary, consist of a unique assemblage of plants and animals. In saltmarshes, much of the energy needed to support life is in the form of food manufactured by chlorophyll-bearing plants (i.e. carbohydrates, proteins, fats, and other complex materials). This energy is produced by the marsh grasses where *Spartina spp*. is the dominant species group. In most terrestrial plant ecosystems the flow of energy from the photosynthetic process moves from plant material to grazers (herbivores) to various levels of consumers (carnivores), through a series of organisms repeatedly eating and then being eaten. However, in the tidal saltmarsh systems there are few direct consumers and most of the plant material remains unconsumed until it dies and is washed into the estuary. There it is decomposed and broken down by microorganisms into organic detritus (finely divided particulate matter). Because decomposition occurs continuously throughout the year, detritus is always available for consumption by many forms of aquatic organisms. This process helps make tidal saltmarshes and their connecting estuaries among the most productive ecosystems known to exist. This process, which occurs throughout Delaware Bay, supports an abundance of fishes that are spawned there or have their larval stages carried or deposited there. An increase in the area of saltmarsh will lead to increased growth in marsh grasses which will lead to an increased food supply for fishes. This increase of saltmarshes required in this Special Condition will also result in an increase in the amount of living space (habitat) available for the various species of fishes.

The species at issue at Salem (white perch, spot, weakfish, bay anchovy, and opossum shrimp) are all consumer organisms in the Delaware Estuary food web. Wetland systems in the Delaware Estuary provide foraging and refuge habitat, serve as nursery areas for early life stages and juveniles, and provide direct food resources. For these reasons, increased wetlands in the Delaware Estuary will contribute directly to the increased abundance of these species. Because wetlands in the Delaware Estuary support production of the species at issue, wetlands restoration and enhancement will minimize the effects of Salem-related losses by increasing productivity of these species. Wetlands restoration and enhancement also benefits the other species dependent on the productivity derived from the wetlands. A conceptualized food-energy web for the Delaware Estuary is included as E Figure IV-12.

Wetland production (estimated by the aggregated food chain model) was related directly to the estimated biomass lost by the Station's operations. This loss was used to estimate the wetlands restoration acreage required to adequately minimize the effects of Salem's losses by increasing the population of these species. The food chain model estimates the production of fish biomass per acre based on the biological conversion of wetland plant productivity through the food chain to the fish species at issue. Primary productivity per acre of wetland per year and food chain transfer conversion factors were derived from published, peer-reviewed scientific literature and were employed in this calculation using information specific to the Delaware Estuary, where available. Conservative assumptions were incorporated in these calculations.

The Department determined in its July 20, 1994 permit that PSE&G's proposal to restore or enhance a minimum of 10,000 acres of wetlands in the Delaware River Basin (which includes wetlands and upland buffer acreage) is adequate to minimize the effects of Station-related operations to assure the protection and propagation of the balanced indigenous population.

Compliance with Special Condition 3: Wetlands Restoration and Enhancement Efforts

Land Acquisition, Development of MPAC, Development of Management Plans

The most complex, demanding and large-scale action required by the Special Conditions is the restoration and enhancement of more than 10,000 acres of wetlands and upland buffers. The locations of the restoration sites secured and preserved by PSE&G are indicated on the map included as G Figure 1. These sites can be briefly described as follows:

The **Commercial Township Salt Hay Farm Site ("Commercial")**, in Commercial Township, Cumberland County, New Jersey, is situated along the southern New Jersey shoreline of the Estuary at the northern margin of the Maurice River Cove, approximately 18 miles northwest of Cape May Point. For at least three generations, much of the site had been farmed commercially; earthen dikes had been constructed to enhance the production of salt hay. The Commercial Township site includes 2,894 acres of restorable wetlands. In addition, the site contributes 339 acres of upland buffer to the restoration program.

The **Dennis Township Salt Hay Farm Site ("Dennis")** is located in Dennis Township, Cape May County, New Jersey. Perimeter dikes were built around this area during the 1950's, eliminating normal tidal inundation. Large portions of the site continued to be farmed for salt hay until acquired by PSE&G. The Dennis Township site contributes 369 acres of restorable wetlands and 15 acres of upland buffer.

The **Maurice River Township Salt Hay Farm Site ("MRT")** is located in Maurice River Township, Cumberland County, New Jersey. As early as 1810, perimeter dikes were constructed and water control structures were installed to eliminate normal tidal inundation. The Maurice River Township Site includes 1,135 acres of restorable wetlands and contributes 108 acres of upland buffer to the restoration program.

The **Alloway Creek Watershed Site ("Alloways")** is located in Elsinboro and Lower Alloway Creek Townships, Salem County, New Jersey. The area of restorable wetlands at the Alloway Creek Watershed Site is 2,813 acres; in addition, the site contributes 220 acres of upland buffer to the restoration program.

The **Cohansey River Watershed Site ("Cohansey")** is located in Fairfield and Hopewell Townships, Cumberland County, New Jersey. The restorable area at the Cohansey River Watershed site is 910 acres; in addition, the site contributes 145 acres of upland buffer to the restoration program.

The **Bayside Tract** is located in Greenwich Township, Cumberland County, New Jersey. This site contains 2585 acres of existing salt marsh wetlands (which are not creditable toward the minimum 10,000 acre requirement as they are already existing wetlands) as well as 1822 acres of upland buffer (which are credited toward the restoration program at a 3:1 ratio.)

There are five *Phragmites*-dominated sites **("Delaware Sites")** in Delaware. The **Lang Tract Site** contains 253 acres of restorable wetlands and is located in Saint Georges and Red Lion Hundreds, New Castle County. This site is part of the Augustine Wildlife Area. The **Silver Run Site**, a site with 309 acres of restorable wetlands, is located in Saint George Hundred, New Castle County. The **Rocks Site**, a site with 736 acres of restorable wetlands, is located in Appoquinimink Hundreds, New Castle County. This site is part of a continuous tidal marsh community, referred to as the Appoquinimink River-Blackbird Creek System. The **Cedar Swamp Site**, a site with 1,863 acres of restorable wetlands, is located in Blackbird Hundred, New Castle County. The **Woodland Beach Site**, a site with 1,177 acres of restorable wetlands, lies in the northeast corner of Kent County. PSE&G has chosen the Rocks Site and the Cedar Swamp Site for the purposes of compliance with the NJPDES permit.

In sum, PSE&G has acquired or gained control of 4,398 acres of restorable diked wetlands, 3,723 acres of restorable *Phragmites*-dominated wetlands in New Jersey, 4,338 acres of restorable *Phragmites*-dominated wetlands in Delaware (of which 2,000 acres will be applied to the Permit requirements), and 2,649 acres of upland buffers (of which 1,822 acres are contributed by the Bayside Tract). PSE&G contends that the total acres of wetlands and upland buffers (converted

at 3:1 ratio pursuant to the terms of the Permit) creditable against the 10,000 acre permit requirement are 11,004.

For each of the selected restoration sites, Management Plans were developed and approved by the Department.. Each Management Plan provides an overview of existing conditions, proposes design provisions for implementation, assesses potential environmental and off-site impacts, provides a schedule for implementation, identifies success criteria, and establishes an adaptive management program. As stated in paragraph 3.(h) of Part IV of the July 20, 1994 NJPDES permit, the Management Plans are automatically incorporated as conditions of the NJPDES permit upon final approval by the Department.

The July 20, 1994 Permit requires PSE&G to establish a Management Plan Advisory Committee ("MPAC") to provide technical advice to PSE&G concerning the development and implementation of the Management Plans. The MPAC was created in accordance with Permit requirements. The MPAC membership currently includes representatives of PSEG, NJDEP, National Marine Fisheries Service ("NMFS"), United States Fish and Wildlife Service ("USFWS"), DNREC, Army Corps of Engineers, and the Delaware Estuary Program ("DELEP"). The MPAC also includes local representatives from Cumberland, Cape May, and Salem Counties in New Jersey, as well as four independent scientists - Michael S. Bruno, Ph.D., a professor at Stevens Institute of Technology; William S. Mitsch, Ph.D., a professor at Ohio State University; R. Eugene Turner, Ph.D., a professor at Louisiana State University Coastal Ecology Institute; and Joseph Shisler, Ph.D of Environmental Impact Statements. Although DRBC and USGS initially participated in the MPAC, their representatives resigned, citing competing demands on their time. The MPAC has been actively involved in the development of the Management Plans, providing technical review and advice that have helped shape the Plans into technically sound and effective blueprints for restoration.

Marsh Restoration at Salt Hay Farm Sites - Dennis, MRT, Commercial

The restoration designs for the salt hay farms were intended to optimize the use of natural factors such as channel size and shape, drainage patterns, and ratio of marsh plain to open water to encourage natural engineering of the site. The designs at these sites were focused on restoration of tidal exchange through breaching of perimeter dikes, excavation and construction of tidal channels and inlets, and development of upland protection dikes. Elevated areas for colonization by high marsh species were also created by selective placement of material excavated from channels. Provisions were made for the protection of threatened and endangered species.

Restoration at NJ Phragmites-dominated sites - Alloways and Cohansey

The wetland restoration program for the Phragmites-dominated sites sought to control Phragmites to promote the growth of Spartina and other desirable naturally occurring marsh vegetation. This program included baseline field data collection; initial Phragmites control and prescribed burning; additional field data collection; continued Phragmites control; and marsh plain modification and upland edge source control. Biological, geomorphic, hydrologic and

chemical data were collected prior to removal of Phragmites to establish baseline characteristics and to support restoration design.

PSE&G then developed a conceptual design consisting of spraying with an herbicide, burning, modification of existing channels, and excavation of additional channels to re-establish a natural hydroperiod. Following the removal of dead standing Phragmites stalks, intermediate channels were identified. Tidal data collected on the marsh plain in areas previously dominated by standing Phragmites indicated that no appreciable tidal restrictions existed at either the Cohansey River or Alloway Creek Watershed sites and that both experienced a natural hydroperiod. Therefore, no additional channel excavation was necessary. However, evaluation of the marsh plain indicated the absence of rivulets and smaller or higher class channels typically present in Spartina-dominated marshes. Following Phragmites spraying and burning, the changing morphology of the marsh plain renders it available for the re-establishment of Spartina and other desirable marsh vegetation. Restoration activities at the New Jersey sites included spraying and burning in 1996 and 1997. Some additional spraying in 1998 occurred, and supplemental control measures were implemented in 1999 and 2000.

Restoration at Delaware Phragmites-dominated Sites

The five Phragmites-dominated sites in Delaware are on public lands managed as State Widlife Areas by DNREC's Division of Fish and Wildlife. Restoration of Phragmites-dominated sites in Delaware is being managed by DNREC, with funds from PSE&G, through an integrated program of spraying and controlled burning. In addition, marsh plain modifications and additional Phragmites control measures will enable more ecologically beneficial species, such as Spartina, to become re-established. The Delaware sites were all sprayed by DNREC during the 1995 growing seasons with follow-up treatments during the 1996, 1997 and 1998 seasons. Portions of these sites were burned during the winters of 1996, 1997 and 1998 to remove the dead Phragmites stalks. Supplemental control measures were implemented in 1999 and 2000.

Restoration at Bayside Tract

The final Permit requirement relating to marshes is the preservation of tidal marshes and uplands at the Bayside Tract. The Bayside Tract covers approximately 4,407 acres in Greenwich Township, Cumberland County, New Jersey. Salt and brackish marshes, which are located primarily along the western perimeter of the Bayside Tract, are the dominant type of land cover and vegetative communities within the Bayside Tract.

The Management Plan for this site was developed to provide for long-term preservation and conservation while maintaining existing uses. The focus of the Plan was to protect aquatic habitat, particularly the 2,585 acres of salt marsh, by preserving 1,822 acres of upland area from development; maintaining and protecting the agricultural economy; protect natural and historic communities and cultural resources; and providing public access in a manner consistent with these goals.

Role of Reference Marshes

Reference marshes were selected to provide a reference point to evaluate the ongoing success of the restoration efforts. Monitoring is conducted at four representative restored wetlands and two reference marshes (Mad Horse Creek for Phragmites-dominated and Moores Beach for salt hay farms). The Phragmites-dominated wetland restoration sites selected for monitoring were the Alloway Creek and the Cohansey River Watershed restoration sites. The diked salt hay farms selected for monitoring were the Commercial Township Salt Hay Farm Wetland Restoration site and the Dennis Township Salt Hay Farm Wetland Restoration Site. Data relating to vegetation coverage (from aerial photographs), geomorphology, macrophyte productivity, and algal productivity from the restoration sites are collected and compared with that from the reference marshes that are monitored.

Adaptive Management at Dennis, MRT, Commercial, Alloways and Cohansey, Delaware

Adaptive Management is a process initiated after initial restoration activities have been completed to ensure the restoration goals are met. The foundation of Adaptive Management is an understanding of tidal marsh ecology based on current literature, historical observations, on-going data collection, and monitoring. The Adaptive Management Process is implemented through the multi-disciplinary Adaptive Management Team (Team) where a Department representative accompanies the Team. The Team evaluates the progress of the wetland restoration by regular site visits (a minimum of quarterly visits), field observations, and by evaluating monitoring activities.

To ensure that the Success Criteria for the wetland restoration sites will be met, thresholds in the form of trends or trajectories have been developed against which the Team and PSE&G monitor the progress of wetland restoration. Defined variances from the expected trends or trajectories trigger the need for further evaluation of potential problems to determine an appropriate course of action. Upon determination that corrective measures are necessary, PSE&G, in consultation with members of the MPAC and the resource management agencies, will evaluate feasible alternatives for the resolution of an identified problem. Upon review and approval of the proposed corrective measure(s) by the Department, PSE&G will initiate implementation of the appropriate corrective measures. The Adaptive Management Process is shown in Figure 8. As indicated in Figure 8, the thresholds relate directly to the success criteria, and address two categories, namely hydrology and vegetation. Potential corrective actions for the hydrologic and vegetative adaptive management threshold triggers at the wetland restoration sites may, at a minimum, include:

- excavation of additional primary tidal channels;
- enlargement of existing primary tidal channels;
- excavation of secondary tidal channels;
- modifications to tidal inlets;
- notching of material that blocks drainage;
- filling existing tidal channels (where circulation patterns are detrimental to vegetation restoration);
- stabilizing existing breaches;
- stabilizing of upland dikes or internal berms;

- microtopographic modifications;
- planting of Spartina species (seeding or plugging) or other desirable marsh vegetation on portions of the restoration sites;
- planting of upland edges to control re-invasion of Phragmites by rhizomes;
- elevation reduction;
- mechanical source control (including mowing) of Phragmites;
- biological control of Phragmites areas;
- soil nutrient modifications/soil chemistry adjustment of Phragmites areas; and
- control of Phragmites by the application of Rodeo® with a surfactant in both previously treated and non-treated areas only after ruling out all other intervention strategies listed above. The application of Rodeo® with a surfactant shall be limited to spot applications that are not to cover more than one third of the vegetative marsh plain on an annual basis.

Together, these biological and mechanical response activities offer alternatives that will provide effective means for corrective action should any active intervention be necessary under the decision making process. In the event that the Department determines that a repetitive application of Rodeo® with a surfactant is the only available method for Phragmites control, PSE&G may be required to eliminate the "failed" acreage from the program and to provide other wetland or upland acreage to meet the NJPDES permit requirements.

