FINAL ENVIRONMENTAL IMPACT STATEMENT

By the

NEW YORK STATE
DEPARTMENT OF ENVIRONMENTAL CONSERVATION

As Lead Agency

Concerning the
Applications to Renew

NEW YORK
STATE POLLUTANT DISCHARGE ELIMINATION SYSTEM
(SPDES) PERMITS

For the

ROSETON 1 & 2, BOWLINE 1 & 2
AND INDIAN POINT 2 & 3
STEAM ELECTRIC GENERATING STATIONS,
ORANGE, ROCKLAND AND WESTCHESTER COUNTIES

HUDSON RIVER POWER PLANTS FEIS

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Prepared by NYS Department of Environmental Conservation

Contact:
Betty Ann Hughes, NYS DEC, Division of Environmental Permits
625 Broadway, Albany, NY 12233-1750
(518) 402-9167; bahughes@gw.dec.state.ny.us

Final Environmental Impact Statement
for SPDES Permit Renewals at
Roseton 1 & 2, Bowline 1 & 2
And Indian Point 2 & 3
Steam Electric Generating Stations

This Final Environmental Impact Statement (FEIS) consists of multiple sections:

- The fundamental underlying data and studies are contained in the 1999 DEIS, which is incorporated as part of this FEIS. The 1999 DEIS contains an extended description of the environmental setting, which is not duplicated in this FEIS.
- An Executive Summary immediately follows the Table of Contents.
- The first section following the Executive Summary of this FEIS is a discussion of the regulatory setting for and history of the proposed action which updates and augments the materials in the DEIS.
- The next section of this FEIS is a table in which all public comments received by the Department on the DEIS are excerpted and summarized. A list of all commentors is provided at the end of the table. The full texts of all comments received by the Department are included in Appendix F-I.
- The Department's responses to public comments complete the FEIS. In the interest of responding most effectively to the submitted comments, Department staff grouped the comments under related themes and responded to each theme.
- In addition to the public comments, other appendices provide background reports and reference materials that may not be readily available to readers.

FINAL ENVIRONMENTAL IMPACT STATEMENT

NEW YORK
STATE POLLUTANT DISCHARGE ELIMINATION SYSTEM PERMITS

For the ROSETON 1 & 2, BOWLINE 1 & 2, and INDIAN POINT 2 & 3
STEAM ELECTRIC GENERATING STATIONS

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EXECUTIVE SUMMARY

The action before the New York State Department of Environmental Conservation (Department) is the decision whether to renew State Pollutant Discharge Elimination System (SPDES) permits which would allow three steam electric generating stations to discharge waste heat, a pollutant, to the waters of the Hudson River; the permits would also allow the facilities to continue to withdraw water from the Hudson River for use as cooling water. The three facilities are:

- Bowline Point (Units 1 and 2), West Haverstraw, Rockland County;
- Indian Point (Units 2 and 3), Buchanan, Westchester County; and
- Roseton (Units 1 and 2), Newburgh, Orange County

(*See* Figure 1 in main text for general locations of all 3 facilities).

In December 1999, the owners and operators of the three facilities submitted a Draft Environmental Impact Statement (DEIS) to the Department which assessed the resources likely to be impacted by the facilities; evaluated alternative technologies and management strategies to mitigate impacts from each facility's operations; and proposed a preferred action intended to reduce the respective impacts. In March 2000, the Department accepted the DEIS for purposes of review and subsequently issued a Notice of Complete Application in the Environmental Notice Bulletin and in newspapers in the vicinity of each facility.

Department staff have further reviewed the DEIS and conclude that, while it was acceptable as an initial evaluation and assessment, it is not sufficient to stand as the final document, and additional information as to alternatives and evaluation of impacts must be considered. These considerations have been undertaken by Department staff to develop a final environmental impact assessment. This Final Environmental Impact Statement (FEIS) consists of the original DEIS submitted by the facilities' operators; comments received on the DEIS; the Department's responses to those comments, with similar comments grouped for response purposes; plus expanded discussions of the regulatory setting and alternatives for mitigation of impacts from the operation of the HRSA plants.

