Chapter B2: Technical and Economic Descriptions of In Scope Facilities of the Delaware Estuary Transition Zone

This chapter presents additional information related to in scope facilities within the Delaware Estuary transition zone. Section B2-1 presents detailed EIA data on the generating units (Salem, Hope Creek, Edge Moor, and Deepwater) addressed by this case study and within the scope of the Phase II rulemaking (i.e., in-scope facilities). Section B2-2 describes the configuration of the intake structure(s) at the in-scope facilities and out-of-scope electric generating and industrial facilities. For the in-scope power facilities, Section B2-3 presents an evaluation of the specific impacts of the proposed Phase II rule, i.e., defines the baseline for calculating benefits.

CHAPTER CONTENTS

B2-1 Operational Profile B2-1
B2-2 CWIS Configuration and Water Withdrawal B2-9

B2-1 Operational Profile

a. Salem

During 1999, the Salem power plant operated three active units.[1] Two of these are large nuclear units that use cooling water withdrawn from the Delaware River (Units 1 and 2). The third unit is a small gas turbine (GT3). The nuclear units began operation in June 1977 and October 1981, respectively.

Salem's total net generation in 1999 was 16.0 million MWh. Unit 1 accounted for 8.0 million MWh, or 50.2 percent of the plant's total, while Unit 2 accounted for 7.9 million MWh or 49.8 percent. The capacity utilization of these two nuclear units was 78.1 percent and 77.6 percent, respectively.

Table B2-1 presents details for Salem's three units.

Table B2-1: Salem Generator Characteristics (1999).

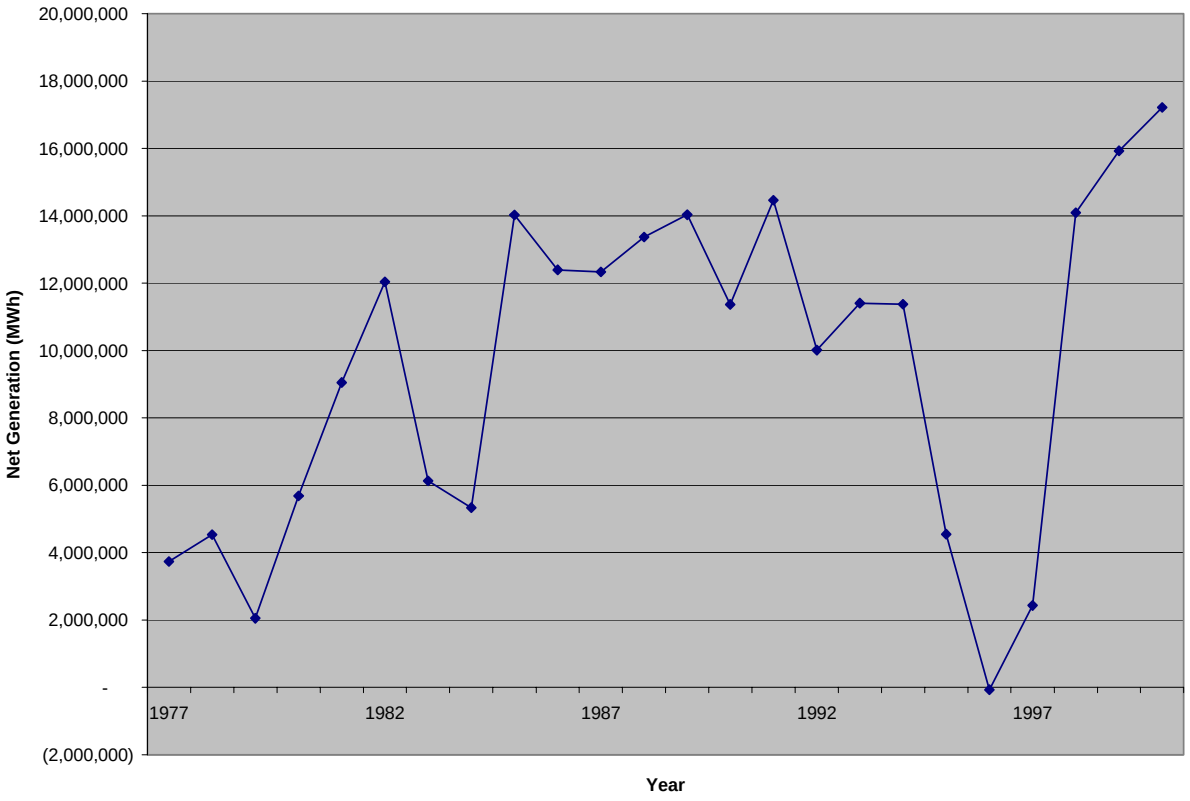
Unit ID	Capacity (MW)	Prime Mover[a]	Energy Source[b]	In-Service Date	Operating Status	Net Generation (MWh)	Capacity Utilization[c]	ID of Associated CWIS
1	1,170	NP	UR	Jun. 1977	Operating	8,009,172	78.1%	SA1
2	1,170	NP	UR	Oct. 1981	Operating	7,949,387	77.6%	SA2
GT3	42	GT	FO2	Jun. 1971	Operating	2,752	0.8%	Not applicable
Total	**2,382**					**15,961,311**	**76.5%**	