Compliance with Interim Vegetative Criteria and Final Success Criteria in Management Plans for Dennis, MRT, Commercial, Alloways, Cohansey and Delaware Sites

As detailed in Figure 8 , the Adaptive Management Process (which is included in the Management Plans for all the sites) contains interim vegetative criteria and final success criteria. Based on this interim vegetative and final success criteria, the compliance dates for the wetland restoration sites are as follows:

	Completion of Restoration Implementation Action	Interim Vegetative Criteria	Final Success Criteria
MRT	March 1998	March 2007	March 2012
Dennis	October 1996	October 2005	October 2010
Commercial	November 1997	November 2006	November 2011
Alloways	September 1999	September 2006	September 2012
Cohansey	September 1999	September 2006	September 2012
The Rocks	June 2000	June 2007	June 2013
Cedar Swamp	June 2000	June 2007	June 2013

Compliance with the interim and final success criteria is determined by the Department's review of aerial photography. At the time of this proposed permit issuance, the permittee is in compliance with the approximate 9% coverage of Spartina and other desirable marsh vegetation per year. The percent coverage by desirable vegetation at all the wetland restoration sites is included as Table 2.

Herbicide Use with Respect to NJ Phragmites-Dominated Sites

The ultimate goal of the wetlands restoration program is to restore Phragmites-dominated wetlands to Spartina wetlands to enhance fish productivity. For various reasons, Phragmites eradication is generally looked upon favorably by natural resource agencies such as the Department.

Natural resource agencies with years of experience in the Phragmites battle have come to regard the application of the herbicide, glyphosate (a component of Rodeo®), as one of the most effective means to eradicate Phragmites. Glyphosate is registered by the United States Environmental Protection Agency for use in an aquatic environment. After a careful and comprehensive review, the Department settled on an approach which uses glyphosate application followed by a prescribed burn of the sprayed area. While the Department approved a follow-up application of glyphosate, it is not intended to be a program of open-ended, perpetual herbicide application. The Department continues to encourage minimization of the use of glyphosate on the wetland restoration sites. Once the proper hydrological regime is established in an affected area, the Department's goal is for native wetland vegetation such as Spartina alterniflora to outcompete Phragmites.

Stranding of Horseshoe Crabs at MRT

The Department acknowledges that prior to completion of PSE&G's Restoration activities at MRT in the spring of 1998, large numbers of horseshoe crabs (*Limulus polyphemus*) were observed stranded on the unvegetated marsh plain. Historically, when the perimeter dikes were in place and salt hay farming was practiced at the site, horseshoe crabs would have been unable to enter the site. After farming activities ceased and prior to ownership of the property by PSE&G, breaches in the dikes had developed during the winter of 1992/1993, due to severe storms and natural erosion. Horseshoe crabs were then able to directly access the site from the Bay. As erosion continued to enlarge the natural breaches, the marsh plain began to drain on low tides. These breaches caused high velocity flood tide currents which carried horseshoe crabs onto the unvegetated marsh plain where they appeared to become disoriented. The lack of tidal channels typical of those present in a natural salt marsh appeared to hinder the crabs from migrating out of the marsh. Thus, horseshoe crabs had been stranded on the marsh plain in 1996 and 1997.

This situation was substantially improved by PSE&G through modifications to drainage at the site which took place after the 1996 and 1997 horseshoe crab spawning seasons, including the addition of new tidal channels and the widening and deepening of existing channels. During the 1998 horseshoe crab spawning season as well as the 1999 and 2000 seasons, there were no more dead or stranded horseshoe crabs at the MRT site than the Department found anywhere else in the State. As revegetation of the MRT site continues to progress, the number of horseshoe crabs which traverse the creek banks on to the marsh plain should be further diminished.

Department representatives, including a representative from the Endangered and Non-Game Species Program, have reviewed the study entitled "Potential Effects of Diked Salt Hay Farm Restoration on Horseshoe Crabs" (conducted by Dr. Robert Loveland of Rutgers University and

Dr. Mark Botton of Fordham University). One of the objectives of this study was to quantify the abundance and distribution of adult horseshoe crabs and the survival of horseshoe crab eggs at this site. This study also assessed the potential effects of the restoration of diked salt hay farms on horseshoe crabs. The Department did not find any deficiencies regarding this study.

Department's Determination Regarding Wetland Restoration Efforts and Oversight and Proposed Permit Conditions

The Department has determined that at the present time, the requirements pertaining to land acquisition and development have been met. The Department has determined that the following acreage is currently creditable towards the permit requirements:

Site	Total Acreage	Total Acreage Creditable Towards Permit
Alloways: Wetlands	2813	2813
Alloways: Upland Buffer	220	73.33
Cohansey: Wetlands	910	455
Cohansey: Upland Buffer	145	48.33
Dennis: Wetlands	369	369
Dennis: Upland Buffer	15	5
MRT: Wetlands	1135	1135
MRT: Upland Buffer	108	36
Commercial: Wetlands	2894	2894
Commercial: Upland Buffer	339	123
Bayside Tract: Wetlands	2585	0
Bayside Tract: Upland Buffer	1822	607.33
The Rocks and **Cedar Swamp**	2599	2000
Other Delaware Sites	1739	0
TOTAL	17,693 acres	10,559 acres

Other Lands Within Site Boundaries	1374
Other DNREC Lands	1452
	20,520 acres

The Cohansey site was dominated by 45% Phragmites prior to the onset of restoration activities, the Department has credited the wetlands acreage at this site at a 2:1 ratio.

The Department is hereby requiring the permittee to continue in its wetland restoration efforts as dictated in the Management Plans for each site.

The input of the MPAC scientists and advisors, as well as members of the public, is integral to the restoration of the marshes that are part of the Estuary Enhancement Program. It is imperative that an active, continuing dialogue is maintained to ensure this success. However, the restoration implementation actions have been completed at all the sites above. As a result, the Department has determined that it is appropriate and beneficial to merge the Management Plan Advisory Committee (MPAC) and the Monitoring Advisory Committee (MAC) under one oversight committee, namely the "Estuary Enhancement Program Oversight Committee" (EEPOC) at this time. This will result in a multi-disciplinary committee with expertise in both wetland restoration and aquatic resources. Upon finalization of this renewal permit, the permittee shall develop a charter for the EEPOC and re-designate select MPAC and MAC members as part of the EEPOC.

In sum, the proposed permit conditions relating to wetland restoration efforts are as follows:

(1) The permittee shall continue to implement the Estuary Enhancement Program sites as dictated in the Management Plans. In order to comply with the 10,000 acreage requirement, the Department may require the permittee to acquire additional lands to serve as "replacement acreage" for any acreage deemed "failed" by the Department.

(2) The permittee shall establish an Estuary Enhancement Oversight Committee (EEPOC) to provide technical advice to the permittee concerning the implementation of the Management Plans and concerning the Biological Monitoring Program (as described later under **Special Condition 6**). The EEPOC shall consist of representatives from at least three agencies having jurisdiction over wetland restoration activities (a minimum of one representative from each agency); a minimum of two scientists with appropriate wetlands expertise; a minimum of three scientists with appropriate expertise in aquatic resources; and representatives from Cape May, Cumberland and Salem Counties. The Department shall designate two representatives from its Division of Fish and Wildlife as well as a representative from its Mosquito Control Commission. The EEPOC shall meet at least twice per year where at least one meeting shall include a tour of some or all of the wetland restoration sites. All materials presented at any EEPOC meetings shall be distributed to EEPOC members at least one week in advance of any meeting. Upon finalization of this permit, all references to the "MPAC" and "MAC" in any documentation required under the July 20, 1994 permit or incorporated therein by reference shall be interpreted to mean "EEPOC".

These proposed permit conditions are included in Part IV.

Special Condition 4: Implement a program for the elimination of impediments to fish migration through the installation of fish ladders at up to five sites in tributaries of the Delaware Estuary in consultation with the Department.

Original Technical Justification for Special Condition 4: River herring (e.g. alewife, blueback herring, american shad) serve as forage for a variety of important commercial and recreational species (e.g. bluefish, white perch, weakfish, and striped bass). River herring are an anadromous

species that return to their natal tributaries to spawn. The adults return downstream to the bay after spawning and the eggs develop into juveniles who remain behind to use the freshwater stream or impoundment as a nursery area. In the fall of the first year of their lives, the young migrate to the estuary.

Many of the tributary streams and rivers utilized by river herring for spawning along the Atlantic Coast of the United States have been dammed or otherwise blocked for industrial, irrigation, recreational, or flood control purposes. The Department determined that the implementation of this measure would provide long-term benefits to the Estuary fisheries through increased river herring production, increased available forage for important commercial and recreational species (including certain of the Target Species at issue), and increased commercial and recreational fishing opportunities in the tributary streams to the Delaware River.

Compliance with Special Condition 4

The July 20, 1994 permit requires PSE&G to construct and maintain five fish ladders on Delaware River tributaries to restore spawning runs of two species of river herring, namely alewife and blueback herring. To fund engineering designs as well as the construction and maintenance of the fish ladders, PSE&G was required to establish an escrow account in the amount of $500,000. The Permit included a compliance schedule for each of the component steps in ladder design and construction. The Permit also required PSE&G to conduct operational and maintenance activities during the term of the Permit and during any period of time that the Permit is extended. Finally, as described later under **Compliance with Special Condition 6**, the permit required PSE&G to submit a Biological Monitoring Program Work Plan (BMPWP) which describes the monitoring program developed to document (1) adult utilization of the ladders, (2) subsequent spawning in upstream waters, and (3) development of spawned river herring to the juvenile life stage.

PSE&G identified impoundments suitable for the installation of fish ladders in several phases, beginning with identifying potential sites based on size as well as feasibility of installation. The next phase involved evaluating candidate sites for their suitability for supporting river herring production. Initially, this evaluation focused on New Jersey sites, but was later expanded, after the Settlement Agreement with Delaware, to include candidate sites identified by DNREC. As part of PSE&G's settlement with DNREC, it was agreed that after completion of the construction of the ladders in Delaware, DNREC would manage and maintain the ladders. PSE&G would have access to the sites and be responsible for performing biological monitoring in accordance with its permit.

On the basis of available literature and a survey of natural resources management agencies, including NJDEP Division of Fish, Game and Wildlife (Bureau of Marine Fisheries) and USFWS, the steeppass ladder design was selected by PSE&G as the appropriate and preferred fishway design for installation at all of the PSE&G sites.

As required by the Permit, engineering feasibility studies were then conducted for the preferred sites identified from the field studies and the suitability analysis. Engineering feasibility study and design focused on the selection of ladder materials, installation details, site modifications and dam safety issues. All ladder designs were developed with review and input from USFWS personnel.

This process led to the selection of eight locations for the installation of ladders. To date, eight fish ladders have been installed: Sunset Lake, NJ; McGinnis Pond, DE; McColley's Pond, DE; Silver Lake, DE; Coursey's Pond, DE; Cooper River, NJ; Garrisons Lake, DE and Moores Lake, DE (refer to G Figure 1 for locations). In addition, PSE&G has assisted USFWS in the installation of fish ladders at two more sites in NJ, namely Wallworth Lake and Evans Pond.

To obtain maximum ecological benefits from the restoration of river herring runs, it is important that the ladders be properly operated and maintained. Operation and maintenance manuals have been developed for the fish ladders installed. Operation and maintenance has been performed by PSE&G at each of the ladders that has become operational as required by the July 20, 1994 permit. Inspections and maintenance are performed during biological monitoring studies.

During the spring 1998 spawning run, a stocking program was initiated to enhance the movement of adult river herring into the impoundments. The goal of the program was to achieve a total movement of at least five adult river herring per acre into each impoundment. In this way, stocking served to supplement the numbers of fish passing up the ladders voluntarily.

The Permit required that PSE&G monitor the fish ladders for adult river herring passage, as well as monitor the impoundments for the presence of eggs, larvae, and juvenile river herring. Components of the BMPWP require that the larval, juvenile, and adult river herring use of these sites be monitored. PSE&G's BMPWP was reviewed and approved by both the Monitoring Advisory Committee (MAC) and the Department. Four elements are important in the restoration process: 1) mature adults use the fish ladder to gain access to the pond; 2) spawning in the pond environment; 3) successful hatching, larval development and juvenile growth; and 4) successful emigration from the pond by juveniles. As discussed earlier, the requisite operations and maintenance activities as contemplated in the Operations and Maintenance manuals are implemented in conjunction with these monitoring activities. A summary of the biological monitoring program for the fish ladders, which indicates the number of fish that have voluntarily passed up the ladders, is included as Tables 3A and 3B.

Biological monitoring to document use of the installed fish ladders and upstream impoundments by blueback herring and alewife was performed as a component of the Biological Monitoring Program (as discussed later under **Special Condition 6**). From 1996 to 1999, the fish ladder monitoring program included monitoring of adult usage of the fish ladders during the spring spawning run; egg and larval herring sampling during the late spring / early summer; and sampling during fall to assess the abundance, size and condition of juvenile herring in the impoundments. Monitoring of adult fish passage was conducted three times per week beginning when water temperatures first reach 12 degrees Celsius and ending when water temperatures first reach 21 degrees Celsius. Larval fish sampling in 3 to 5 areas of each impoundment was

conducted two times a month during the upstream migration period. Juvenile sampling was conducted at 3 to 5 locations in each impoundment monthly from September through November.

In summary, PSEG has fully complied with the Permit Condition requiring installation of five fish ladders and other associated fish ladder requirements. By completing installation of eight ladders, it has exceeded the amount of fish ladders required by the permit. In addition, PSEG has complied with the requirement to perform abundance monitoring for ichthyoplankton and juvenile blueback herring in connection with the fish ladder sites. The Department has reviewed the Operations and Maintenance Manuals and has determined that they are comprehensive and hence acceptable.

Proposed Permit Condition Regarding Fish Ladders

By proposing the following conditions, the Department is hereby requiring PSEG to continue in its efforts to ensure that the ladders are utilized by river herring and also appropriately operated and maintained:

(1) The permittee has installed eight fish ladders in accordance with the conditions of the July 20, 1994 permit. The permittee shall operate and maintain these eight fish ladders in accordance with the developed Operations and Maintenance Manuals. Routine maintenance and inspections shall be performed to ensure that the ladders are operating as designed. Inspection reports prepared as part of routine Operations and Maintenance shall be made available to the Department upon request.

(2) The permittee shall continue to perform monitoring for adult and juvenile passage in connection with the fish ladder sites where the monitoring results shall be included in the annual biological monitoring program.

(3) The permittee shall continue to stock any impoundments until such time as the adults using the ladder meets the minimum number of adults calculated per acre for the minimum number of juveniles (1005 /acre).

These proposed permit conditions are included in Part IV.

Special Condition 5: Conduct a study to evaluate the feasibility of using sound to divert fish away from the CWS intake.

Original Technical Justification for Special Condition 5: Successful diversion of fish from the area of the CWS intake would reduce the number of fish impinged onto the intake screen thereby reducing Salem-related losses. Laboratory tests, field tests and even in-situ applications have indicated some success in diverting certain fish species from specific areas, including cooling water intake structures, through the use of sound generating devices, such as underwater speakers or sound projectors. Unlike poppers and hammers, these devices are capable of varying the frequency and producing sounds heard by fish. This condition is a component of the July 20, 1994 BTA determination.