The Hudson River is rich with aquatic life, providing habitat for the early, sub-adult, and adult life stages of many aquatic species, including a number of game, commercial, and forage fish species. The Department's regulatory role includes limiting thermal discharges from each facility to ensure the survival of aquatic resources and also preventing aquatic organism mortality

resulting from impingement and entrainment at each facility's cooling water intake structure (CWIS).[1]

To illustrate the magnitude of impacts of entrainment, Table 1 (below) uses data from the DEIS to calculate the average annual number of organisms of six of the fish species entrained by the three facilities.[2] If one assumes that all entrained fish die, as does the United States Environmental Protection Agency (USEPA) in its proposed rulemaking for cooling water intakes, then the total number of fish entrained is equal to total mortality from entrainment.[3]

Table 1. Estimated Average Numbers of Selected Fish Species Entrained Annually at Roseton, Indian Point, and Bowline Stations, Based on In-plant Abundance Sampling, 1981-1987.[4]

Plant / Species	Roseton	Indian Point	Bowline	Total
American Shad	3,128,571	13,380,000	346,667	16,855,238
Bay Anchovy	1,892,500	326,666,667	81,000,000	409,559,167
River Herring[5]	345,714,286	466,666,667	13,814,286	826,195,238

[1] Entrainment occurs when small aquatic life forms are carried into and through the cooling system as water is withdrawn for use in a plant's cooling system; impingement occurs when larger aquatic life forms are caught against racks or screens at the intakes, where they may be trapped by the force of the water, suffocate or be otherwise injured.

[2] DEIS Appendix VI-1-D-2, "Estimated Total Number of Fish Entrained", and DEIS Appendix VI-1-D-1, "Estimated Number of Fish Killed Due to Entrainment", (both utilizing generator estimates of through-plant survival), and calculating the mean mortality over the years presented for each species at each facility.

[3] National Pollutant Discharge Elimination System - Proposed Regulations to Establish Requirements for Cooling Water Intake Structures at Phase II Existing Facilities. USEPA Docket No. OW-2002-0049; *see* 67 FR 17122.

[4] Figures are absolute numbers of entrainable life stages, including eggs, yolk-sac larvae, post-yolk-sac larvae, and some juveniles, of the species studied.

[5] "River Herring" includes both Blueback Herring and Alewife, which are difficult to differentiate in their early life stages. It does not include other herring species like shad.

Striped Bass	129,857,143	158,000,000	15,571,429	303,428,571
White Perch	211,428,571	243,333,333	13,257,143	468,019,048
Atlantic Tomcod[6]	No Data This Study	No Data This Study	No Data This Study	No Data This Study
Total	692,021,071	1,208,046,667	123,989,524	2,024,057,262

The generators attempted to estimate through-plant survival, and using those adjustments, the calculations result in a slightly lower number of fish killed by entrainment mortality, as shown in Table 2 (below).

Table 2. Estimated Annual Entrainment Mortality of Six Fish Species at Roseton, Indian Point, and Bowline Stations, Using Generator Estimates of Through-plant Survival.

Plant / Species	Roseton	Indian Point	Bowline	Total
American Shad	2,500,000	10,640,000	281,667	13,421,667
Bay Anchovy	1,892,500	326,666,667	78,285,714	406,844,881
River Herring	277,142,857	371,666,667	11,085,714	659,895,238
Striped Bass	40,428,571	46,500,000	4,671,429	91,600,000
White Perch	130,000,000	138,666,667	8,071,429	276,738,095
Atlantic Tomcod	No Data This Study	No Data This Study	No Data This Study	No Data This Study
Total	451,963,929	894,140,000	102,395,952	1,448,499,881

[6] No numbers are available for Atlantic tomcod because, for the source study, no collections were made during the early part of the season when Atlantic tomcod entrainment and mortality would be a serious issue.

Based on data presented in the DEIS and analyses in that and in this FEIS, Department staff conclude that the generators' estimates represent the lower boundary of the actual mortality range, that is, the actual mortality lies somewhere between the generators' number (low end) and 100% (upper end, all entrained organisms die). Later sections of this FEIS discuss the significance of entrainment mortality; other impacts of continued operation of the HRSA generating stations, including thermal impacts; and potential control or mitigation measures.

As a result of the Department's further review of the DEIS plus the additional information and analysis provided by staff, a draft permit can be developed for each facility. Each draft permit will be based on this FEIS together with a detailed, site-specific application for that station and will contain a decision on the "best technology available" (BTA) to minimize entrainment and impingement mortality at that station. These BTA decisions are required by §316(b) of the federal Clean Water Act.[7] Supplemental application materials relating to existing facilities and system designs are still necessary for each site. An individual draft permit will be issued for each site, but in general terms, each permit will require the covered facility to meet BTA by designating, as SPDES permit conditions, a compliance schedule to implement one or more of the technologies now available to substantially reduce entrainment and impingement mortalities from the cooling water intake at that station.