[a] Prime mover categories: NP = nuclear power; GT = gas turbine.
[b] Energy source categories: UR = Uranium; FO2 = No. 2 Fuel Oil.
[c] Capacity utilization was calculated by dividing the unit's actual net generation by the potential net generation if the unit ran at full capacity all the time (i.e., capacity * 24 hours * 365 days).
Source: U.S. Department of Energy, 2001a, 2001b, 2001d.

[1] For the purposes of this analysis, "active" units include generating units that are operating, on standby, on cold standby, on test, on maintenance/repairs, or out of service (all year). Active units do not include units that are on indefinite shutdown or retired.

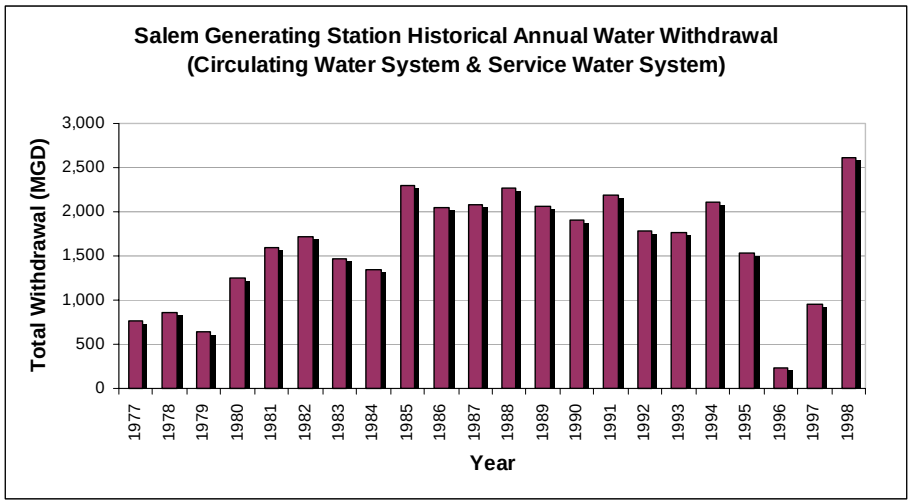
Figure B2-1 below presents Salem's electricity generation history between 1977 and 2000 and Figure B2-2 presents Salem's operational intake flows. Figure B2-1 shows that since 1982, when both of Salem's nuclear units were fully operational, Salem's generation has ranged between 10 and 18 million MW. During two periods, however, 1983-1984 and 1995-1996, Salem's generation was considerably lower. During 1995, Unit 1 was operating at only 26.0 percent while Unit 2 was operating at 20.8 percent. Both nuclear units were shut down during 1996, and during 1997, Unit 2 resumed generation at 25.5 percent of capacity while Unit 1 remained shut down (U.S. Department of Energy, 2002).