Compliance with Special Condition 5

The Permit required PSE&G to submit (for NJDEP's approval) a Plan of Study ("POS") for assessing the feasibility of deterring fish from the area of the intake using underwater speakers or sound projectors; implement the POS in accordance with the schedule approved by the Department; and file a report of the results on or before March 4, 1999. The Permit also required that the POS provide for an assessment of the potential for detrimental effects of sound deterrent systems on fish species in the Estuary.

The 1994 POS was submitted to and approved by the Department. Sound deterrent feasibility studies were conducted using the nine Salem finfish RIS, namely, weakfish, bay anchovy, white perch, Atlantic croaker, spot, striped bass, alewife, American shad and blueback herring. Two series of cage tests were performed in 1994 to identify sounds that would potentially be effective in repelling fish from the intake during subsequent in-situ tests. The cage tests involved exposing fish to a wide range of sounds that varied in frequency, waveform, sound pressure level ("SPL"), and pulse width and interval duration.

The POS provided that cage tests would be followed by in situ tests at the intake. Because Salem was not operating at full power in 1996 and 1997, the sound feasibility study, including the in situ testing, was not completed until 1998.

PSE&G obtained the assistance of Dr. Arthur N. Popper, an expert on fish hearing, in designing the tests conducted in 1998. PSE&G implemented in 1998 a revised Plan of Study (approved by the Department) for additional cage testing in 1998. Following the conclusions of the 1998 cage tests, in situ testing was conducted at the Salem intake in the summer and fall. PSE&G also performed studies to assess whether the sounds used at the Salem intake during in situ testing could have adverse effects on fish behavior.

In sum, PSEG has complied with the Special Condition pertaining to the conduct of sound deterrent studies.

Department's Contractor Review regarding Sound Deterrent Studies

ESSA reviewed the sections in the March 4, 1999 application which detail the sound studies described above, namely Attachment G-7 "Feasibility Study on the Use of Sound to Deter Fish from the Vicinity of the Salem Generating Station Circulating Water Intake Structure" including support Exhibit G-7-1 "Study Chronology"; Exhibit G-7-2 "Report on 1994 Cage Tests"; Exhibit G-7-3 "Report on 1998 Supplemental Cage Tests"; Exhibit G-7-4 "Report on Sound Field Mapping"; and Exhibit G-7-5 "Report on 1998 In Situ Tests". ESSA was contracted to review these sections to determine if the use of sound would reduce impingement losses at the cooling water intake structure by reviewing available data and statistics. In its report, ESSA provided a brief technical description of the sound deterrent studies performed, as well as comments and concerns on each of the tests. A brief overview of this information is included below. However, for more information concerning ESSA's concerns and conclusions, please refer to the ESSA Report included as Attachment A.

ESSA's Description of 1994 Cage Tests

Feasibility Studies - The objective was to identify those sounds that could potentially be effective in repelling fish from the CWS during subsequent in-situ tests. The 1994 cage tests involved a sound system and a testing platform. Sounds were tested using two waveforms: pseudo-random noise and FM chirps (100 Hz to 145 KHz). Nine RIS were tested over the September to November period.

ESSA's Concerns with Test Protocol of 1994 Cage Tests

- given the size of the cage facility, fish may have been stressed in this small enclosure (3 feet x 3 feet x 12 feet)
- the acclimation period for fish prior to testing (i.e. 2-3 days) probably should have been longer.
- the number of individuals per test (between 20 and 30) was adequate, but perhaps a few tests should have been conducted for larger numbers of fish (50-100).
- the design does not include investigating any far-field effects (i.e. responses beyond 4 m)
- duration periods (10-15 minutes) were not long enough given the time period allowed for in-situ tests.

ESSA's Conclusions of 1994 Cage Test Results

In its June 14, 2000 report, ESSA cites PSE&G's summary as follows: "The Alosa species was the only test group that showed a consistent avoidance response to a specific acoustic signal. Weakfish, Atlantic Croaker, and bay anchovy showed some promising results to at least one one-half octave band, but the responses were quite variable. Spot, striped bass, and white perch exhibited weak or no responses. These preliminary results with Alosids (in response to ultrasound) are very encouraging but the avoidance response was not consistent among other species tested." ESSA concurs with PSE&G's review and analysis of the shortcomings and/or limitations of the 1994 cage tests with regard to limiting the number of sounds tested; the need for more replication; and the need for more quantitative analysis. However, ESSA concludes that the decision to make data more quantitative by reducing the size of the cage facility may have itself been a limitation.

ESSA's Description of 1998 Cage Tests

Overall, the experimental approach in 1998 was similar to that in 1994, although there were significant changes in the way the experiments were conducted. These changes included testing fewer fish species (bay anchovy, weakfish and Atlantic croaker), the use of fewer sounds, more replication, and the use of quantitative analysis versus qualitative. The goal of testing new sounds was to try to elicit stronger and more consistent responses than what was observed in the 1994 tests. These tests were conducted during July.

ESSA's Concerns with Test Protocol of 1998 Cage Tests

- the size of the cage facility area was further reduced from 1994 to a channel of 1.3 feet x 2 feet x 11 feet - again size may have constrained movement by stressing the fish in restricting schooling behavior.
- again, the acclimation period (i.e. 2-3 days) probably should have been longer.
- the design does not include investigating any far-field effects (i.e. responses beyond 4 m) only one type of signal for each test (e.g. low frequency) rather than different types of simultaneously transmitted sound (e.g. low and ultra-sound transmitted simultaneously from different projectors).

Description of In-Situ Tests

These tests were conducted at the cooling water structure (CWS). Two sounds were used, one for non-Alosa species (low frequency) and the other for the Alosa species (ultrasound). The ultrasonic and low frequency signals were transmitted independently. This evaluation was conducted during the summer (July 16 - August 23) and in the fall (October 20 - December 2). Evaluation consisted of monitoring fish impinged using a randomized design of 6 hour testing (3-hour sound on, and 3 hour control or sound off).

ESSA's Concerns with Test Protocol for In-Situ Tests

- The justification for conducting the "in-situ" tests is unclear since there were no consistent avoidance responses for several RIS species based on the cage test results.

- the in-situ test results were mixed, showing both reduced and enhanced impingement. In many of the comparisons of control and experimental data sets, sample size was inconsistent among species and may have played a role in the inconsistency of the results. This influences the relative importance of many of the statistical tests since in many instances, although the number of replicates may have been high, there were very small numbers of fish.

ESSA questions - Based on the In-Situ Study, does sound reduce impingement?

Using the in-situ raw count sound data, ESSA performed a calculation of the number of fish impinged for both control and experimental sound tests over the 3 in-situ testing periods for all 11 species, 8 of which are RIS. Based on this data, ESSA concludes that "...sound is not very effective in reducing TOTAL FISH IMPINGEMENT at Salem Generating Station. However, there is evidence based on the 1994 cage tests (and in the literature) that some sounds (e.g. FM chirp, with a center frequency of 121.8 KHz) show promise for deterring alosid species."

ESSA cautions that there are many examples of statistical reductions for the in-situ tests described in Attachment G-2; however, the results are inconsistent. Furthermore, there seems to be a focus on the statistical significance of results rather than the percent reductions. ESSA suggests that consideration of a fish exclusion system should have an effectiveness approach of 70% exclusion for some key target species.

ESSA's Recommendations for Improvements to any Future In-Situ Sound Studies

ESSA identifies the following problems with the sound studies and suggests ideas as to how to rectify these problems in any future studies:

- The duration of the testing period should be expanded to at least 12 hours to increase the opportunity for encountering large groups of fish.

- The question of fish residency in the forebay prior to being collected on the screens needs to be addressed. If residence occurs, counts for specific species such as bay anchovy could be seriously influenced. A longer time period for conducting these tests would minimize the impact of this error.

- The permit application contains no assessment of fish behavioral responses to sound signals in front of the intake. Reliable information about potential far-field attraction behavior, or potential acclimation must be obtained before a permanent system can be installed "In-situ" tests of at least 12 hours in duration, rather than 3, would provide a much clearer idea about the potential for acclimation to sound by fish.

Department's Determination Regarding Sound Deterrent Studies and Proposed Permit Conditions

The Department acknowledges PSEG's comprehensive efforts in its study of sound deterrents, specifically the 1994 and 1998 Cage Tests; the literature review; the 1998 In-Situ Tests and the Sound Larval Data study. Likewise, ESSA states "For the required study of the effects of sound as a fish deterrent, the investigators did a thorough job in data collection and analysis. It is indeed one of the most comprehensive data collections on sound and fish response to date." ESSA continues with "Considerable inconsistency in results occurred between 1994 and 1998. After examining all the data, we cannot recommend sound as a single deterrent system for excluding all RIS species at Salem GS. There was simply not enough impingement reduction demonstrated." However, on page 32 ESSA states "The 1994 results were positive on the issue of ultrasound for repelling alosids at Salem GS. This is also consistent with the literature for alosid species in other locations - e.g. alewife, blueback herring and American shad (Dunning et al. 1992, Nesler et al. 1992, Ross et al 1993, Ross et al. 1996)."

Based on the review of sound studies detailed above, the Department is hereby proposing the following Permit Conditions to further study sound as part of a hybrid intake protection technology:

(1) Further study of sound deterrents shall be pursued as part of a hybrid system as discussed later under **Compliance with Special Condition 11**. The concerns and limitations documented by ESSA in its report for the 1994 Cage Tests; 1998 Cage Tests; and the in-situ tests shall be considered in the development of any Plan of Study.

(2) Far field attraction behavior or potential acclimation shall also be studied for any hybrid intake protection technology that includes the use of sound. The concerns raised by ESSA for the larval sound studies shall be considered.

The study of alternate intake protection technologies is discussed in further detail under the section entitled "Department's Determination regarding Cost/Benefit Analysis and Alternate Intake Protection Technologies" later in this Fact Sheet. The due dates for these required studies are specified in Part IV.

Special Condition 6: Conduct a Department approved **biological monitoring program** for the Estuary which shall include:
- comprehensive thermal monitoring and performance of a biothermal assessment on the RIS
- bay-wide abundance monitoring
- impingement and entrainment monitoring

- abundance monitoring for ichthyoplankton and juvenile blueback herring and alewife in connection with fish ladder sites
- detrital production monitoring
- residual pesticide release monitoring (in salt hay impoundments)
- other special monitoring studies including effects of sound deterrents as may be required by the Department.

In addition, the permittee was required establish a **Monitoring Advisory Committee** (MAC) to serve as a body to provide technical advice to the permittee concerning the design, implementation, modifications and interpretation of the Biological Monitoring Program. The MAC shall consist of representatives from at least three agencies that have expertise in the aquatic resources of the Delaware Estuary as well as at least three independent scientists having similar experience. The Department shall designate representatives from its Division of Fish, Game and Wildlife and its Mosquito Control Commission. The MAC shall be chaired by the permittee's representative.

Original Technical Justification for Special Condition 6: Long-term abundance data will provide information as to population status of various aquatic species compared to past levels; information on the factors that may cause changes in their populations over time; and provide a basis for better understanding the interactions and relationships between the species so as to apply this knowledge in making prudent resource management decisions. The program will be conducted pursuant to a Department approved work plan which will contain a schedule for reporting the monitoring results.

Compliance with Special Condition 6: Biological Monitoring

PSE&G developed and implemented a biological monitoring program for the Estuary as required by the Permit. The MAC was created in accordance with this Permit requirement. The MAC membership currently includes representatives of PSEG, NJDEP, DNREC, USFWS, NMFS and DELEP, as well as four independent scientists – Edward Houde, Ph.D. of the University of Maryland – Chesapeake Biological Laboratory Center for Environmental and Estuarine Studies; Ronald T. Kneib, Ph.D., of the University of Georgia - Marine Institute; Nancy Rabalais, Ph.D., of Louisiana University Marine Consortium, Rick Deriso, Ph.D., of Scripps Oceanic Institute and Joseph Miller, formerly with USFWS. With MAC's input and approval, PSE&G developed a Biological Monitoring Work Plan ("BMPWP") which was approved by the Department.

To comply with the biological monitoring program condition PSE&G performed a number of studies. The data from each year's monitoring are summarized and discussed in annual progress reports submitted to the Department by June 30 of the following year. A brief description of each study as well as its objective is included below. Following the descriptions, are an explanation of the Department's determination regarding these studies as well as any permit conditions that are proposed in this renewal permit.

Biological Monitoring: Fisheries Issues

Thermal Monitoring and Biothermal Assessment for Representative Important Species

A thermal monitoring program has been conducted to collect temperature and hydrodynamic data required as input to mathematical models to characterize the thermal plume in both the near-field and far-field. In addition, the permittee has completed a biothermal assessment. A summary of these studies as well as the Department's determination regarding these studies is further described under Section 316(a).

Entrainment Abundance Monitoring

The objective of entrainment abundance monitoring is to estimate the number and size distribution of ichthyoplankton entrained. Sampling was conducted six times over 24-hours three days per week from April through September, conditions permitting; and one day per week from October through March, conditions permitting, during 1997 and 1998. In 1995 and 1996, samples were collected one day per week, conditions permitting, throughout the year. For all years of sampling, all specimens collected were identified to the lowest practical taxon and life stage, and counted. In addition, total length was measured to the nearest millimeter for a representative subsample of each target species and life stage per sample.

Impingement Abundance Monitoring

The objective of impingement abundance monitoring is to estimate the number and size distribution of target species impinged. Based on the annual Biological Monitoring Program Reports, impingement samples were collected ten times over 24 hours one day per week, conditions permitting, during 1995 and 1996. During 1997 and 1998, impingement sampling was conducted three days per week. Samples were collected by diversion of screen wash water into an impingement sampling pool. During all years, all fish collected were sorted by species and counted, and the condition (live, dead, or damaged) of each specimen was recorded. The length of each specimen was measured for a subset of each target species along with the total weight for all specimens of each species. In addition, information on station operation, sampling information, salinity and environmental conditions was recorded.

The data from each year's impingement and entrainment monitoring activities is summarized and discussed in annual progress reports that are submitted to the Department by June 30 of the following year.

Department's Determination and Contractor Review Regarding Entrainment and Impingement Abundance Monitoring

ESSA conducted a complete review of entrainment and impingement sampling where a summary of this review, as well as an explanation of the importance of this sampling with regard to subsequent analysis, is included later as item X.3 in the section entitled "Special Studies Proposed in this Renewal Permit". To address ESSA's concerns regarding entrainment and

impingement, the Department is requiring additional studies relating to entrainment and impingement which are described further in this same section.

Likewise, based on ESSA's concerns, the Department is also recommending increased entrainment and impingement abundance monitoring. Because the frequency of entrainment and impingement abundance sampling is specified in the Biological Monitoring Program, which shall be approved by both the Estuary Enhancement Program Oversight Committee (EEPOC) and the Department, this increased sampling frequency shall be set forth in a revised Biological Monitoring Program.

Proposed Permit Condition Regarding Entrainment and Impingement Abundance Monitoring

Entrainment Abundance Monitoring - until such time as an improved entrainment sampling plan is developed, approved, and implemented as part of a Biological Monitoring Program, the permittee shall continue to conduct entrainment sampling during normal Station operations at a minimum frequency of three days per week, from April – September and once per week from October through March, weather conditions permitting. During normal operations, nighttime sampling shall be included and a minimum of six abundance samples shall be collected per sampling day, weather conditions permitting.