[7] 33 U.S.C. §§ 1251 - 1376

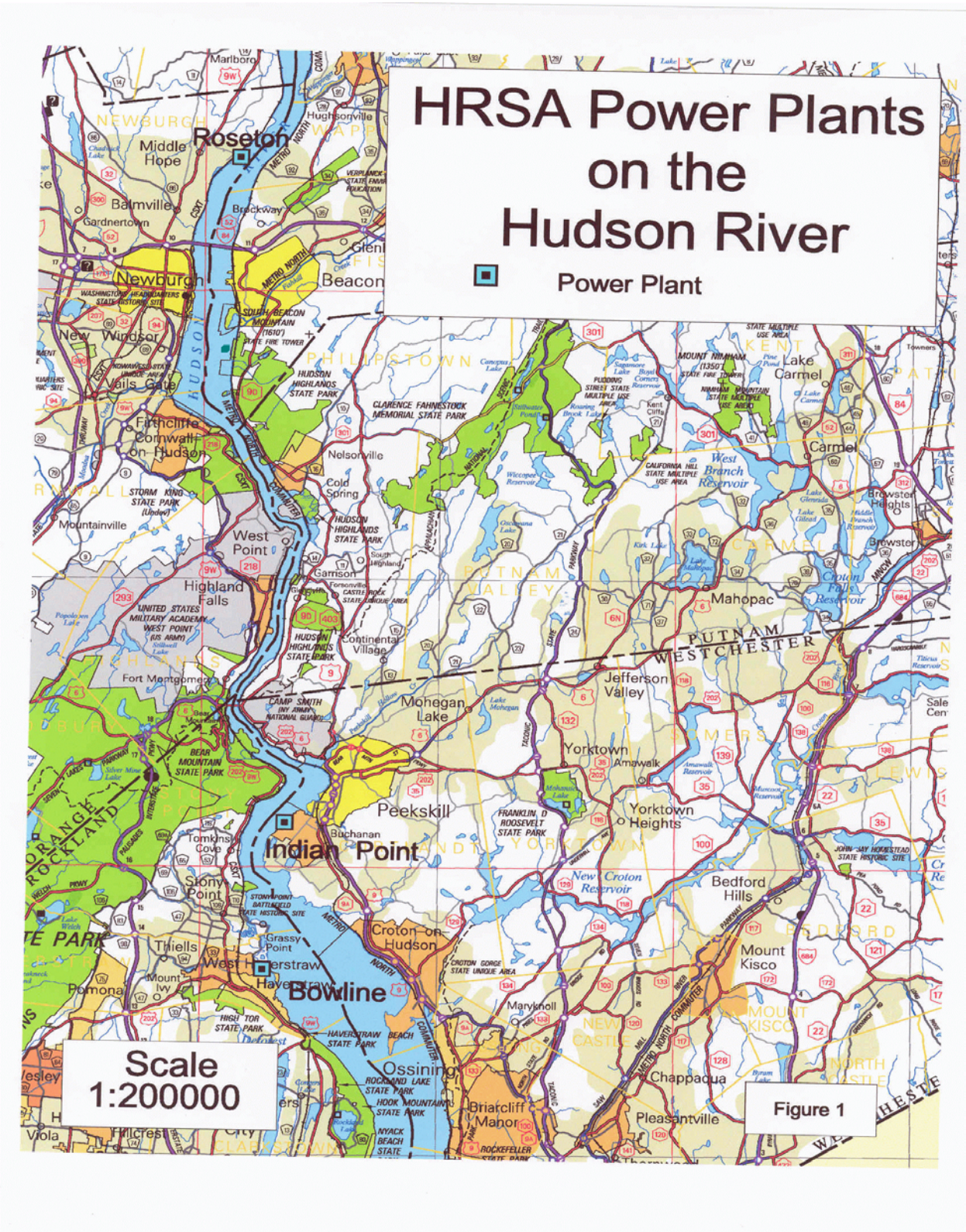
PROPOSED ACTION

The action before the New York State (NYS) Department of Environmental Conservation (Department) is the decision whether to renew State Pollutant Discharge Elimination System (SPDES) permits which would allow three steam electric generating stations to discharge pollutants, including waste heat, to the waters of the Hudson River. The permits, if renewed, would also allow the continued withdrawal of water from the Hudson River to be used as cooling water. The three facilities are:

- Bowline Point (Units 1 and 2), West Haverstraw, Rockland County;
- Indian Point (Units 2 and 3), Buchanan, Westchester County; and
- Roseton (Units 1 and 2), Newburgh, Orange County.