Figure B2-1: Salem Net Electricity Generation 1977 - 2000 (in MWh)



Source: U.S. Department of Energy, 2001d.

Figure B2-2: Salem Operational Intake Flows 1977 - 1998 (in MGD)



Year	Total Withdrawal (MGD)
1977	758
1978	858
1979	644
1980	1,254
1981	1,598
1982	1,713
1983	1,462
1984	1,336
1985	2,298
1986	2,040
1987	2,082
1988	2,267
1989	2,056
1990	1,903
1991	2,184
1992	1,778
1993	1,763
1994	2,109
1995	1,529
1996	227
1997	949
1998	2,612

Source: PSEG, 2001f.

b. Hope Creek

Hope Creek operates one active nuclear unit. The unit began operation in November 1986 and uses cooling water withdrawn from the Delaware River. Hope Creek's total net generation in 1999 was 7.7 million MWh with a capacity utilization of 75.1 percent.

Table B2-2 presents details for Hope Creek's unit.

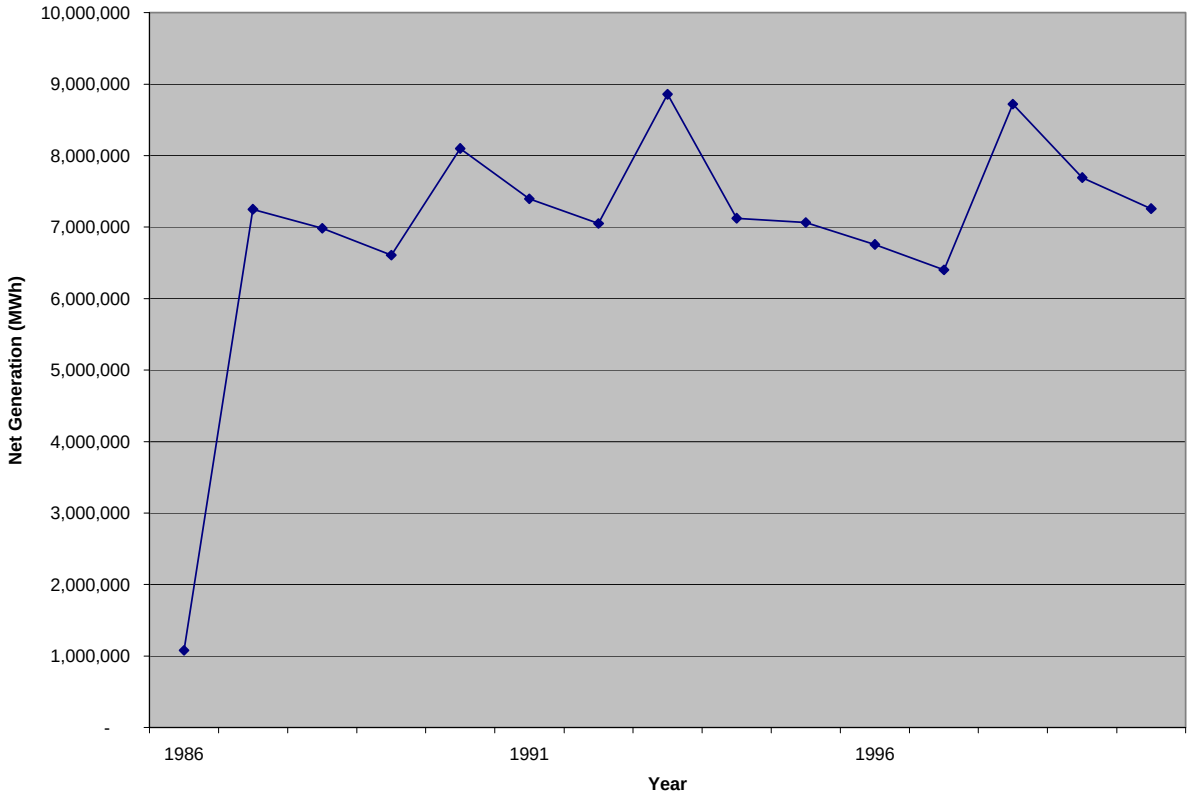
Table B2-2: Hope Creek Generator Characteristics (1999)