Impingement Abundance Monitoring - until such time as an improved impingement sampling plan is developed, approved, and implemented as part of a Biological Monitoring Program, the permittee shall continue to conduct impingement sampling during normal Station operations at a minimum frequency of three times per week, weather conditions permitting. During normal operations, nighttime sampling shall be included and a minimum of ten samples shall be collected per sampling day, weather conditions permitting.

The results of all entrainment and impingment abundance monitoring shall be reported annually in the Biological Monitoring Program.

Elimination of Impediments to Fish Migration

Biological monitoring to document the use of the installed fish ladders and upstream impoundments was performed as a component of the Biological Monitoring Work Plan. This data, as well as the Department's determination regarding this data, is described previously in **Compliance with Special Condition 4**.

Bay-Wide Abundance Monitoring

To comply with this permit condition, the permittee conducted two studies, namely the PSE&G Bay-wide Bottom Trawl Survey and the PSE&G Baywide Beach Seine Survey. These studies focused on nine target species including: weakfish (*Cynoscion regalis*), bay anchovy (*Anchoa mitchilli*), white perch *(Morone americana*), sriped bass (*M. saxatilis*), spot (*Leiostomus xanthurus*), Atlantic croaker (*Micropogonias undulatus*), American shad (*Alosa sapidissima*), blueback herring (*A. aestivalis*), and alewife (*A. pseudoharengus).*

The on-going **PSE&G Bay-wide Bottom Trawl Survey** is conducted to compliment the long-term program conducted by DNREC. The objective of the PSE&G Baywide Bottom Trawl is to determine relative species abundance and distribution of juvenile and small adult fish populations in the Delaware Estuary. Bay-wide bottom trawl sampling is conducted during daylight hours with a 4.9 meter otter trawl. In 1995 and 1997 sampling was conducted once per month from April through October. In 1996 and 1998 sampling was conducted once in April and twice per month during May through October for a total of 13 sampling events. Daylight is defined as the period one hour after sunrise to one hour before sunset. A total of 40 samples are collected from eight river zones ranging from the mouth of the bay to the Delaware Memorial Bridge. Sampling stations within each zone are randomly selected. Stations are allocated among the zones proportional to the size and historical catch of the zones.

The **PSE&G Bay-wide Beach Seine Program** is designed to provide data on the distribution and abundance of fish populations in the shore zone of the lower Delaware Estuary. This program compliments the long-term NJDEP Beach Seine Program by providing data on a time frame and geographical scope unavailable under the NJDEP Beach Seine Program. The on-going PSE&G Bay-wide Beach Seine Program is conducted from August through October. The perimeter of the low Delaware River and Delaware Bay is divided into 32 equal-length regions. Each region is further partitioned into 0.1-nautical mile segments. One station per region is randomly selected from each of the 32 regions. Eight additional samples are collected from Bay front locations adjacent to PSE&G marsh restoration sites. The gear has been 100 by 6 foot bagged haul seine with a 3/8 inch nylon mesh, identical to the gear employed by NJDEP. The seine was set by boat from the shore and pulled in the direction of the prevailing tide, wind and surf as conditions required to result in the best deployment of the gear. Water quality parameters, including water temperature, salinity, dissolved oxygen and water clarity were measured in near surface waters at each seine sampling station.

Department's Determination Regarding Compliance with Bay-wide Abundance Monitoring

The broad issue of fisheries monitoring data is an integral part of the Section 316(b) Determination. The Department's contractor, ESSA, has conducted a comprehensive review of the Section 316(b) Determination and hence the fisheries data. A summary of ESSA's review is included in the Section 316(b) Determination which is discussed later in this fact sheet.

Although the permittee has complied with the bay-wide monitoring requirements set forth in the Biological Monitoring Program, the Department has determined that improved biological monitoring is needed to further enhance the general understanding of the fish populations in the Delaware Estuary. As a result, the Department is hereby requiring that an improved biological monitoring program be developed for the EEPOC's consideration and the Department's approval as a condition of this NJPDES permit. This is further discussed at the end of this section.

Department's Determination Regarding the need for Review and Discussion as to the Appropriateness of the Representative Important Species

Given that populations of representative important species are subject to many changing factors over time, the Department is hereby requiring the permittee to include a discussion as to the appropriateness of the representative important species (RIS) in its improved biological monitoring program for the purposes of Section 316(a) and Section 316(b) of the Clean Water Act. Consideration should be given to the appropriateness of the existing RIS as well as the possible inclusion of atlantic silverside and atlantic menhaden. The inclusion of these two species has been suggested in several Monitoring Advisory Committee (MAC) meetings by several MAC members.

Detrital Production Monitoring

The objective of the detrital production monitoring is to determine the vegetation structure, productivity, and detrital production of restored marshes as compared to the reference marshes. Data from this monitoring are primarily used to assess the basic vegetation structure and productivity of natural estuarine marshes that are being achieved through restoration at the degraded marsh sites. The data have also been used to determine the contribution of the restored marsh to estuarine food webs and the capacity to support fish production.

Detrital production at the wetland restoration sites has been monitored using a combination of aerial photography and field sampling methodologies. Aerial photography has been conducted annually at all restoration sites to map changes in the vegetative communities associated with the restoration process. Quantitative field sampling has also been conducted on four representative restored wetland sites (two formerly diked salt hay farm sites and two Phragmites-dominated sites) and two reference sites to assess changes in community abundance and composition for vascular plants as well as benthic and epiphytic algae.

Sampling has been conducted during the peak growing season, in quadrates located along fixed transects at each study site. This sampling consists of percent cover, vegetation height, and calculation of aboveground biomass for the vascular plants; and biomass and productivity of the benthic and epiphytic algae.

Benthic algae sampling has been conducted during alternate years once during the peak growing season along fixed transects at each study site.

Department's Determination Regarding Compliance with Biological Monitoring Program: Detrital Production Monitoring

Ongoing detrital production monitoring and quantitative detrital production field sampling is still necessary. Although not a specific requirement of this renewal permit, the Department encourages any increases in sampling frequencies and/or locations with regard to this monitoring. This requirement is therefore retained in this renewal permit.

Because the study objectives of the epiphytic and benthic algal monitoring has been fulfilled, the Department is not requiring further continuation of this monitoring.

Residual Pesticide Release Monitoring

The objective of residual pesticide monitoring was to assess the potential for release of residual pesticides from restored marshes at the salt hay farms. Data from this program were used to address the issue of potential offsite transport of residual pesticides and any associated ecological risk. Composite sampling of the water and suspended sediments has been conducted in the three representative salt hay impoundment wetland restoration sites following dike breaching and again at approximately two, four, and eight weeks subsequent to the first dike breaching.

Department's Determination Regarding Residual Pesticide Release Monitoring

Because the dikes have already been breached at the salt hay farm wetland restoration sites, this requirement is no longer necessary for the existing salt hay farm wetland restoration sites. However, in the event that replacement acreage is deemed necessary, this requirement will be retained for any diked salt hay farm sites that may be used in the future as replacement acreage.

Fish Utilization of Restored Wetlands

The objective of the fish habitat utilization monitoring was to document the seasonal abundance and community composition of fishes using the restored marshes. This monitoring was conducted on four restoration sites (two formerly diked salt hay farm sites and two Phragmites dominated sites) and two reference marsh sites. The results were used to compare abundance indices and community descriptors of the fishes sampled within restored and reference marshes in different salinity regimes (as indicators of the progress of the restoration program); and to examine the length and weight relationships for the fish RIS collected in each marsh and near shore bay sample (as indicators of the quality of the habitat in each area). These analyses have then been used to address two issues: (1) whether restored marshes provide additional critical habitat for valued species; and (2) how closely species distributions and abundances in restored marshes match those of reference marshes. Thus, these data illustrate the success of marsh restoration relative to reference marshes.

The study was conducted from April through November in 1996, 1997, 1998 and 1999. Reference sites and their associated tidal creeks were selected based upon their similarity to the restored sites in terms of area, salinity regime, and other physical parameters.

Department's Determination Regarding Compliance with Fish Utilization of Restored Wetlands

The premise of the wetland restoration efforts is to support production of the species at issue at Salem by increasing their production through detrital production. Understanding the fish utilization of wetlands is therefore important. Because all the wetland restoration sites have not yet met the final success criteria, these sites are continuing to evolve. This requirement is therefore retained in this renewal permit to continue an understanding of fish utilization.

Food Habits of Fish Utilizing Restored Wetlands

A food habits and trophic linkage study of finfishes was conducted in restored wetlands and the results compared to reference wetlands. Specimens were obtained from the fish utilization studies described above.

The total stomach contents weight divided by the total fish weight for each site/tide/species/length class stratum has been calculated for all four target species. A gravimetric, taxonomic prey analysis was performed on weakfish, white perch, spot, and a subsample of bay anchovy. Diet composition has been determined to the lowest practical taxonomic level.

Department's Determination Regarding Food Habits of Fish Utilizing Restored Wetlands

The food habits study has been completed and the study objectives have been fulfilled. Therefore, this requirement has not been retained in this renewal permit.

Supplemental Wetlands Restoration Related Studies in Addition to the BMPWP

In addition to the Permit-required monitoring program, PSE&G undertook supplemental studies to provide additional information on the functions of estuarine marshes in the mid-Atlantic region and specific data on fish utilization (both young of year and large predators), growth, reproduction, and movement within PSE&G's restored wetlands as well as the linkage of these marshes to specific migratory species.

The Contents of the Administrative Record included at the end of this Fact Sheet contains a listing of all components of the March 4, 1999 NJPDES application, including the titles of these additional studies.

Proposed Permit Condition Regarding Biological Monitoring Plan

To summarize the proposed permit requirements above, as well as in the other relevant sections that pertain to the biological monitoring program, the proposed biological monitoring program required under this renewal permit shall include:

- continued monitoring for adult and juvenile passage of river herring in connection with fish ladder sites. Stocking of impoundments shall also be continued until such time as the adults using the ladder meets the minimum number of adults calculated per acre for the minimum number of juveniles (1005 / acre).
- improved impingement and entrainment abundance monitoring
- improved bay-wide abundance monitoring
- review and discussion as to the appropriateness of the representative important species
- continued detrital production monitoring, including vegetative cover mapping, quantitative field sampling and geomorphology.
- continued study of fish utilization of restored wetlands

- other special monitoring studies as may be required by the Department and/or recommended by the EEPOC. Residual pesticide release monitoring could be required for any replacement acreage deemed necessary.

A proposed Biological Monitoring Work Plan shall be distributed to the Department and EEPOC members by the effective date of the permit (EDP) + 3 months. As described previously under **Special Condition 3**, the Department has determined that it is appropriate and beneficial to merge the MPAC and MAC under one oversight committee, namely the EEPOC. The new Biological Monitoring Plan shall be implemented within 60 days of the Department's approval.

Special Condition 7: Special Condition 7 of the July 20, 1994 permit relates to financial assurance requirements. Because the land acquisition requirements have been met and the fish ladders have been constructed, this requirement is no longer necessary and has not been retained in this renewal permit. As described under **Special Condition 3**, it is important to note that the Department may deem it necessary to require replacement acreage for any lands under Special Condition 3 which are deemed "failed".

Special Condition 8: Special Condition 8 relates to "force majeure" and any delays in the compliance with Special Conditions 2, 3, 4, 5 and/or 6 as described above. Because these requirements have been met, this requirement has not been retained. Force majeure conditions are contained in the NJPDES Regulations and apply to this facility even though they are not specifically reiterated in this permit.

Special Condition 9 – Special Condition 9 relates to the termination of the Section 316(a) variance granted in this permit or termination of this NJPDES permit based on the permittee's non-compliance with any of the terms or conditions of this permit. This requirement is still applicable and has therefore been retained in this renewal permit. This requirement has been included in Part IV.

Special Condition 10: Special Condition 10 relates to the submission requirements for all documents required by the Special Conditions specified in Part IV, including without limitation biological monitoring workplans and feasibility studies etc.. This requirement has been retained in the renewal permit and is specified in Part IV. This condition is included in its entirety in Part IV.

Special Condition 11: Special Condition 11 relates to the submission requirements for Sections 316(a) and (b) as part of any renewal application. This condition states that the following information shall be submitted:

Section 316(a)

- a review of whether the nature of the thermal discharge or the aquatic population associated with the Station have changed

- whether the measures required under the Special Conditions have assured the protection and propagation of the balanced indigenous population
- whether the best scientific methods to assess the effect of the permittee's cooling system have changed
- whether the technical knowledge of stresses caused by the cooling system has changed.

Section 316(b)

- an evaluation of whether technologies, their costs and benefits, and potential for application at Salem have changed

Department's Determination Regarding Compliance with Special Condition 11

The permittee has provided a Section 316(a) Demonstration and a Section 316(b) Demonstration as part of its March 4, 1999 application, where these demonstrations address all the issues identified above. Therefore, the permittee has fully complied with Special Condition 11. Given the importance of this information, a summary of regulatory history, overview of studies performed, regulatory standards and any proposed permit requirements has been provided below for both Sections 316(a) and Section 316(b).

1. Section 316(a) Variance

Regulatory History prior to issuance of July 20, 1994 permit

On page 54 of the 1990 Draft Permit, a determination was made that closed cycle cooling was an "available technology...[for reducing] the adverse effects of the cooling water intake and thermal discharge which threathen[ed] the balanced, indigenous community of receiving waters....". This determination was made under Section 316(a) after considering both thermal discharge and intake effects on the "protection and propagation of a balanced indigenous population". Having made that determination, the Department concluded that closed cycle cooling was also BTA for minimizing adverse environmental impact under Section 316(b).

USEPA's comments on the 1990 Draft Permit referred the Department to USEPA determinations in other power plant cases under Section 316. Two USEPA references to Decisions of General Counsel discuss the relationships between Sections 316(a) and (b), namely in Re Central Hudson Gas and Electric Corporation, OGC 63, ZELPS Fed. Ref. Service, USEPA, NPDES Permits 371 (July 29, 1977) and OGC 75, ZELPS Fed. Ref. Service, USEPA, NPDES Permits 441 (January 15, 1979). While acknowledging that the application of Section 316(a) and Section 316(b) should be coordinated to the extent possible, Opinion No. 63 provides, in pertinent part, that "... conditions may be imposed under Section 316(b) independent of any proceeding to modify an effluent limitation under Section 316(a)..."(OGC 63, ZELPS at 378) and, further, that "... there is no legal basis for predicating determinations under Section 316(b) on determinations under Section 316(a)." OGC 63, ZELPS at 379.

With respect to the thermal component of the Station's discharge, the Department stated in its 1990 Draft Permit that its consultant had concluded that adverse effects from the thermal loading

would be "restricted" and did not need to be reduced to protect the balanced indigenous population. In sum, the administrative record demonstrated that the thermal component of Salem's discharge assured the protection and propagation of a balanced, indigenous population.

Section 316(a) Variance under July 20, 1994 Permit

On page 151 of the Fact Sheet of the draft June 24, 1993 NJPDES permit, the Department determined that a thermal discharge at the Station, which does not exceed a maximum of 115^{o}F (46.1^{o}C), is expected to assure the protection and propagation of the balanced indigenous population. Accordingly, the Department determined that a WQBEL would be more stringent than necessary to assure the protection and propagation of the balanced indigenous population. In summary, the Department granted PSE&G's request for a variance pursuant to Section 316(a) and proposed thermal limits which would allow the continued operation of the existing once-through cooling water system with an intake flow limit of 3024 million gallons per day.