Figure 1, on the following page, shows the location of the three generating stations

Fig. 1. General Location of HRSA Plants[8]



[8] Scale about 20% reduced from original.

Project History

Permitting Authority

Bowline Point, Indian Point, and Roseton steam electric generating stations are all facilities which were in operation prior to enactment of the federal Clean Water Act in 1972. The Department regulates Bowline Point, Indian Point, and Roseton pursuant to its authority as the State agency approved by the United States Environmental Protection Agency (USEPA) to issue SPDES permits. On October 28, 1975, the USEPA gave its approval to the Department to administer the federal National Pollutant Discharge Elimination System (NPDES) program by virtue of a memorandum of agreement signed by the Department's Commissioner, Ogden R. Reed, and the Acting Region II Administrator for the USEPA, Eric B. Outwater. The Department's SPDES program is set forth in Article 17 of the Environmental Conservation Law (ECL), with underlying regulations promulgated at 6 NYCRR Parts 700 et seq and 750 et seq.

The Hudson River Settlement Agreement

Prior to authorizing the NYS SPDES program, earlier in 1975, the USEPA issued NPDES permits for the Indian Point nuclear power facility and the Roseton and Bowline Point fossil fuel power facilities. All three permits contained conditions to restrict thermal discharges, that is, water heated by the process of cooling the condenser coils at the fossil plants and by the secondary cooling phase of the nuclear power generation systems. At the time those permits were issued, the operators of these Hudson River power plants, Consolidated Edison (Con Ed) for Indian Point Unit 2, the New York Power Authority (NYPA) for Indian Point Unit 3, Central Hudson Gas and Electric (CHG&E) for Roseton, and Orange and Rockland Utilities (O&R) for Bowline Point used once-through cooling systems, withdrawing cooling water directly from and discharging the warmed effluent back to the Hudson River.

Among the issues considered by USEPA in issuing those 1975 NPDES permits were concerns regarding thermal discharges, cooling water intakes, and fish mortalities associated with the cooling water intakes. The USEPA's 1975 NPDES permits would have in effect required retrofitting of cooling towers at all three of these Hudson River power plants. In 1977, Con Ed, NYPA, CHG&E, and O&R (collectively, the "generators") sought an administrative adjudicatory hearing against the USEPA draft permits to overturn those cooling water intake conditions and other requirements of the 1975 NPDES permits. That and subsequent proceedings were joined by a number of other government agencies and non-governmental organizations (NGO's).

In 1981, after a number of years of adjudicatory proceedings, the generators signed the Hudson River Settlement Agreement (HRSA) to resolve the disputes relating to the USEPA's 1975 NPDES draft permits.[9] The HRSA was a 10-year agreement designed to obtain necessary data, impose needed analytical assessments, and develop an impact assessment to determine how best to mitigate impacts to the Hudson River from the three generating facilities. The HRSA was also executed by the USEPA, the NYS Attorney General, the Department, and involved NGO stakeholders including the Scenic Hudson Preservation Conference (Scenic Hudson), Hudson River Fishermen's Association (Riverkeeper), and the Natural Resources Defense Council (NRDC). The HRSA was effective for the ten year period from May 10, 1981 to May 10, 1991.

The HRSA provided, among other things, for mitigative measures to reduce fish mortalities at each generation facility as a result of: (a) impingement of adult and juvenile fish on racks and screens at the plants' intake structures, and (b) entrainment of fish eggs and larvae through the respective units' cooling apparatus. Those measures included seasonal "outages", or discontinuing cooling water usage by ceasing plant operations. Those measures also included installation of variable speed pumps at Indian Point Units 2 and 3 within three and one-half years after the effective date of the agreement, to keep the volumes of Hudson River water used for cooling to the minimum required for efficient operation. In addition, the HRSA established a biological monitoring program for monitoring fish species and their life stages at different Hudson River locations during each season.

Department SPDES Permits

By statute, SPDES permits for surface water discharges have a maximum duration of five years.[10] In 1982, the Department issued a SPDES permit to each of the facilities covered by the HRSA, including limitations governing the release of thermal discharges, and incorporating the terms of the HRSA agreement into the permit so that the environmentally protective mitigation measures set forth in the Agreement were included as conditions. These permits expired in 1987.