Unit ID	Capacity (MW)	Prime Mover[a]	Energy Source[b]	In-Service Date	Operating Status	Net Generation (MWh)	Capacity Utilization[c]	ID of Associated CWIS
1	1,170	NB	UR	Nov. 1986	Operating	7,701,078	75.1%	HC1
Total	**1,170**					**7,701,078**	**75.1%**	

[a] Prime mover categories: NB = nuclear.
[b] Energy source categories: UR = uranium.
[c] Capacity utilization was calculated by dividing the unit's actual net generation by the potential net generation if the unit ran at full capacity all the time (i.e., capacity * 24 hours * 365 days).
Source: U.S. Department of Energy, 2001a, 2001b.

Figure B2-3 below presents Hope Creek's electricity generation history between 1986 and 2000. The graph shows that Hope Creek's generation has been relatively stable since its first full year of operation in 1987, ranging between 6.5 and 9 million MW, with a capacity utilization of between 64 and 86 percent.

Figure B2-3: Hope Creek Net Electricity Generation 1986 - 2000 (in MWh)



Source: U.S. Department of Energy, 2001d.

c. Edge Moor

During 1999, the Edge Moor power plant operated four active units. Three of these units employ a steam-electric prime mover (Units 3 and 4 are coal-fired, Unit 5 is oil-fired) and use cooling water withdrawn from the Delaware River while Unit 10 is a gas turbine. All active units were built between December 1954 and August 1973. Two additional steam-electric units, Units 1 and 2, were retired during July 1983.

Edge Moor's total net electricity generation in 1999 was 2.2 million MWh. The oil-fired steam-electric unit accounted for 1.2 million, or 54 percent, of this total. The two coal-fired steam-electric units accounted for a combined 1.0 million, or 45 percent. The capacity utilization of Edge Moor's steam-electric units ranged from 30.7 percent to 49.3 percent.

Table B2-3 presents details for Edge Moor's four active and two retired units.

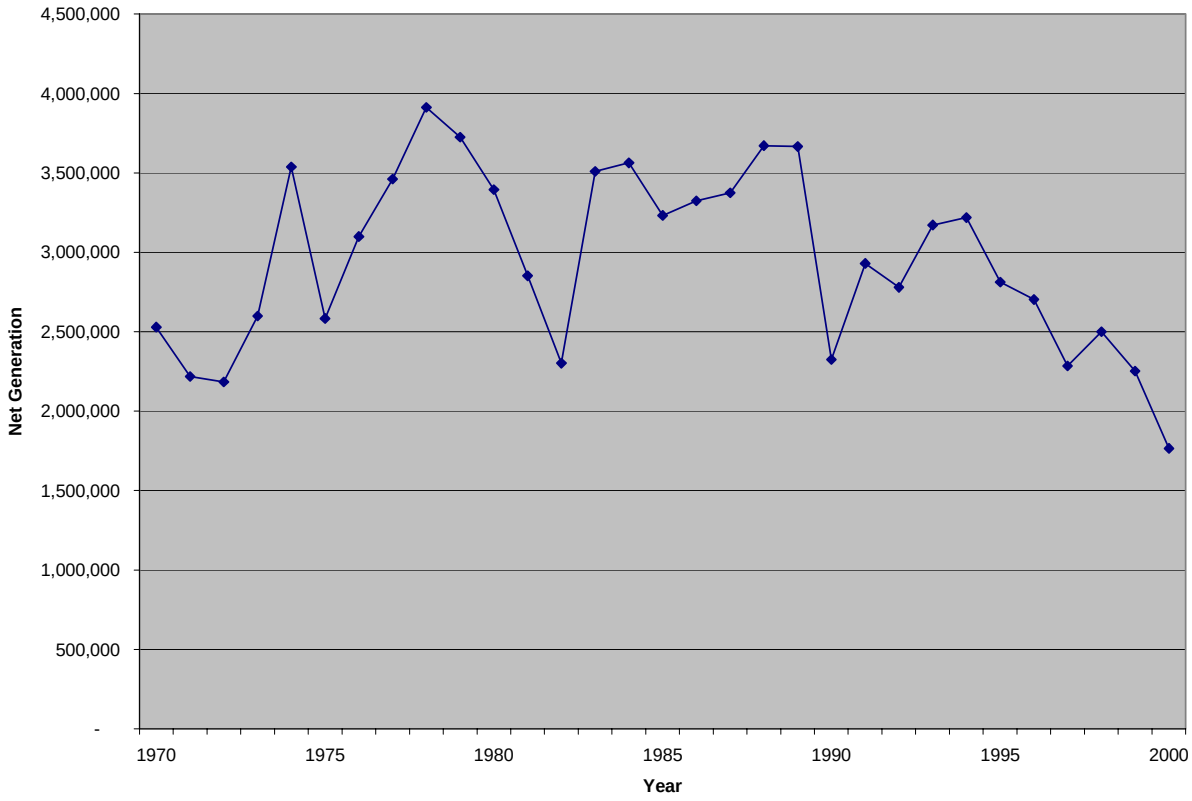
Table B2-3: Edge Moor Generator Characteristics (1999).