Background to the Thermal Plume as well as an Overview of Thermal and Biothermal Studies Performed as part of the Section 316(a) Demonstration

Description of Thermal Plume

The thermal plume is created as the Station's cooling water is discharged to the Estuary. After the water is withdrawn from the Estuary, it passes through the cooling water system to the condensers where its temperature is raised as the steam is condensed from the turbines. At the 30-day average flow rate of 175,000 gpm per pump, the increase in water temperature across the condensers ($\Delta T_{condenser}$) is 14.8°F. The expected maximum $\Delta T_{condenser}$ is 18.6°F, at the expected minimum flow rate of 140,000 gpm per pump. The maximum $\Delta T_{condenser}$ can occur when fouling reduces pump flow rates or when some circulating pumps are not operating.

Overview of Field Surveys and Thermal Modeling

In the thirty-year period between 1968 and 1998, a variety of physical and numerical modeling and field data collection programs have been implemented to characterize the Salem thermal plume. The complexity of these studies has increased over the years as science and technology have advanced. As a result, more and more detailed information has been gathered about the thermal plume, particularly in the vicinity of the discharge itself. A comprehensive description of the methodologies and findings of the various thermal monitoring programs performed prior to issuance of the July 20, 1994 permit is included in the Section 316(a) Demonstration which is part of the March 4, 1999 application. A description of studies performed subsequent to issuance of the July 20, 1994 permit is included below.

Recent field surveys and the times that they were conducted include: the Estuary hydrodynamic survey (March – July 1995); ambient condition survey (July 1997); 1-unit survey (October 1997); and the Modified Thermal Monitoring Program, which was a 2-unit survey, (May – November 1998).

As described previously in **Compliance with Special Condition 6: Biological Monitoring**, the permittee was required to perform a comprehensive thermal monitoring program and a biothermal assessment as part of its Biological Monitoring Program. The Original Thermal Monitoring Program (TMP) was submitted to both the MAC as well as the Department for comment. After some revisions based on comments from the Department, the BMPWP was revised then subsequently approved on April 6, 1996. The planned implementation of the Original TMP was delayed due to an extended outage of both units beginning in the spring of 1995.

When both Units returned to full power operation in May 1998, implementation of the Original TMP was not possible due to time constraints. To accommodate this conflict, PSE&G prepared proposed revisions to the TMP which were submitted to the Department for approval as well as to the MAC for technical advice. After considering the input from the MAC and making some revisions as a result, the Department approved the Modified TMP on May 5, 1998.

The Modified TMP (MTMP) was implemented in late May 1998 when Units 1 and 2 were operating near full capacity. This implementation, which is termed the Two-Unit Survey, provided a comprehensive data set for understanding the hydrodynamic transport characteristics of the Estuary. Components of the MTMP included: fixed moorings to estimate the heat contribution from the marshes and ambient river temperatures; shipboard surveys to measure the spatial variability of river temperatures and salinity, dye-tracer studies to measure the mixing of the discharge, infrared surveys of the nearfield, hydrodynamic surveys and marsh surveys. The 1998 hydrothermal modeling components of the MTMP used these data to calibrate and verify a set of computer models, namely the ATM (Ambient Temperature Model), CORMIX (near-field), RMA-10 (far-field) and the Total Temperature Model. Models are critical to understanding the receiving water conditions during Salem's operations. Lacking the ability to observe all conditions, including those extreme conditions of importance for biological characterizations and assessments, observations must be combined with modeling. Models also provide means to simulate actual conditions or scenarios that might exist in the future as well as temperature fields in the Estuary with and without Station operations. These simulations are necessary to derive estimates of ΔT contours, which are required for the Biothermal Assessment and other regulatory analyses. Once calibrated, these models were then applied to predict the ΔT fields, size, trajectory, and other characteristics of the thermal plume, and to compute seasonal variations of water temperatures in the thermal plume. In some cases, model improvements were implemented for site-specific Station applications. The data collection program was designed specifically to support the models. Diagrams of the thermal plume at the end of flood and end of ebb tide are included as E-2 Figure V-53 and E-2 Figure V-54.

Characterization of Thermal Plume Based on previous 316(a) Demonstrations versus Current Application

As described in the March 4, 1999 application, the thermal plume consists of a near-field region, a transition region, and the far-field. The near-field, which is also referred to as the "zone of initial mixing" (ZIM), is a small region within the thermal plume where the mixing of the Salem thermal discharge with the waters of the Estuary is dominated by the momentum of the thermal discharge. In the 1999 Application, the length of the near-field is approximately 300 feet during running tides (flood and ebb), and approximately 1000 feet during the times of slack water for Two-Unit operations. The length is measured along the centerline of the ZIM, which may have a curved shape depending on the magnitude and direction of the local currents in the vicinity of Salem. The transition regions extend from the end of the near-field to the beginning of the far-field. In the 1999 Application, the length of the transition region is taken to be approximately 700 feet for the four principal phases of a tide (namely, ebb, end-of ebb, flood, and end-of-flood). Except for slack tides, the velocity at the end of the transition region is assumed to have a magnitude equal to the ambient current. The far-field comprises the remainder of the thermal plume and is the region where mixing is controlled by the ambient currents. The boundary of the far-field, which is also the boundary of the thermal plume, is often delimited using a line of constant ΔT (or ΔT isopleth). In the July 20, 1994 NJPDES permit, the thermal plume is delimited by the $1.5^{o}\Delta T$ isopleth for the summer months (June - August) and the $4.0^{o}F\ \Delta T$ isopleth for the non-summer months (September - May).

The thermal plume has been characterized in past 316(a) Demonstrations and related permit submittals. Once Unit 2 came on line in 1982, the thermal discharge and thermal plume have remained fundamentally the same except as Station operations vary (e.g. outages, maintenance etc.). Although dredging of the navigation channel has altered the Estuary's circulation, this occurred mainly in the years before the Station was constructed. The plume is characterized by a very small area of more elevated temperatures in the immediate vicinity of the discharge that cools rapidly as the discharge surfaces and spreads, and a larger area of mildly elevated temperatures.

A comparison of the results of the characteristics of the current thermal plume included in the current application versus previous applications is as follows:

Characteristic	Current Application	Previous Applications
Surfacing distance	<100 feet	Approximately 300'
Dilution at point of surfacing:	Approximately 2	Approximately 2
Surface area of 4°F isotherm	45 - 250 Acres	210 – 1011 Acres
Cross-section area of 4°F isotherm:	6-20%	1-5%
Length of 1.5 °F isotherm		
Upstream:	43,000 feet	37,000 feet
Downstream:	36,000 feet	36,000 feet

As illustrated, the plume characterization collected in the most recent demonstration shows that the surface area of the 4°F isotherm is smaller than in past demonstrations.

Biothermal Assessment

The Biothermal Assessment included in the March 4, 1999 application is an assessment of the effects of the thermal plume on the biological community. This assessment relies directly on the results of the thermal plume modeling described above. The purpose of the biothermal assessment is to identify the likelihood and magnitude of biothermal responses elicited by Salem's thermal discharge and to assess their significance to the key species and the biological community. In PSE&G's 316(a) Demonstration, there were five sequential steps to the biothermal assessment: (1) Review of regulatory standards and decision criteria; (2) Evaluation of biological vulnerability (critical functions, biotic categories); (3) Selection of Representative Important Species (RIS); (4) Detailed evaluation (Predictive, Retrospective - No Prior Appreciable Harm); (5) Overall evaluation of "balanced indigenous community" (BIC).

As described previously, the discharge and plume can be characterized by high velocity, buoyance, turbulence and rapid temperature reduction. The potential for exposure to biota is generally low where the biological resistance to impacts is often high. The application contains two biothermal assessments of the Salem plume, a predictive assessment and a retrospective assessment. The predictive assessment, in accordance with the applicable guidance issued by the United States Environmental Protection Agency ("USEPA") uses reasonable worse case assumptions to project the maximum likely extent and duration of exposure by the (RIS) to the

elevated temperatures of the Salem plume, and then evaluates the potential adverse effects of such exposures based on the results of laboratory tests on the effects of heat on those species. To provide some background, RIS species for the Section 316(a) demonstration include bay anchovy, weakfish, white perch, blueback herring, alewife, American shad, blue crab, Atlantic croaker, striped bass, spot, opossum shrimp and scud. PSE&G's evaluation, which also takes into account the effects on the RIS of nearby thermal discharges other than Salem, the interaction of the heat in the plume with other pollutants, and fish losses at the Salem intake, concluded that the discharge would not have any adverse effect on any RIS populations. The essential basis for this conclusion is that the area of more elevated plume temperatures in the immediate vicinity of the discharge is very small and larger fish avoid it, while the less elevated temperatures in the remainder of the plume are too low to have adverse effects.

The retrospective assessment examined abundance trends for RIS, which show that for the most relevant RIS, trends are stable or increasing. The retrospective assessment was conducted in two parts. First, specific biotic components potentially vulnerable to the Station's thermal discharge were evaluated to determine if there were changes in species composition or abundance attributable to Salem's thermal discharge. Second, the evaluation focused on trends in the abundance of RIS populations. The results of these evaluations revealed that the changes in species composition or overall abundance were within the range of natural variation and that juveniles of most species showed statistically significant increases in abundance. Other data was examined to identify any adverse effects of the plume, in conjunction with other influences including the Salem intake, on fish populations. PSE&G contends that no such effect was found.

Thermal Surface Water Quality Standards for Zone 5 of the Delaware River and Section 316(a) Regulatory Conditions

The Department's thermal surface water quality standards (SWQS), at N.J.A.C. 7:9B-1 et seq. for Zone 5 of the Delaware River, require that the water temperature in the receiving water not be raised by more than $4^{o}F$ ($2.2^{o}C$) during the period from September through May and no more than $1.5^{o}F$ ($0.8^{o}C$) during the period from June through August, nor shall the maximum temperature exceed $86^{o}F$ ($30^{o}C$), except in designated heat dissipation areas not longer than 3500 feet measured from the point of discharge.

PSE&G requires a Section 316 variance from the SWQS in that the physical dimensions of the thermal plume during the summer, as measured by a $1.5^{o}F$ ($0.8^{o}C$) above ambient isotherm, extend beyond the mixing zone specified in these standards and the maximum temperature at 3500 feet may exceed $86^{o}F$ ($30^{o}C$). As described previously, Section 316(a) of the CWA provides that alternative limits may be applied to thermal discharges which exceed technology-based or water quality-based effluent limits, upon a showing that the alternative effluent limits assure the protection and propagation of a balanced, indigenous population of shellfish, fish and wildlife in and on the receiving waterbody.

Proposed Section 316(a) Variance in this renewal permit

The Department acknowledges that the most recent plume characterization, which is a comprehensive effort with regards to field data collection and modeling, differs somewhat from the plume characterizations in past 316 demonstrations. However, the Department agrees that the Station operations and the resulting physical thermal plume have not significantly changed since the onset of Station operations, with the exception of extended outages. The Department also agrees that the velocities associated with the ZIM are high and available data shows that RIS species could not reside in this area of biological significance for very long. The Department notes that the trends of most RIS species appear to be increasing as documented in Appendix J of the March 4, 1999 NJPDES application.

Therefore, based on a review of the current data and modeling pertaining to the thermal plume as well as the biothermal assessment, the Department has determined that a variance under Section 316(a) is warranted. A thermal discharge at the Station, which does not exceed a maximum of 115^{o} F (46.1^{o} C) is expected to assure the protection and propagation of the balanced indigenous population. These effluent limitations for temperature are set forth in Part III-B/C as described previously. In addition, effluent limitations are also retained for heat in this proposed renewal permit (applied to Units 1 and 2).

Renewal of Section 316(a) Variance

As discussed above, the Department proposes to grant a variance pursuant to Section 316(a). Procedures for reissuance of a Section 316(a) variance are virtually unchanged from an initial Section 316(a) determination.

If upon renewal, the permittee wants the variance to be continued in any renewal permit, the request for the variance along with a basis for its continuance, must be submitted at the time of application for the renewal permit. In the event that the permittee wants the variance to be continued, the Department's Section 316(a) determination will include, but not be limited to, a review of whether the nature of the thermal discharge or the aquatic populations associated with the Station have changed; whether the measures required under the proposed existing permit have, in fact, assured the protection and propagation of the balanced indigenous population; whether the best scientific methods to assess the effect of the permittee's cooling water system have changed; and whether the technical knowledge of stresses caused by the cooling system has changed. This requirement is included in Part IV.

Any Future Alterations to the Thermal Discharge

In accordance with N.J.A.C. 7:14A-16.4, the permittee is required to notify the Department of any changes to its discharges, including any additional heat or temperature loadings, that may occur as a result of changes to the Station's operations. This notification shall be made in writing so that the Department can make a determination as to whether any Section 316(a) variance granted by the Department is still appropriate. The Department reserves the right to request additional thermal modeling data and/or a modified biothermal assessment. This condition is included in Part IV.

2. Section 316(b) Determination

Under Section 316 (b), the Department must determine whether the location, design, construction, and capacity of the Station's intake structure reflects the best technology available (BTA) for minimizing adverse environmental impact.

Decisions under Section 316(b) concerning BTA for cooling water intake structures require a case-by-case determination and should include an evaluation of economic considerations. BTA is intended to mean the best technology available commercially at an economically practicable cost and, further, that the costs of a technology must not be wholly disproportionate to the environmental benefit to be gained. In the Matter of Carolina Power and Light Company (Brunswick Steam Electric Plant), NPDES Permit No. NC0007064 (November 7, 1977) at 31-32; In the Matter of Public Service Co. of New Hampshire (Seabrook Station), Case No. 76-6 (June 0, 1977) ("Seabrook Administrator's Decision") at 13; Letter from Cynthia C. Dougherty, Director, Permits Division, USEPA to John Fields, NJDEP.

Section 316(b) Best Technology Available Determination in July 20, 1994 Permit

As discussed in the June 24, 1993 Fact Sheet, the Department evaluated information on various alternative technologies, including their technical feasibility, biological effectiveness and associated costs (presented in PSE&G's 1984 Section 316(b) Demonstration, Versar's 1989 Report, PSE&G's 1991 Comments (Appendices J, K, and L) and PSE&G's 1993 Application Supplement). The alternative technologies having the greatest potential for application at the Station were determined to be (i) closed cycle cooling, (ii) wedgewire screens, (iii) variable speed pumps, (iv) fine mesh screens, (v) screen modifications to incorporate an improved fish bucket design, (vi) circulating water intake flow limitations, and (vii) behavioral barriers, i.e., sound deterrents.

With respect to the above referenced technologies, the Department concluded that : (i) the estimated cost of closed cycle cooling is wholly disproportionate to the environmental benefit to be realized; (ii) wedgewire screens are not an available technology given the volume of once-through cooling water used by the Station and potential for biofouling due to the Station's location; (iii) variable speed pumps are not an available technology for application at the Station since the lower intake flows would lead to higher cooling water temperature causing additional stress to entrained organisms possibly resulting in no net environmental benefit; (iv) fine mesh screens are not an available technology for application at the Station since fine mesh screens may cause an overall increase in impingement mortality rates for early life stages of many species; (v) recent developments had occurred, with respect to the cooling water intake structure traveling screens, which incorporate an improved fish bucket design enabling the Department to demonstrate it to be an available technology at a cost which is not wholly disproportionate to the environmental benefits to be realized; (vi) a restriction on the cooling water system intake flow to a monthly average of 3,024 MGD (present average flow) is an available technology at a cost which is not wholly disproportionate to the environmental benefits to be realized; and, (vii) the study of fish behavioral barrier technologies, specifically the utilization of sound deterrents, is an

available technology at a cost which is not wholly disproportionate to the environmental benefits to be realized.