In 1987, the Department issued SPDES permit renewals to each of the three HRSA generation facilities (Indian Point Units 2 and 3 were issued a single permit even though the two units had different owners). These most recent SPDES permits for Indian Point Units 2 & 3, Bowline Point Units 1 & 2, and Roseton Units 1 & 2 Generating Stations became effective on October 1, 1987, with a common expiration date of October 1, 1992. Again, along with

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[9] The complete text of the HRSA is included as Appendix F-II to this FEIS.

[10] ECL §17-0817(1)

appropriate thermal discharge conditions, the HRSA agreement was incorporated into these permits and the HRSA mitigation provisions were continued as conditions for operation.

Prior to the expiration of the 1987 permits, on April 3, 1992, the generators submitted timely applications to the Department for renewal of their respective SPDES permits. Pursuant to the New York State Administrative Procedure Act (SAPA) and the Department's implementing regulations, "[w]hen a licensee has made a timely and sufficient application for the renewal of a license or a new license with reference to any activity of a continuing nature, the existing license does not expire until the application has been finally determined by the agency...".[11]

Also prior to the expiration of the 1987 SPDES permit, by correspondence dated May 15, 1991, the Department and the generators executed an agreement to continue the mitigative measures established in the 1981 agreement until SPDES renewal permits were issued. With respect to Indian Point Units 2 and 3, the letter agreement also memorialized Con Ed's and NYPA's commitment to install special fish protective screens to reduce fish impingement at the intake structures. In addition, the agreement provided that the parties would negotiate in good faith to develop a long-term resolution of**:** cooling water intake structures (CWIS), thermal discharges, fish mortality reductions due to mitigative measures, the costs of mitigative measures, and alternatives. Public notice was to be given of such negotiations and the parties expressed their understanding that intervener, including such groups as the Riverkeeper and Scenic Hudson, would be involved as participants in the negotiations.

On September 13, 1991, Riverkeeper, Scenic Hudson, and NRDC filed a law suit against the Department and the four generators seeking:

- annulment of the May 15, 1991 agreement between the Department and the generators;
- participation by those three NGO entities in the permitting process; as well as
- resolution of outstanding issues regarding mitigation measures.

Consent Orders

On March 23, 1992, the parties to that legal proceeding executed a judicially approved Consent Order resolving the matter which provided that the generators would continue the HRSA mitigative measures, such as the "outages" timed to reduce impacts to certain fish species, and to continue

[11] New York State Administrative Procedure Act (SAPA) §401(2); 6 NYCRR Part 621.

underwriting significant Hudson River fish species studies and data acquisition.[12]

The 1992 Consent Order was extended by the parties on four separate occasions, having expiration dates of September 1, 1994, September 1, 1995, September 1, 1997, and February 1, 1998. When the Fourth Amended Consent Order expired on February 1, 1998, the parties, who were by then actively engaged in negotiations regarding elements of draft SPDES permits, did not reach agreement to continue with a fifth extension of the Consent Order.[13] However, the generators agreed to continue the mitigative measures included in the continuing SPDES permit and provisions of the Fourth Amended Consent Order until new SPDES permits were issued to them.[14]

The Draft Environmental Impact Statements

On May 20, 1992, pursuant to the State Environmental Quality Review Act (SEQR), the Department issued a positive declaration requiring the generators to prepare an environmental impact statement regarding the 1992 applications for permit renewals.[15] That determination was based on the Department's assessment that the measures proposed in the generators' 1992 renewal applications were less protective of the Hudson River and its aquatic resources than the HRSA terms had been. In June 1993, the generators submitted a preliminary Draft Environmental Impact Statement (DEIS) to the Department in accordance with the regulatory requirement to submit a draft environmental impact statement for the renewal of their respective SPDES permits.

On September 3, 1993, the Department advised the four HRSA generators that it had reviewed the June 1993 preliminary DEIS and that their respective SPDES renewal applications remained incomplete pending receipt of additional information. The Department advised the generators of inadequacies of the preliminary DEIS, to which the generators later responded.

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[12] Natural Resources Defense Council, Inc., Hudson River Fishermen's Association, et al., v. NYSDEC, Consolidated Edison Company of New York, Inc., New York Power Authority, Orange and Rockland Utilities, Inc., and Central Hudson Gas & Electric Corp., Albany County, Index No. 6570-91.

[13] The Fourth Amended Consent Order is attached as Appendix F-III.

[14] In the remainder of this FEIS, the general term "Consent Order" will apply to the entire series of extensions unless a particular date or extension is named.

[15] ECL §8-0109.4; 6 NYCRR §617.7.