Unit ID	Capacity (MW)	Prime Mover[a]	Energy Source[b]	In-Service Date	Operating Status	Net Generation (MWh)	Capacity Utilization[c]	ID of Associated CWIS
1	69	ST	FO6	Jun. 1951	Retired - Jul. 1983			
2	69	ST	FO6	Jul. 1951	Retired - Jul. 1983			
3	75	ST	BIT	Dec. 1954	Operating	278,410	42.4%	3
4	177	ST	BIT	Apr. 1966	Operating	763,383	49.3%	4
5	446	ST	FO6	Aug. 1973	Operating	1,201,164	30.7%	5
10	13	GT	FO2	Jun. 1963	Operating	662	0.6%	Not applicable
Total[d]	**710**					**2,243,619**	**36.1%**	

[a] Prime mover categories: ST = steam turbine, GT = gas turbine.
[b] Energy source categories: FO6 = No. 6 Fuel Oil, BIT = Bituminous Coal, FO2 =No. 2 Fuel Oil.
[c] Capacity utilization was calculated by dividing the unit's actual net generation by the potential net generation if the unit ran at full capacity all the time (i.e., capacity * 24 hours * 365 days).
[d] Total only includes units that are operating.
Source: U.S. Department of Energy, 2001a, 2001b, 2001d.

Figure B2-4 below presents Edge Moor's electricity generation history between 1970 and 2000. Edge Moor's generation has varied considerably during this time period, ranging from a high of almost 4 million MWh to a low of less than 1.8 million. The closure of Units 1 and 2 in 1983 does not seem to have affected Edge Moor's electricity generation profile between 1970 and 2000.

Figure B2-4: Edge Moor Net Electricity Generation 1970 - 2000 (in MWh)



Source: U.S. Department of Energy, 2001d.

d. Deepwater

During 1999, the Deepwater power plant operated four active units: Units 1, 4, 6, and GTA. Each unit has a steam-electric prime mover and uses cooling water withdrawn from the Delaware River; while Unit GTA is a gas turbine. All active units were built between May 1930 and April 1967. In addition, three steam-electric units were retired between June 1991 and July 1994 (Units 3, 5, and 7).

Deepwater's total net generation in 1999 was approximately 0.36 million MWh. Unit 6 accounted for 0.32 million MWh, or 87 percent, of this total. Unit 1 was shut down for five months during 1999 but accounted for most of the remaining 10.5 percent of total net generation. The capacity utilization of Deepwater's active operating units ranged from 4.6 percent (Unit 1) to 39.2 percent (Unit 6). Unit 4 was on cold standby during 1999 and had a capacity utilization rate of 0.1 percent.

Table B2-4 presents details for Deepwater's four active and three retired units.