Based on this review of available technologies, the Department determined that the existing cooling water intake structure, in conjunction with the screen modifications, improved fish bucket design, a cooling water intake flow limitation, and a sound deterrent study, to be BTA under Section 316(b) in its July 20, 1994 permit.

Overview of Alternate Intake Protection Technology Analysis included in the March 4, 1999 Application

The BTA component of the Section 316(b) Demonstration submitted as part of this application, employed a functional evaluation of potential intake-related technologies and other fish protection options involving a three-step process: (1) identify all potential fish protection options; (2) eliminate those options with no or limited proven biological effectiveness at circulating water intake structures; and (3) provide a detailed evaluation of the applicability of the remaining alternative to Salem.

The options included in this compilation were as follows:

Strobe Lights	Air bubble curtains	Acoustic sound
Infrasound	Mercury lights	Electric screens
Water jet curtains	Hanging chains	Chemicals
Visual keys	Hybrid barriers	Infiltration intakes
Porous dike	Gunderboom	Wedge-wire screens
Barrier nets	Bar racks	Traveling screens
Stationary screens	Rotary drum screens	Modified traveling screens
Fish pumps	Angled screens	Angled rotary drum screens
Inclined plane screens	Eicher screens	Modular Inclined Screens
Submerged traveling screens		Louvers

Each of these options was considered by PSE&G in a preliminary screening to identify those appropriate for further consideration. The factors applied in the preliminary screening were: (1) whether the option has a known effectiveness for reducing fish losses generally (and not necessarily in relation to the specific species involved at the Station); (2) whether further engineering development would be required for the option to be considered “available”; and (3) the relative engineering and/or biological advantages of one option over another. Potential application of the options to the specific conditions of the Station was not considered.

On the basis of the preliminary screening, four fish protection alternatives and three flow modification schemes were selected for detailed evaluation including:

Wedge-wire screens
Fine mesh screens
Modular inclined screens

Hybrid strobe light/air bubble curtain barriers
Seasonal flow reductions
Revised refueling outage schedules
Closed cycle cooling

PSE&G developed an analyses of five factors related to evaluating the impacts of implementing each alternative including: (1) relevant background knowledge derived from previous assessments of the feasibility of implementing the alternative at Salem; (2) engineering and technical considerations affecting implementation at Salem; (3) potential biological effectiveness in reducing intake losses at Salem; (4) other potential environmental impacts that could result from implementation at Salem; and (5) costs and operational impacts of implementing the alternative at Salem. For those options considered to be feasible for implementation at Salem, their costs and benefits were assessed.

Department's Contractor Review of Alternate Intake Protection Technologies

ESSA reviewed the Section 316(b) Demonstration which includes the alternate intake protection technologies. The contractor reviewed the alternatives in terms of engineering and operating feasibility, and ability to reduce fish mortality. Regarding each of the seven technologies, ESSA concluded the following:

Wedge-Wire Screens - "Although this technology is being used elsewhere (e.g. J.H. Campbell Plant Unit 3 - Lake Michigan, and Eddystone Station - Philadelphia Electric), its potential for application at Salem would be low. Salem's cooling water flow rate is more than five times the rate where this technology is presently used, and there are real concerns about biofouling and clogging with this technology at Salem."

Dual-Flow Fine Mesh Screens - "No fine mesh screening systems currently in use operate at flow velocities typical of Salem CWS, nor do these existing installations appear to deal with the same level of debris loading as at Salem ….....This system does not appear to offer any significant advantages over the present Ristroph screen system already in place at Salem GS."

Modular Inclined Screens (MIS) - "These screens were originally developed for application at hydroelectric plants, and have never been used at a once through-cooling facility...Furthermore, MIS have only been evaluated in the lab or in small-scale testing, and there are no plans of which we are aware for this system to be installed at an operating fossil/nuclear station with a once-through cooling system. The application of this system for Salem has a lot of question marks."

Strobe Light/Air Bubble Combination - "Strobe light/air bubble combinations have been studied extensively. Like other behavioral system such as sound (as tested at Salem), there is a species specific response, and a strobe light/air bubble system will not work for all 11 RIS at Salem (neither will sound alone). There is evidence, however, that this system will work for several species found at Salem. However, its use as a sole deterrent system at Salem would be limited. To be considered at Salem GS, a strobe light/air bubble system must be used with other technologies as part of a hybrid system.."

Seasonal Flow, Revised Outages,and Retrofit with New Closed-Cycle System – "These options, in particular revised outages, have potential for application at Salem. However, more quantitative data on fish entrainment/impingement issues with respect to timing is required to better define the period when an option such as seasonal flow could be used to maximize reductions in entrainment/impingement.....Cooling towers, of course, would minimize entrainment/impingement events, but there are engineering issues with this technology at Salem."

In conclusion, ESSA states "An improved "fish defense system" using multi-sensory or hybrid technologies is recommended for further study at Salem GS. This recommendation is based on the observation that sound alone has shown limited success as a deterrent at Salem (the notable exception being ultrasound based in the 1994 cage tests, and external literature) Other systems should be integrated with sound to better reduce fish impingement. Initially, this integration should focus on behavioral systems since these are less costly and easier to implement than physical systems. However, if behavioral systems fail to significantly reduce impingement, then the more costly alternatives would need to be considered..."

Based on ESSA's review, the Department is requiring further study of a hybrid system as described later.

Cost/Benefit Analysis included in the 3/4/99 application

PSE&G included cost estimates in its March 4, 1999 application for those intake protection technologies for which a detailed evaluation was performed. This cost analysis included the following: 1) the costs associated with construction and installation necessary to implement the alternative; (2) incremental operating and maintenance costs associated with the alternative; and (3) the value of lost power at Salem as a result of construction and changes in continuing plant operations. These costs were converted to present value estimated as of January 1, 2001, expressed in 1998 dollars.

The benefits of the six alternatives that were quantified in PSE&G's analysis consist of commercial and recreational fishing benefits predicted to result due to additional fish protection alternatives at Salem. The methodology used to estimate benefits for each alternative is 1) convert impingement and entrainment losses to equivalent recruits (i.e. one year olds); 2) calculate resulting change in yield to the fishery; 3) divide commercial and recreational split; 4) determine wholesale commercial values; 5) determine recreational values; 6) calculate benefits from increases in RIS; 7) determine additional pounds of non-RIS; 8) calculate benefits from increases in non-RIS; 9) calculate annual benefits; 10) determine present value of benefits. To estimate the benefits of each of the alternatives, the number of fish protected by the alternative was converted to pounds of yield added to the fishery.

Based on these results, PSE&G contends that the costs of any of these alternatives would be wholly disproportionate to any benefits provided. As a result, PSE&G contends that none of these alternatives is best technology available for Salem.

Department's Contractor Review of Cost/Benefit Analysis

Regarding the costs of the intake protection technologies, ESSA states "The estimated construction costs of the various technologies are reasonable given normal uncertainty associated with pre-tender engineering cost estimation. The documentation and methodology presented in the Application seem reasonable for the major design modifications that would be required for the cooling water intake system." Regarding the benefits assessment, ESSA states "The purpose of the benefits assessment was to identify the benefits of the alternative BTAs for comparison with the costs. The assessment focused on benefits to the commercial and recreational fisheries of the Delaware River. The review, however, found that the documentation and written explanation of the benefits assessment was incomplete and generally did not provide a clear description of the justification of methodology, procedures and assumptions used in the assessment...."

Department's Review of Cost/Benefit Analysis and Requirements regarding Alternate Intake Protection Technologies

It is important to note Section 316(b) does not require a detailed cost/benefit analysis. See, Decision of the General Counsel, No. 63, July 29, 1977 at p. 382. Rather, decisions under Section 316(b) concerning BTA for cooling water intake structures require a case-by-case determination and should include an evaluation of economic considerations. BTA is intended to mean the best technology available commercially at an economically practicable cost and, further, that the costs of a technology must not be wholly disproportionate to the environmental benefits to be gained. See, In the Matter of Carolina Power and Light Company (Brunswick Steam Electric Plant), NPDES Permit No. NC0007064 (November 7, 1977) at 31-32; In the Matter of Public Service Co. of New Hampshire (Seabrook Station), Case No. 76-7 (June 10, 1977) ("Seabrook Administrator's Decision") at 13; Letter dated January 14, 1991 from Cynthia C. Dougherty, Director, Permits Division, USEPA to John Fields, NJDEPE. Under Section 316(b), a permitting agency has the ultimate burden of persuasion that any BTA measure that it requires is "available" for a given facility, and that its costs are not "wholly disproportionate" to environmental benefits. See, Decision of the General Counsel, No. 63, July 29, 1977 at p. 382.

PSE&G states that the strobe light/air bubble curtain technology has the lowest cost ($10 million) and might produce benefits of $1.4 million, thus having a net benefit of negative $8.5 million and a cost-benefit ratio of 7.0. A table showing the potential benefits to each RIS for the strobe light/air bubble curtain technology is included as F-VIII Table 2.

At this time, the Department is not requiring implementation of strobe light/air bubble curtain technology, as a component of a multi-sensory hybrid system, rather it is only requiring further study. As discussed previously, the cost value for the strobe light/air bubble curtain technology considers construction and installation costs as well as operating and maintenance costs (year-round). Therefore, the Department has determined that study of a multi-sensory hybrid system, of which strobe light/air bubble is a component of, is an available technology at a cost which is not wholly disproportionate to the environmental benefits to be realized. Study of a multi-

sensory hybrid system is required as specified in Part IV and is considered by the Department to be a component of best technology available.

It is important to note that the Department is committed to requiring implementation of any cost-effective alternate intake protection technologies that will minimize impingement and/or entrainment effects. In sum, the Department is requiring the following:

(1) Study of a Multi-Sensory Hybrid System

- strobe light/ air bubble combination technology
- sound deterrent
- light attraction technologies such as mercury vapor light coupled with enhancements to the fish return system (e.g. fish pumps) to allow the fish to be returned to the estuary

These technologies shall be studied individually as well as in various combinations as a hybrid system. The objective of this study is to minimize impacts to those species that do not survive well off the intake travelling screens as well as those species that are most affected by Salem's operations (as indicated by conditional mortality rates).

The concerns and limitations documented by ESSA in its report for the 1994 Cage Tests; 1998 Cage Tests; and the in-situ tests shall be considered in the development of any Plan of Study with regard to any ultrasound technologies. Also related to ultrasound, far field attraction behavior or potential acclimation shall also be studied.

- PSEG shall present a Plan of Study regarding the above technologies to the Department within EDP + 6 months.
- Not later than sixty days after receipt of the Department's approval of the Plan of Study, PSEG shall implement the Plan of Study in accordance with the schedule approved by the Department subject to species availability.
- Not later than EDP + 36 months, PSEG shall complete the Plan of Study and file a report of the results to the Department in accordance with the schedule approved by the Department.

Department's Regulatory Position with regards to Section 316(b)

The cornerstone of PSE&G's March 4, 1999 application is the impact assessment where many of the analyses included in the application feed into this assessment. Likewise, Figure 1.1 of ESSA's report illustrates the interdependence of data and analyses in the application that were reviewed by ESSA. It is important to note that PSEG and the Department do not agree regarding definition of the term "adverse environmental impact". PSEG's position is that this term, as used in Section 316(b), is intended to address impacts only at the level of the population or above where determinations of an impact must be made on a case-by-case basis. Conversely, NJDEP and other states, such as New York, have considered the death of any fish at or through a cooling water intake to be an "adverse impact" which must be minimized through available technologies under Section 316(b). Based on this legal position, the Department has determined that it is

therefore justified in requiring the pursuit of alternate intake protection technologies, to further minimize the impacts at the Salem Station.

Nonetheless, although the level of impacts may not be central to the Department's Section 316(b) Determination, it is important to understand Salem's direct effects on fish populations (through impingement and entrainment sampling and the resulting loss estimates) and the resulting effect on fish populations (which can be measured by conditional mortality rates). An assessment of these effects are integral to defining alternatives to minimize these losses.

Overview of Impact Assessment included in the March 4, 1999 application

Section 316(b) of the CWA addresses "adverse environmental impact" associated with the cooling water intake structures of a permit applicant's facility. There is no statutory or regulatory definition of "adverse environmental impact," and no authoritative regulatory assessment approach. Based on the statute, draft EPA guidance, and understanding of the relevant science, PSE&G has selected three benchmarks, each employing a somewhat different perspective, by which to address possible adverse environmental effects at Salem.

(i) Absence of Balance in the Indigenous Community of Aquatic Biota

This community structure benchmark is drawn from Section 316(a) of the CWA, where PSE&G contends that Congress views the loss of population or community level "balance" as an adverse environmental effect.

Data from the Estuary can be evaluated to determine whether, taking account of 30 years of changes in water quality, fishing pressure, and habitat, the past operation of Salem has upset or modified the balanced indigenous community of the Estuary. The following three indicators are used in this evaluation.

1) Whether the species composition of the Estuary is similar in pre-operational and operational periods;
2) Whether fluctuations in species abundance have remained within anticipated ranges; and
3) Whether there have been eruptions of nuisance species, non-indigenous species or species indicative of degraded conditions.

(ii) Continuing Decline in Abundance of Aquatic Species
This benchmark is drawn from biology and population dynamics. The benchmark evaluates whether any long-term continuous declines in RIS abundance have occurred, and, if so, whether the operation of Salem is the cause.

(iii) Fish Stock Sustainability Placed in Jeopardy
This benchmark, drawn from fisheries management, uses predictive models and fishery management reference points to evaluate the potential effects of Salem. The analysis performed for this assessment evaluates whether the effects of Salem, combined with the

existing effects of fishing, would significantly reduce the ability of fish populations to sustain themselves and place the sustainability of the stock in jeopardy.

Department's Contractor Review of Impact Assessment, as a component of Section 316(b)

In addition to the alternate intake protection technologies and cost/benefit assessment discussed above, ESSA reviewed the other components of the Section 316(b) Demonstration including the impact assessment; overview of biological sampling programs; and fisheries modeling. Important analyses which feed into the Section 316(b) demonstration are the Cumulative Effects Assessment (Appendix H), Compensation (Appendix I) and the Analysis of Trends for Finfish and Blue Crab (Appendix J).

ESSA has included the findings of its detailed review in Section 5.0 of its report. This includes a review of indicators of adverse impact; production and catch foregone, balanced indigenous community, trends and retrospective analysis, prospective stock jeopardy analysis as well as comments on the use of data in the application. In addition, in Section 2.0, ESSA included its findings on PSE&G's analysis of Conditional Mortality Rates (CMR's). Please refer to ESSA's report (included as Attachment A) for a comprehensive description of its review and findings regarding the fisheries and CMR analyses.