From 1993 to 1999, the Department, the generators, the New York State Department of Public Service (NYSDPS), the USEPA, the National Marine Fisheries Service (NMFS), the United States Fish and Wildlife Service (USFWS), Riverkeeper, NRDC, Scenic Hudson and New York Rivers United (NYRU) participated in an extensive effort to address numerous technical and procedural issues regarding the generators' plants, including conducting technical meetings or "workshops" of experts representing each participant or group, and conducting plenary meetings of all participants to draw together the technical and legal expertise devoted to resolving issues with the SPDES renewal applications for the HRSA plants.

On December 14, 1999, CHG&E, Southern Energy New York (successor to O&R), Con Ed, and NYPA presented the Department with a revised DEIS. Department Staff reviewed the DEIS and issued a Notice of Complete Application dated February 28, 2000, which was published in the Environmental Notice Bulletin (ENB) on March 8, 2000, and in newspapers in the vicinity of the plants during the week following March 8, 2000.[16] The Notice sought public comments on the DEIS, which were to be submitted to the Department by April 24, 2000.

Public Hearings

Subsequently, on May 2, 2000, the Department's Office of Hearings and Mediation Services issued a Notice of Hearing and Notice of Extension of Comment Period.[15] The Notice of Hearing announced a public legislative hearing to receive unsworn statements about the DEIS at the Croton Village Hall, Croton-on-Hudson, New York, at 2:00 PM and 7:30 PM on June 8, 2000. The Notice also extended the public comment deadline from April 24, 2000 to June 24, 2000. The May 2, 2000, Notice of Hearing was also published in the ENB and in newspapers in the vicinity of the plants. These notices included the times and location of the June 8, 2000, public hearing and also identified eight locations where the DEIS was available for review by the public. Sixteen written comments were received, and seventeen individuals spoke at the hearings, including representatives of the generators, NGO's, individuals, and the Department. The Department also provided the generators with several pages of comments.

Ownership Changes

As part of NYS's energy market restructuring, the HRSA plants have undergone ownership changes since the submission of the DEIS. Indian Point Units 2 and 3 are now owned and operated by Entergy Nuclear Indian Point 2, LLC, and Entergy Nuclear Indian Point 3, LLC. Bowline Point is now owned and operated by Mirant Bowline, LLC. Roseton is now owned and operated by Dynegy Northeast Generation.

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[16] Notices are included in Appendix F-I to this FEIS.

Final Environmental Impact Statement

This Final Environmental Impact Statement (FEIS) consists of multiple sections. The fundamental underlying data and studies are contained in the 1999 DEIS, which is incorporated as part of this FEIS. An augmented discussion of the regulatory setting for and history of the proposed action in this FEIS augments the materials in the DEIS. The full texts of all comments received by the Department are included in Appendix F-I, and public comments are excerpted and summarized in Table 3 (page –) of this FEIS; a list of all commentors is provided at the end of Table 3. The Department's responses to public comments complete the FEIS. In the interest of responding most effectively to the submitted comments, Department staff grouped the comments under related themes and responded to each theme.

REGULATORY SETTING

Federal Clean Water Act

NPDES Permitting

The basic federal law governing water pollution control in the United States is the federal Water Pollution Control Act (FWPCA), more commonly referred to as the Clean Water Act (CWA).[16] Although the FWPCA itself dates to 1948, the CWA as we now know it was largely shaped by comprehensive amendments in 1972 which completely overhauled the existing system.[17] The 1972 CWA is properly viewed as the starting point for modern water pollution control law.

While the CWA has been amended several times since 1972, the heart of the Act which has remained intact is its system of regulating both direct and indirect discharges of pollutants into U.S. waters: the National Pollutant Discharge Elimination System (NPDES).[18] The fundamental premise of the CWA, expressed in §301, is not to regulate an otherwise lawful activity, but to make unlawful the discharge of *any* pollutant from a point source by any person.[19] Thus, the discharge of pollutants is not a right and may only be allowed as specifically provided in the CWA. The bulk of the CWA may, therefore, be viewed as a detailed and highly regulated exception to the "no discharge" rule of §301.

Pollution control standards under the Act are of two general types:

> (1) effluent standards which limit the quality and quantity of pollutants discharged from the source, also called "technology-based" standards; and
>
> (2) ambient standards which limit the concentration of pollutants in a defined water segment, also called "water quality-based" standards.

By establishing limits tailored to the nature of a discharge rather than its location, a uniform nationwide playing field was established that removed incentives for dischargers to relocate to other states to avoid treatment requirements.