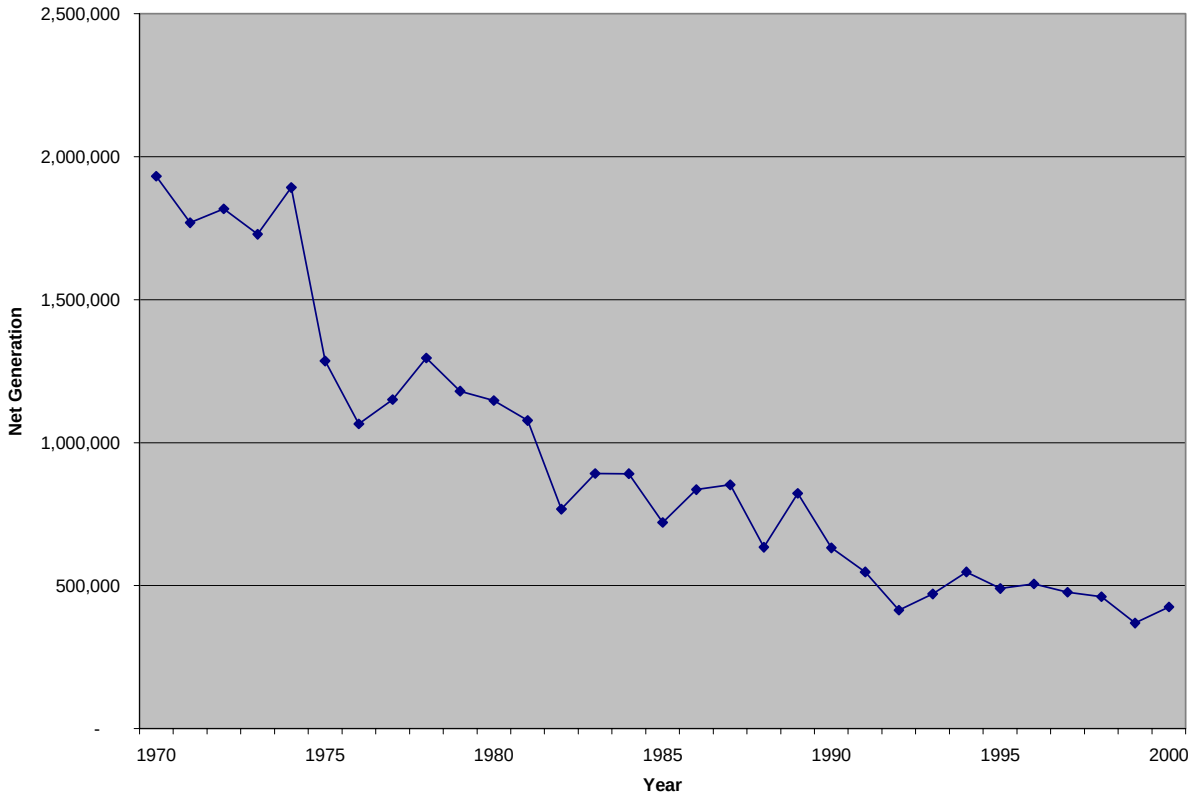
Table B2-4: Deepwater Generator Characteristics (1999).

Unit ID	Capacity (MW)	Prime Mover[a]	Energy Source[b]	In-Service Date	Operating Status	Net Generation (MWh)	Capacity Utilization[c]	ID of Associated CWIS
3	53	ST	FO6	Mar. 1930	Retired - Jun. 1991			
5	20	ST	BIT	Mar. 1942	Retired - Jul. 1994			
7	27	ST	BIT	May 1957	Retired - Jul. 1994			
4	53	ST	FO6	May 1930	Cold Standby	664	0.1%	4
6	92	ST	BIT	Dec. 1954	Operating	315,683	39.2%	4
1	96	ST	NG	Dec. 1958	Operating	38,262	4.6%	1
GTA	19	GT	NG	Apr. 1967	Operating	9,787	5.9%	Not applicable
Total[d]	**260**					**364,396**	**16.0%**	

[a] Prime mover categories: ST = steam turbine, GT = gas turbine.
[b] Energy source categories: FO6 = No. 6 Fuel Oil, BIT = Bituminous Coal, NG = natural gas.
[c] Capacity utilization was calculated by dividing the unit's actual net generation by the potential net generation if the unit ran at full capacity all the time (i.e., capacity * 24 hours * 365 days).
[d] Total only includes units that are operating.
Source: U.S. Department of Energy, 2001a, 2001b, 2001d.