ESSA states, "Each of the three assessment endpoints chosen in the PSE&G Application (i.e., historical trends, long term sustainability, fish community structure) are confounded by changes in other stressors (i.e., water quality, changes in harvest). Inferences made on these assessment endpoints are therefore dependent on historical and future assumptions regarding other stressors. By contrast, assessment endpoints such as fish killed by entrainment and impingement and foregone production, are related directly to the impacts of the power plant intakes, are less confounded by other factors, and require fewer assumptions about unknown parameters." Based on such, the Department is hereby requiring PSEG to address ESSA's findings regarding the Production and Catch Foregone analysis only. The objective of this analysis is described later.

It is important to note that ESSA's report recommends further study of behavioral technologies as well as an improved fish return system. Based on the fact that ESSA did not recommend wedgewire screens, dual flow fine mesh screens, modular inclined screens and retrofit with a new closed-cycle cooling system are infeasible, **a revised fisheries analysis will not have a bearing on the inclusion of the above referenced alternative intake protection technologies at this time**. ESSA states that the intent of its recommended intake protection technologies (including the study of a multi-sensory hybrid technology and an enhanced fish return system) is to significantly improve Salem's system to reduce fish impingement, without incurring costs that are wholly disproportionate to the benefits.

Another important finding of the ESSA report pertains to the utility of biological survey data as it relates to the trends and the survey data for each RIS. This is discussed in Section 5.4.1.3 of the ESSA report. A useful chart is included as Table 5.17 which shows the appropriateness of the survey data for each RIS. The Department is requiring improved biological monitoring, as discussed under **Compliance with Special Condition 6**, which will aid in addressing this

concern. Improved biological monitoring will also improve any future fisheries analysis including loss estimates.

Proposed Permit Condition

In sum, the Department is requiring the following:

(1) Further Analysis of Losses at the Station

The objectives of this analysis are as follows:

- The biomass lost to the ecosystem should be calculated either using a slightly modified version of the production foregone model for all RIS or the spreadsheet approach.
- The contribution of RIS other than Bay Anchovy to the forage available for commercial and recreationally important species should be examined. This has the potential to significantly increase the estimates of lost revenue in the fishery.
- A more detailed analysis of the levels of uncertainty in the production and catch foregone estimate needs to be considered.
- The estimates used for the survival rates of Age 0 - Blueback Herring used in the Appendix F4 analysis (March 4, 1999 application) should be reviewed given the different values used in Appendix G-6.
- The base case entrainment and impingement mortality estimates should be compared against the historical averages to ensure consistency.
- Projected increases in RIS abundance should be included in the estimates of catch and production foregone.
- The potential to customize intake protection strategies to minimize the impact of the plant on catch foregone and the biomass lost to the ecosystem should be further investigated.

PSEG shall utilize the advice of the EEPOC or other groups deemed appropriate by PSEG and/or the Department in completing this analysis.

3. Special Studies Proposed in this Renewal Permit

A. Entrainment and Impingement

DEP Contractor Review and Department's Determination regarding Entrainment Abundance Monitoring and Impingement Abundance Monitoring

ESSA reviewed all analyses in the March 4, 1999 application for which impingement and entrainment data is a significant input. This includes Appendix F (Section 316(b) Demonstration) as well as supporting appendices H and I. A complete listing of these appendices and their attachments is included in the Contents of the Administrative Record included at the end of this Fact Sheet. Regarding impingement and entrainment specifically, ESSA was required to "review the accuracy of PSE&G's entrainment and impingement mortality

estimations..." As illustrated in Figure 1.1 of ESSA's report, it is important to understand that entrainment and impingement data are an essential building block for further analyses.

ESSA describes in its report "In the present 316(b) Demonstration, the estimation of entrainment is essentially used in two ways. First, the entrainment samples taken at the station are expanded to yield estimates of historical annual entrainment losses. These historical estimates provide a simple direct indicator of station impact from year to year.... Second, entrainment samples are expanded as above to yield losses which are placed in the context of the surviving population of juveniles to calculate a conditional entrainment mortality (CMR), i.e. mortality attibutable to entrainment by the station independent of other mortality sources). The CMR is used in subsequent modeling of the potential effects of the Salem GS at the population level."

ESSA noted the following with regards to the entrainment sampling:

- there appears to be an ongoing pattern of change to the protocols of the program where the shifts in the protocols necessitate the use of adjustments.

- interpolation and extrapolation were also necessary to estimate missing data where the program design did not provide for consistent coverage

- the predominant intake sampling locations and protocols have known biases that also require "correction" of the data.

- of the various adjustments made to the data set, the adjustments made for net extrusion is cause for the greatest degree of concern, because of the magnitude of the correction necessary.

- an additional source of entrainment mortality, not discussed in the documentation, are eggs and larvae that become impinged on the material clogging the screens. This material would get cleaned from the system by the high pressure sprays and disappear into the impingement/detritus discharge flow system.

ESSA concludes by stating: "The methods employed for interpolation/extrapolation of data are reasonable and generally conservative. Weaknesses in the data are explicitly acknowledged and various adjustments or correction coefficients have been developed and applied to attempt to correct for known biases. In this regard, the overall approach taken by the investigators working with the data is not unreasonable; in fact their attempts to make the most of an incomplete and biased data set are laudable. It is critically important when evaluating the conclusions based on the analyses to keep in mind that in order to conduct the 316(b) Demonstration, it was necessary for the investigators to substantially interpolate, extrapolate and adjust the data so the analysis could proceed."

In an effort to better understand any **future impingement/entrainment data sets**, particularly entrainment, ESSA recommends two studies and an expanded analysis as indicated below. In addition, to better understand the existing analyses, ESSA recommends an expansion to the

current analysis as described below. Please refer to the ESSA Report for additional information regarding ESSA's review and the findings for impingement and entrainment sampling.

As recommended by ESSA in its report, PSEG shall conduct the following studies and analysis as described below:

Study of the Hydrodynamics at the Intakes of the Station

(a) The flow field in front of the intake and the existence of vortices at the intake shall be observed and photographed during: (1) an extreme low tide (2) when the current is strongest, namely at mid tide on the flood and mid tide on the ebb.

(b) The pumping records of each pump should be examined to determine if the flow distribution is asymmetrical among the intake bays, particularly the most northern bay and the most southern bay (i.e. two outer bays).

(c) The bathymetric chart of the area should be examined to determine the potential for a strong back eddy during the ebb in Ship Wreck Bay immediately to the south of the intake. If such an eddy exists it will be observable from shore and from the air when the ebb current is at a maximum. The chart may also provide insight in to the flow field entering the dredged channel from the side.

Study of Enhancements to Entrainment and Impingement Sampling

(a) An analysis of the optimum sampling frequency for entrainment and impingement shall be conducted considering any episodic nature of the entrainment process. This needs to take explicit account of the shape of the zone of entrainment as well as the hydrodynamic study discussed above.

(b) Alternative entrainment sampling methods with less process error shall be investigated.

PSEG shall present its findings regarding the Study of the Hydrodynamics at the Intakes of the Station and the Study of Enhancements to Entrainment and Impingement Sampling to the Department within EDP + 1 year. Based on the results of these studies, the Department may reassess and adjust the entrainment and/or impingement sampling frequencies and/ sampling locations. The Department may also define alternative entrainment sampling methods with less process error. Any such changes deemed appropriate and necessary by the Department shall be incorporated into the Biological Monitoring Program.

Expansion of Current Analysis with regard to Entrainment Sampling

(a) The uncertainty of the estimated historic annual entrainment loss estimates should be characterized and presented as ranges with maximum and minimum levels.

(b) Any error in the estimation of M, and the effect on CMR estimates with the Extended Empirical Impingement Model (EEIM) (which was used to derive estimates of CMR for alewife, blueback herring, American shad, white perch and spot) shall be investigated. The uncertainty with the CMR estimates shall also be characterized and presented.

These expanded analyses identified in (1) and (2) shall be submitted to the Department within EDP + 6 months.

B. Estimated Productivity of the Wetlands Restoration Sites

PSE&G States that the Wetland Restoration Sites and Fish Ladders are Producing Fish

Marsh restoration and the revival of the river herring runs are not yet fully complete and a widely acceptable common metric for quantifying all of the increased production is not readily at hand. Nevertheless, despite these constraints, it is important to consider the available evidence relevant to assessing the fish production benefits of these measures.

First, the evidence is clear that the restored marshes are quickly coming to have the form and function of "natural" marshes based on a comparison of restored verses reference marshes.

Second, bioenergetics modeling can be used to provide some indication of the marsh productivity. Though not a specific requirement of the July 20, 1994 permit, the permittee conducted a bioenergetics analysis for the salt hay farms to gain quantitative insight into the productivity of the marsh. The bioenergetics approach relies on fish captured in the marsh by the monitoring programs as well as on growth by predators feeding on fish produced in the tidal marsh. The bioenergetic method has limitations. This approach does not account for detrital export-based production which is important in Delaware Bay. Both small invertebrates and very early life forms of fish pass through the monitoring nests and are lost to the bioenergetics calculations. Similarly, the larger fish are able to avoid the gear. Finally, the restoration of the salt hay farms is not complete.

Third, there is evidence from the stable isotope analysis that top predator fish which migrate through the Estuary to the open coast carry with them the imprint of the energy flow from the marsh vegetation to the highest trophic level. Thus, the evidence shows that the restored marshes are producing food that is eventually consumed by upper-level predators, which would include many of the commercially and recreationally important RIS.

Fourth, the aggregated food chain model, which was used in estimating acreage prior to the issuance of the present permit, was a general model that did not attempt to provide a detailed depiction of the energy flows in tidal marshes on the Delaware. Nevertheless, PSE&G contends that data collected from the restored marshes show detrital production on a per acre basis at a rate roughly equivalent to that used in the aggregate food chain modeling to support the acreage calculation for the July 20, 1994 NJPDES permit.

Fifth, more than 700 acres of impoundments are being made available for river herring spawning as a result of the installation of fish ladders. The production of juvenile herring varies in such ponds and lakes. PSE&G anticipates that the ponds will produce between 2,564 and 338,350 kg of forage fish which would be consumed by predators such as striped bass and weakfish. In addition, approximately 200,000 adult river herring should return to the Estuary annually where they will be available for fishery harvest or for spawning.

Lastly, the marshes are an important food and habitat support to other wildlife, particularly birds. Both the Ramsar Convention and The Nature Conservancy have recognized the significant importance of the marshes of Delaware Bay to migratory birds-shore birds, ducks and geese, raptors and songbirds, as well as colonial wading birds.

Results of the PSE&G's Bioenergetics Analysis for the Salt Hay Farms

The bioenergetics analysis was done independently for 1997 and 1998 and, in each year, a high and low estimate was provided based on differing estimates of the catchability of the fish. The low amount for the RIS occurred in 1998 when production of 50,835 kg live weight was calculated; the high figure of 404,055 occurred in 1997. The RIS category includes bay anchovy, spot, striped bass, weakfish, white perch, and Atlantic croaker. Blue crab were particularly abundant in 1998 with a high estimate at 273,168 kg as against a low figure in 1997 of 28,128 kg. The total for all species combined varies from a low of 196,477 kg in 1998 to a high of 945,996 kg in 1997.

Proposed Permit Requirement Regarding Production Measurement of the Wetland Restoration Sites

PSE&G was not required to estimate fish production at its wetland restoration sites as part of the July 20, 1994 permit. The Department recognized at that time the many factors, variables and limitations to measuring productivity of the wetland restoration sites and of the fish ladders. On page 45 of the Response to Comments document in the July 20, 1994 NJPDES permit, the Department states:

> The Permittee would not be required to demonstrate how many fish of each species have been generated from the restored wetlands. Such a demonstration would not be practicable given the many environmental variables that influence fish populations in the Delaware Estuary. Accordingly, the restoration program does not include fish abundance indices or goals. Rather, the Permittee is required to demonstrate that it has restored the requisite acreage of wetlands from which, based on the best scientific evidence available, it is logical and appropriate to conclude that there will be increased productivity of fish in the Estuary.

The Department required the best technology available pursuant to Section 316(b) and then separately, based on the permittee's proposal, incorporated the wetlands restoration conditions and fish ladder conditions. Thus, the permittee's compliance with Section 316(b) does not depend on a certain level of productivity. Moreover, the Department finds that the detrital production monitoring indicates that the continually evolving wetland restoration sites show detrital production at a comparable level to the reference sites. Nonetheless, a more definitive

quantification of fish production is important in a general sense and because the permittee has made and continues to make general statements about the level of fish productivity from wetlands restoration as a factor in fish population trends. Therefore, the Department is proposing the following:

(1) As part of any renewal application, the permittee shall include estimates of fish production from all PSE&G wetland restoration sites as well as the fish ladders. The permittee shall utilize appropriate methods, which may include bioenergetics. The Department acknowledges that these "estimates" are subject to many environmental variables. Losses at the intake structure and measures of productivity shall be expressed in common units of biomass.

4. Minimization of Impacts through Continued and Proposed Special Conditions

The Department has determined that the Station's existing once-through cooling system in conjunction with an intake flow limitation, an enhanced fish return system and the study and potential implementation of a multi-sensory hybrid system constitutes **best technology available**. The Department is also continuing to require further development of the Special Conditions which include wetlands restoration and enhancement; continued monitoring of the fish ladders; and improved biological monitoring. Lastly, the Department is requiring further study and analysis relating to entrainment and impingement and productivity on the marsh. These Special Conditions are required to minimize environmental impacts related to the Station's cooling water system pursuant to Section 316(b) of the Clean Water Act.

XI. COMPARISON OF THE SECTION 316 SPECIAL CONDITIONS INCLUDED IN THE JULY 20, 1994 PERMIT AS COMPARED TO THE SECTION 316 SPECIAL CONDITIONS PROPOSED IN THIS RENEWAL PERMIT

This table provides a brief overview of the Section 316 Special Conditions included in the July 20, 1994 NJPDES Permit as compared to the Section 316 Special Conditions proposed in the renewal permit. Please refer to Part IV for additional detail regarding proposed conditions.

Section 316 Special Condition in the July 20, 1994 Permit	Special Condition Retained in Proposed Renewal Permit?	Reference in Part IV of Proposed Renewal Permit
Intake Flow Limit and Dye Tracer Evaluation	Yes	G.1.
Intake Screen Modifications	Modified to require further study and enhancements particularly the fish return system.	G.2.
Wetlands Restoration and Enhancement	Modified to continue with wetlands restoration and enhancement efforts – requirements included for any "replacement acreage" deemed necessary.	G.3.d.
Installation of Fish Ladders	Modified to continue monitoring of adult and juvenile passage and stocking.	G.4.
Sound Deterrent Study	Modified to require further study of a multi-sensory hybrid system which shall include sound	G.5.a.
Biological Monitoring Program	Modified to require improvements to the biological monitoring program. Until such time as improvements	G.6.

	are proposed, program shall continue.	
Financial Assurance Requirements	No – No longer applicable	N/A
Force Majeure	No – No longer applicable	N/A
Submission of all Documents	Yes	G.10
Termination of Section 316(a) Variance/Penalties	Yes	G.11.
Information Required to be Submitted as part of a Section 316(a) Variance Request and Section 316(b) Determination	Retained for any Future NJPDES Renewal Application.	G.12.a.

This table provides a brief overview of any **new** Section 316 Special Conditions proposed in this renewal permit. Please refer to Part IV for additional detail regarding these proposed conditions.