The focus of an ambient standard is on the capacity of the receiving water to absorb or dilute a given pollutant. Thus, water quality-based standards vary according to

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[16] 33 U.S.C. §§ 1251 - 1376.

[17] FWPCA Amendments of 1972, Pub. L. No. 92-500, 86 Stat. 816.

[18] *See* CWA § 402; 33 U.S.C. § 1342.

[19] "Pollutant" is defined as including solid, industrial, agricultural and other wastes, sewage, sludge, heat, rock, sand, and biological and radioactive materials; CWA § 502(6), 33 U.S.C. § 1362(6). "Point source" is defined as any "discernable, confined, and discrete conveyance"; CWA § 502(14), 33 U.S.C. § 1362(14).

the use of the receiving water - for example, recreational, industrial, or public drinking water - and on local conditions, such as the size and flow of the receiving water, its turbidity, and other factors unique to the segment.

Technology-based effluent standards, on the other hand, do not focus on the qualities of the receiving water, but on the treatment a pollutant receives prior to its discharge. Technology-based standards define and mandate a level of effluent quality that is achievable using pollution control technology so that a pollutant's capacity to degrade the water segment into which it is discharged is lessened. Of the two, technology-based effluent standards dominate the CWA's regulatory system.

Both of these standards are implemented and enforced through the NPDES permit program, administered by the USEPA. Under §402 of the CWA, a discharger must obtain an NPDES permit from EPA or from a state that has an EPA-approved program.[20] The technology-based and water quality-based standards are written into the permits and are tailored to meet the particular permittee's situation, such as the pollutant-producing operation, the type and amount of pollutants to be discharged and the condition of the receiving water.

The CWA mandated development of water quality standards for water bodies and effluent limitations based on those standards, and it set forth the mechanism for incorporating water quality standards into NPDES permits. States were required to adopt classifications of water bodies according to their best uses. They were also required to develop standards for various pollutants that would establish maximum levels of pollutants in water bodies that would be allowable so that the water bodies could retain their best uses.[21] These standards are then, in turn, incorporated into the NPDES permit as effluent limitations, along with any other relevant technology-based effluent limitations.

NPDES permits may also contain other conditions a permittee must meet, such as requirements for monitoring and reporting effluent discharges.[22] Discharge without a permit or in violation of its conditions may subject the discharger to an enforcement action by the federal or state government, which in turn may result in civil and criminal penalties.[23] A noncomplying discharger may also be subject to enforcement by private individuals or groups under the Act's citizen suit provision.[24] In sum, the NPDES permit program is the focal point of the CWA's regulatory system, and compliance with an NPDES permit's conditions is deemed to be compliance with almost all of the Act's regulatory provisions.[25]

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[20] CWA § 402(a) and (b), 33 U.S.C. § 1342(a) and (b).

[21] CWA § 303, 33 U.S.C. § 1313.

[22] 40 C.F.R. §§ 122.41 to 122.50 (permit conditions).

[23] CWA § 309, 33 U.S.C. § 1319.

[24] CWA § 505, 33 U.S.C. § 1365.

[25] CWA § 402(k), 33 U.S.C. § 1342(k).

CWA §316(b) and Cooling Water Intake Structures

§ 316(b) of the CWA provides that any "point source" discharge standard established pursuant to §§301 or 306 of the CWA must require that the location, design, construction, and capacity of CWIS reflect the "best technology available" (BTA) for minimizing adverse environmental impacts.

EPA has defined a "cooling water intake structure" as the total physical structure and any associated constructed waterways used to withdraw water from waters of the U.S., extending from the point at which water is withdrawn from waters of the U.S. up to and including the intake pumps. EPA has defined "cooling water" as water used for contact or non-contact cooling, including water used for equipment cooling, evaporative cooling tower makeup, and dilution of effluent heat content.[26] The intended use of cooling water is to absorb waste heat from production processes or auxiliary operations.

CWA §316(b) addresses the adverse environmental impact caused by the intake of cooling water, not discharges into water. Despite this special focus, the requirements of §316(b) are closely linked to several of the core elements of the NPDES permit program established under §402 of the CWA to control discharges of pollutants into navigable waters. For example, §316(b) applies to point sources (facilities) that withdraw water from the waters of the U.S. for cooling through a CWIS and are subject to an NPDES permit. Conditions implementing §316(b) are included in NPDES permits on a case-by-case, site-specific basis.