Figure B2-5 below presents Deepwater's electricity generation history between 1970 and 2000. The graph shows that Deepwater's electricity generation has steadily declined throughout the 30-year time period. The considerable decline in the mid-1970s may partly be explained by the construction of two new large nuclear facilities in the region. *Three Mile Island* began operation of an 872 MW unit in 1974. A second unit of 961 MW began operation in December of 1978. In addition, *Calvert Cliffs* began operation of a 918 MW unit in 1975 and of a second, 911 MW, unit in 1977. These modern baseload plants may have displaced some of the generation of older, less efficient plants like Deepwater.

Figure B2-5: Deepwater Net Electricity Generation 1970 - 2000 (in MWh)



Source: U.S. Department of Energy, 2001d.

B2-2 CWIS Configuration and Water Withdrawal

This section describes clean water intake structure technologies at power generating and industrial facilities in the Delaware River Transition Zone. In addition to the 4 in-scope power generating facilities, PSE&G's Logan Generating Station and Conectiv's Hay Road Generating Station are located in the Transition Zone. The Logan Generating Station withdraws only 2 million gallons per day (MGD) from the Delaware River and has fine mesh wedgewire screens on the intake structure. The Hay Road Station withdraws only 1.6 MGD and has a wet, closed cycle cooling system. EPA does not have information on the design of the intake structure at Hay Road or three industrial facilities, SPI Polyols, Citisteel, and Sun Refining, also in the Transition Zone. Each of the industrial facilities has intake flows of less than 10 MGD. The combined intake flows for the three industrial facilities (about 12 MGD) represented only about 0.4 percent of the total cooling water intake flow. For purposes of estimating damages, EPA has assumed that Hay Road and three industrial facilities have conventional traveling screens.

a. Salem

PSE&G's Salem Generating Station has twelve separate intake bays in the Delaware River, six bays each for Generating Units 1 and 2. Prior to 1979, Salem Unit 1 had conventional (linkbelt) traveling screens designed for intermittent operation and debris handling. In 1979, Ristoph traveling screens with 3/8 inch mesh were installed on the Unit 1 intakes. The screens were designed for continuous rotation with fish handling and return systems. When Unit 2 came on-line in 1981, its intakes were designed with the same Ristoph screen system as Unit 1. Salem's screen and fish handling and return systems were most recently modified in 1994-95 to enhance fish survival. Both the screens and the fish baskets are now constructed of smooth materials with curved lips on the 10-foot long fish baskets. A low pressure spray is used to remove organisms followed by a high pressure spray to remove remaining debris. Fish and debris washed from the screens are returned to the river through bi-directional troughs on the north or south side of the intake structure depending upon the direction of tidal flow.

Under the conditions of the facility's 1994 NPDES permit reissuance, the operator has been required to restore a minimum of 10,000 acres of formerly diked wetlands and/or wetlands dominated by *Phragmites Australis*. Upland buffer can also count towards the 10,000 acre total at a 3:1 ratio. This has been ongoing since 1995. In addition, the permit requires the facility to construct a minimum of five fish ladders on the Delaware River tributaries to restore spawning runs of two species of river herring, namely alewife and blueback herring (steeppass ladder design). The permit also requires the operator to pursue the study of sound deterrents.

b. Hope Creek

PSE&G's Hope Creek Nuclear Generating station has a natural draft cooling tower system. Water is withdrawn from the Delaware River at Artificial Island just north of Salem, 20 feet from the shore. The cooling water intake structure consists of: (1) trash racks and trash rake, (2) curtain wall, and (3) four conventional traveling screens. Each screen is continuously rotated and baskets have troughs on the lower lips. A 20 pound per square inch (psi) low pressure wash is used to remove organisms followed by a 90 psi high pressure wash for debris removal. The average intake flow at the facility is 62 MGD to replace losses from evaporation and drift and the discharge of cooling tower blowdown.