Proposed Section 316 Special Condition in this Renewal Permit	**Item Reference in Part IV of Proposed Renewal Permit**
Designation of Estuary Enhancement Oversight Committee Members	G.3.
Entrainment and Impingement Abundance Monitoring shall continue until an Improved Biological Monitoring Program is Developed	G.7.a. and G.7.b.
Expansion of Current Analysis regarding Losses at the Station	G.8.a. and c.
Expansion of Current Analysis regarding Entrainment Sampling	G.8.b. and c
Study of the Hydrodynamics at the Intake	G.9.a. and c.
Study of Enhancements to Entrainment and Impingement Sampling	G.9.b. and c.
Estimates of Production of the Wetland Restoration Sites and Fish Ladders	G.12.b.

XII. CONTENTS OF THE ADMINISTRATIVE RECORD

The following items are used to establish the basis of the Draft Permit:

1. 33 U.S.C. 1251 et seq., Federal Water Pollution Control Act.
2. N.J.S.A. 58:10A-1 et seq., New Jersey Water Pollution Control Act.
3. 40 CFR Part 122, National Pollutant Discharge Elimination System.
4. N.J.A.C. 7:14A-1 et seq., New Jersey Pollutant Discharge Elimination System Regulations. [A]
5. N.J.A.C. 7:9B-1 et seq., New Jersey Surface Water Quality Standards. [A]
6. 40 CFR Part 131, Federal Water Quality Standards. [A]
7. "Field Sampling Procedures Manual", published by the NJDEP. [A]
8. "Discharge Monitoring Report (DMR) Instructional Manual", published by the NJDEP. [A]
9. "EPA Technical Support Document for Water Quality-based Toxics Control", EPA/505/2-90-001, March 1991. [A]
10. Delaware River Basin Commission Water Quality Regulations.
11. NJPDES/DSW Permit Application dated 3/4/99 (see below for more detail) as well as subsequent submittals.
12. NJPDES/DSW Permit NJ0005266, issued 7/20/94 and draft issued 6/24/93.
13. Review of Portions of New Jersey Pollutant Discharge Elimination System (NJPDES) Renewal Application for the Public Service Electric & Gas' (PSE&G) Salem Generating Station – Final Report. Prepared by ESSA Technologies, Ltd. dated June 14, 2000 (included as Attachment A).
14. Presentation on April 26, 2000 by representatives of the ESSA Review Team.
15. Site Tour of Salem Generating Station in April 1999 by NJDEP Representatives as well as the site tour with NJDEP and ESSA Representatives in December 1999.
16. Current Management Plans for Dennis, Commercial, Maurice River Township, Cohansey River, Alloways Creek and Delaware Wetland Restoration Sites as well as Deed of Conservation Restrictions for all sites.
17. Biological Monitoring Program – Annual Reports for Years 1996-1999
18. Information Distributed at Monitoring Advisory Committee Meetings and Management Plan Committee Meetings as well as associated site tours.
19. Effluent Characterization Study Reports from PSE&G dated March 18, 1996 (Phase 1), February 26, 1999 (Phase 2) and March 17, 1999 (Phase 2).
20. Correspondence dated June 19, 1998 addressed to Edward Keating of PSE&G from Debra Hammond of NJDEP reducing the number of parameters for Phase 2 of the effluent characterization study based on the results of Phase 1.
21. Correspondence dated July 14, 1999 addressed to E. Keating of PSE&G from D. Hammond requiring a chronic toxicity characterization study (included as Attachment 1).
22. Correspondence dated November 24, 1999 addressed to all MPAC and MAC members requesting comments on specific portions of the March 4, 1999 PSE&G renewal application.

23. Correspondence dated December 14, 1999 from Belva Prycl (MPAC member) in response to the November 24, 1999 correspondence.
24. Correspondence dated December 22, 1999 addressed to D. Hammond from Roy Miller of DNREC which includes as an attachment a report prepared by Dr. Phil Goodyear (a consultant hired by DNREC). This report includes comments on Appendix F of the PSE&G application.
25. Correspondence dated February 18, 2000 addressed to Dennis Hart of NJDEP from R. Edwin Selover of PSE&G which includes a rebuttal to Dr. Goodyear's review.
26. Correspondence dated March 30, 2000 addressed to D. Hammond from R. Miller which includes a report prepared by Dr. Desmond Kahn of DNREC regarding review of the striped bass impingement and entrainment calculations.
27. Correspondence dated May 17, 2000 addressed to S. Rosenwinkel of NJDEP from Maureen Vaskis of PSE&G in response to the April 26, 2000 meeting.
28. Correspondence dated June 9, 2000 addressed to M. Vaskis granting a one month extension on the chronic toxicity characterization study as required by the July 14, 1999 correspondence.
29. Correspondence dated June 30, 2000 from Eric Shrading of US Fish and Wildlife Service containing comments on the March 4, 1999 application.
30. Correspondence dated April 24, 2000 addressed to W. Boehle of NJDEP from Gabor Salamon of PSEG requesting transfer of NJPDES permits from "PSE&G" to "PSEG".

[A] Denotes items which may be found in the NJPDES/DSW Administrative Record Library located in the NJDEP Central File Room, 401 East State Street, Trenton, NJ.

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Components of the March 4, 1999 NJPDES/DSW Permit Application

Appendix A - Procedural History
Appendix B - Description of Station
Appendix C - Ecosystem of the Delaware System
- Attachment C-1Weakfish
- Attachment C-2 Striped Bass
- Attachment C-3 White Perch
- Attachment C-4 Spot
- Attachment C-5 Atlantic Croaker
- Attachment C-6 American Shad
- Attachment C-7 Alewife
- Attachment C-8 Blueback Herring
- Attachment C-9 Bay Anchovy
- Attachment C-10 *Gammarus Tigrinus* Group
- Attachment C-11 *Neomysis* Americana
- Attachment C-12 Blue Crab
- Attachment C-13 Mummichog
- Attachment C-14 Atlantic Silverside
- Attachment C-15 General Water Quality and Trend Analysis of the Delaware Estuary

Appendix D - Legal Appendix
Appendix E - 316(a) Demonstration
- Attachment E-1 - Assessment of PSE&G River Monitoring and Modeling Programs

Exhibit E-1-1 1995 Hydrodynamic Monitoring Results
Exhibit E-1-2 PSE&G 1997 Hydrothermal Monitoring - Ambient and One Unit Survey
Exhibit E-1-3 1998 Hydrothermal Monitoring - Two Unit Survey
Exhibit E-1-4 Bathymetric Survey
Attachment E-2 Hydrothermal Modeling Program
Attachment E-3 Analysis of Dissolved Oxygen in the Vicinity of the Station
Exhibit E-3-1 6 Month Mooring Dissolved Oxygen Calibration Protocol
Attachment E-4
Attachment E-5

Appendix F - Section 316(b) Demonstration
Attachment F-1 Baywide and In-Plant Sampling Programs and Sampling Methods
Attachment F-2 Model Methodologies and Common Input Parameters
Attachment F-3 Review of Intake Technologies for Fish Protection
Attachment F-4 Biological Modeling of Fish Protection Alternatives
Attachment F-5 Seasonal Flow Reduction
Attachment F-6 Revised Outage Schedule
Attachment F-7 Closed-Cycle Cooling
Attachment F-8 Schedule for Modeling Unit Outages and Flow Reductions
Attachment F-9 The Value of lost Energy and Capacity
Attachment F-10 The Value of Increased Air Emissions Costs Due to Lost Power
Attachment F-11 Detailed Cost Tables
Attachment F-12 Commercial and Recreational Splits
Attachment F-13 Valuation of Commercial Catch
Attachment F-14 Valuation of Recreational Catch
Attachment F-15 Detailed Benefits Tables
Attachment F-16 Other Environmental Costs and Benefits

Appendix G - PSE&G's Compliance with the Special Conditions of the 1994 Permit is Providing and Will Provide Substantial Benefits
Supplement 1 - Special Conditions of the 1994 Settlement with DNREC

Attachment G-1 Intake Screen Improvements
Exhibit G-1-1 Traveling Water Intake Screen Modifications
Addendum G-1-1-1 Salem Maintenance Procedure Circulating Water Traveling Screen Periodic Inspection
Addendum G-1-1-2 Salem Maintenance Procedure Circulating Water Traveling Screen On-Line Inspection
Addendum G-1-1-3 Salem Operations Procedure Circulating Water Trash Rack Rake Operation
Exhibit G-1-2 Biological Efficiency of Improved Intake Screens

Attachment G-2 Wetlands Restoration Success
Attachment G-2-1 Land Selection, Acquisition and Preservation Program
Exhibit G-2-2 Reference Marsh: Background for Selection and Use
Exhibit G-2-3 Restoration of Normal Daily Tidal Inundation and PSE&G's Wetlands Sites
Exhibit G-2-4 Vascular Plant and Algal Production Monitoring and Geomorphological Monitoring
Addendum G-2-4-1 Orthophotographs
Addendum G-2-4-2 Vegetation Type Maps
Addendum G-2-4-3 Geomorphologic Maps
Addendum G-2-4-4 Algal Sampling Statistical Summaries
Addendum G-2-4-5 Ground Level Photographs of Selected Vegetation Covers Types
Exhibit G-2-5 Preservation and Management of the Bayside Tract and Upland Buffers Benefits the Delaware Estuary
Exhibit G-2-6 Common Reed (*Phragmites Australis*): The Plant and its Relationships

Exhibit G-2-7 Residual Pesticide Monitoring at PSE&G's Salt Hay Farm Wetland Restoration Sites
Exhibit G-2-8 Assessment of Offsite Flooding Effects Associates with Wetland Restoration Activities
Exhibit G-2-9 Groundwater Response to Wetland Restoration Activities
Addendum G-2-9-1 Field Investigation Procedures Followed by Woodward Clyde Consultants at Salt Hay Farm Sites
Exhibit G-2-10 Part 1 PSE&G's Spray and Burn Program for the Control of Phragmites
Exhibit G-2-10 Part II Toxicological Hazard and Risk Assessment of Glyphosate in Association with Marsh Restoration in the Delaware Estuary
Exhibit G-2-10 Part III Ecological Risk Assessment of the Use of Glyphosate for the PSE&G Wetland Restoration Program
Addendum G-2-10-III-1 Raw Data Table of Acute Toxicity Values
Exhibit G-2-11 Assessment of Potential Effects of PSE&G's Wetland Restoration and Upland Buffer Preservation Activities on Threatened and Endangered Species
Exhibit G-2-12 Potential Effects of Diked Salt Hay Farm Restoration on Horseshoe Crabs
Exhibit G-2-13 Enhancement Benefits to Waterfowl, Shorebirds and Other Wildlife of the Delaware Bayshore Region
Exhibit G-2-14 Human Access-Related Benefits Associates with the Wetlands Restoration
Exhibit G-2-17 Phragmites Migration Addendum G-2-17-1 Mapping/Difficulties

Attachment G-3 Evaluation of Faunal Response to Marsh Restoration: A Synthesis
Exhibit G-3-1 Evaluating Salt Marsh Restoration in Delaware Bay: Summary of Three Years of Fish Utilization Monitoring
Exhibit G-3-2 Evaluating Salt Marsh Restoration in Delaware Bay: Summary of Two Years of Food Habits Monitoring
Exhibit G-3-3 Food Habits of Large Predatory Fishes: Comparisons Between Restored and Reference Marshes
Exhibit G-3-4 Utilization of Reference and Restored Tidal Creeks by Young-Of-The-Year Atlantic Croaker, *Micropogonias Undulatus*, as Demonstrated by Mark-And-Recapture Techniques
Exhibit G-3-5 Utilization of Tidal Creeks by a Large Predatory Fish as Demonstrated by Ultrasonic Tracking: Comparison of a Restored and a Reference Marsh
Exhibit G-3-6 Response of Killifishes to Marsh Restoration in Delaware Bay
Exhibit G-3-7 Comparison of Distribution and Feeding Ecology of Young-Of-The-Year *Fundulus Heteroclitus* Between a Restored Salt Hay Farm and a Reference Marsh
Exhibit G-3-8 Relative Importance of Benthic Microalgae, Phytoplankton and the Detritus of Smooth Cordgrass (*Spartina*) and the Common Reed (Phragmites) to Brackish Marsh Food Webs
Exhibit G-3-9 Occurrence of Small Pelagic Fishes in Tidal Creeks at the Dennis Township Salt Hay Farm Restoration Site
Exhibit G-3-10 The Response of Blue Crabs, *Callinectes Sapidus*, to Salt-Marsh Restoration in Delaware Bay
Exhibit G-3-11 Spatial Variation in Delaware Bay (U.S.A.) Marsh Creek Fish Assemblages
Exhibit G-3-12 Fish Studies in the Delaware Bay and Adjacent Marshes Literature
Exhibit G-3-13 Preliminary Analysis of Effects of Reed Grass (*Phragmites Australis*) Invasion on Marsh Surface Macrofauna: Response to Fishes
Exhibit G-3-14 Stable Isotope and RNA-DNA Analysis of Juvenile Fishes From Open Water and Tidal Marsh Habitats of Delaware Bay
Exhibit G-3-17 Aspects of the Distribution and Life History for Selected Species in Delaware Bay
Exhibit G-3-18 Occurrence of *Neomysis Americana* in Tidal Creeks at Dennis Township Salt Hay Farm Wetland Restoration Sites

Attachment G-4 Bioenergetic Modeling of Restored and Reference Wetland Sites

Attachment G-5 Fish Ladders Provide Increased Fisheries Production in the Delaware Estuary
- Exhibit G-5-1 Site Characterization and Selection Process
- Exhibit G-5-2 Fish Ladder Design/As-Build Drawings
- Exhibit G-5-3 Ladder Operation and Maintenance
- Exhibit G-5-4 Fish Ladder Monitoring
- Exhibit G-5-6 Juvenile Herring Emigration at PSE&G Fish Ladder Sites
- Exhibit G-5-7 Fish Ladder Site Photographs

Attachment G-6 Bioenergetic Modeling of Sites Where Fish Ladders Have Been Installed

Attachment G-7 Feasibility Study on the Use of Sound to Deter Fish From the Vicinity of the Salem Generating Station Circulating Water Intake Structure
- Exhibit G-7-1 Study Chronology
- Exhibit G-7-2 Report on 1994 Cage Tests
- Exhibit G-7-3 Report on 1998 Supplemental Cage Tests
- Addendum G-7-3-1 Sound Spectrum Plots
- Exhibit G-7-4 Report on Sound Field Mapping
- Addendum G-7-4-1 Sound Pressure Level Spectrum Plots
- Exhibit G-7-5 Report on 1998 In Situ Tests
- Addendum G-7-5-1Summer and Fall Sonic Deterrent Study Schedule and Fish Length Data

Attachment G-8 PSE&G Monitoring Programs
- Exhibit G-8-1 Biological Monitoring Program Workplan

Attachment G-9 Other Estuarine Improvements: Artificial Reefs and Restoration of Augustine Creek Impoundment
- Exhibit G-9-1 Artificial Reefs Increase Fisheries Production in the Delaware Estuary
- Exhibit G-9-2 Restoration of Augustine Creek Impoundment

Appendix H - Cumulative Effects Assessment

Appendix I - Compensation

Appendix J - Analysis of Trends for Selected Finfish and Blue Crab

Appendix L - Data Set Descriptions

Reference Volumes