c. Edge Moor

Conectiv's Edge Moor Power Plant withdraws water from the Delaware River. Since 1983, the cooling water intake structure has consisted of trash racks followed by traveling screens. Units 3 and 4 have a total of five 9.5 mm, dual flow traveling screens rotated intermittently. Unit 5 has 7 conventional traveling screens and one dual flow screen that are rotated intermittently once every 8 hours. Organisms and debris are washed off the screens with 80-120 psi sprays into a trough and then returned to the River. The total design capacity of the cooling water intake structures is about 782 MGD, which is also the approximate volume of water withdrawn from the river.

d. Deepwater

Conectiv's Deepwater Generating Station obtains cooling water make-up from three intake bays in the Delaware River at the Delaware Memorial Bridge. The average intake flow at the facility is 104.6 MGD from the river. The 3 intake bays supply water to Generating Units 1, 4, and 6. As noted above, Unit 4 was on cold standby as of 1999 with only minimal generation and intake requirements. Water is withdrawn through an intake structure (or intake crib) which is located approximately 75 feet off shore. Each intake is equipped with a single bay and trash racks. The intake water passes through submerged pipes that are located eight feet (bottom elevation) below mean low water on the shoreline bulkhead opposite the intake crib. The space between the face of the bulkhead and the back of the intake crib forms a discharge canal that is parallel to the river and open at both ends. The intake water then passes through on-shore conventional traveling screens where there are two screens

for each unit. The screens are not rotated on a continuous basis. The screens are equipped with a debris removal system and return sluice.

e. Chambers Works

Dupont's Chambers Works facility has a dedicated intake structure co-located with the Deepwater Generating Station's offshore intakes in Delaware River at the Delaware Memorial Bridge. The intake consists of angled bar screens and two modified traveling screens. The screens are stainless steel wire mesh with 6.4 mm openings and lip troughs. Organisms removed by the low pressure spray are collected and returned to the river through a fiberglass fish sluice that is not submerged. Therefore, any surviving organisms returned to the surface waterbody via the return system would experience a drop in gravity prior to reaching the water surface. The operator can provide flow augmentation, as needed, to the fish sluice. The screens are rotated and cleaned once every 8 hours. The average intake flow is 37 MGD from the River.

f. Delaware City Refinery

Motiva's Delaware City Refinery withdraws water from the Delaware River via Cedar Creek. Cedar Creek is essentially an intake canal, used primarily for non-contact cooling. The facility's cooling water intake structure is located at the terminus of Cedar Creek approximately one mile from the river. The cooling water intake structure consists of a trash rack followed by 9 vertical traveling screens located in front of the circulating water pumps. Six screens have 3/8 inch mesh and the other three are 3/16 inch mesh. During summer, each screen is rotated once every 8 hours for 30 minutes. During winter, screen rotation occurs once per day. Organisms and fish are washed off the screen with a 70 psi spray into 6 inch deep trough. The trough flows back into Cedar Creek about 1,000 feet downstream from the intake. The facility has a small cooling tower on-site. However, the recirculating flow is minimal compared to the overall intake flow. The average intake flow is 364 MGD from Cedar Creek.

g. Dupont Chemical and Pigment

The Dupont Chemical and Pigment Department facility has one cooling water intake structure that provides make-up for two non-contact, once through cooling systems as well as process water for facility operations. The intake is located 180 feet offshore in the Delaware River. The intake has vertical, conventional single entry/exit traveling screen and fish/debris conveyance trough. The design capacity of the intake is 33.8 MGD. The average intake flow is 7 MGD from the river.

h. General Chemical Corporation

General Chemical Corporation's Delaware Valley facility has an intake structure located along the Delaware River shoreline. The structure is dedicated to facility cooling operations and consists of trash racks and conventional vertical traveling screens. The average intake flow is 33.9 MGD from the river.