The majority of impacts to aquatic organisms and habitat associated with intake structures is closely linked to water withdrawals from the various waters in which the intakes are located. Based upon preliminary estimates from an EPA questionnaire sent to more than 1,200 existing power plants and factories, industrial facilities in the U.S. withdraw more than 279 billion gallons of cooling water each day from waters of the U.S.[27]

The withdrawal of such quantities of cooling water affects large numbers of aquatic organisms annually, including phytoplankton (tiny, free-floating photosynthetic organisms suspended in the water column), zooplankton (small aquatic animals, including fish eggs and larvae, that consume phytoplankton and other zooplankton), fish, crustaceans, shellfish, and many other forms of aquatic life.[28] Aquatic organisms drawn into CWIS are either impinged on components of the CWIS or entrained in the cooling water system itself.

Impingement takes place when organisms are trapped against intake screens by the force of the water passing through the cooling water intake structure. This can result in starvation and exhaustion (organisms are trapped against an intake screen

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[26] *See* 66 Fed. Reg. 65259 (Dec. 18, 2001).

[27] *See generally,* 65 Fed. Reg. 49071 through 4 (Aug. 10, 2000) and 66 Fed. Reg. 65262 (Dec. 18, 2001).

[28] 66 Fed. Reg. 65262 (Dec. 18, 2001).

or other barrier at the entrance to the cooling water intake structure), asphyxiation (organisms are pressed against an intake screen or other barrier at the entrance to the cooling water intake structure by velocity forces which prevent proper gill movement, or organisms are removed from the water for prolonged periods of time), descaling (fish lose scales when removed from an intake screen by a wash system), and other physical harms.[29]

Entrainment usually occurs when relatively small benthic, planktonic, and nektonic organisms, including early life stages of fish and shellfish, are drawn through the cooling water intake structure into the cooling system. In the normal water body ecosystem, many of these small organisms serve as prey for larger organisms that are found higher on the food chain. As entrained organisms pass through a plant's cooling system they are subject to mechanical, thermal, or toxic stress. Sources of such stress include physical impacts in the pumps and condenser tubing, pressure changes caused by diversion of the cooling water into the plant or by the hydraulic effects of the condensers, sheer stress, thermal shock, and chemical toxemia induced by antifouling agents such as chlorine.[30]

In addition to impingement and entrainment losses associated with the operation of CWIS, another concern is the cumulative degradation of the aquatic environment as a result of:

(1) multiple intake structures operating in the same watershed or in the same or nearby reaches; and
(2) intakes located within or adjacent to an impaired waterbody.

Historically, impacts related to CWIS have been evaluated pursuant to CWA §316(b) on a facility-by-facility basis. While the potential cumulative effects of multiple intakes located within a specific waterbody or along a coastal segment are largely unknown, there is concern about the effects of multiple intakes on fishery stocks.[31]

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[29] 66 Fed. Reg. 65263 (Dec. 18, 2001); *see also* Thurber, N.J. and D.J. Jude, *Impingement Losses at the D.C. Cook Nuclear Power Plant During 1975-1982 With a Discussion of Factors Responsible and Possible Impact on Local Populations,* Special Report No. 115 of the Great Lakes Research Division, Great Lakes and Marine Waters Center, Univ. of Mich. (1985).

[30] 66 Fed. Reg. 65263 (Dec. 18, 2001) *citing* Mayhew, D.A., L.D. Jensen, D.F. Hanson, and P.H. Muessig, *A Comparative Review of Entrainment Survival Studies at Power Plants in Estuarine Environments,* Environmental Science & Policy, 3:S295-S301 (2000).

[31] 66 Fed. Reg. 65263 (Dec. 18, 2001) *referring to* Request by member States of Atlantic States Marine Fisheries Commission to investigate the cumulative impacts on commercial fishery stocks attributable to cooling water intakes located in coastal regions of the Atlantic in 2001.

New York State Laws

SPDES Permitting Program

Pursuant to authority granted by Congress in CWA § 402, USEPA has authority to allow states to carry out specified permitting functions, which would otherwise be performed by USEPA, for discharges into both interstate and intrastate waters. New York State received USEPA approval of such authority in the form of a Memorandum of Agreement between the state and USEPA in October 1975. The Memorandum established the basis for the SPDES permit program in New York State in lieu of a federally administered program.

Originally enacted in 1973, Article 17, Title 8 of the Environmental Conservation Law (ECL) authorizes The Department to administer the SPDES permitting program that governs the discharge of pollutants into the waters of the state at a given facility.[1] The purpose of ECL Article 17, Title 8 is:

> To create a state pollutant discharge elimination system (SPDES) to insure that the State of New York shall possess adequate authority to issue permits regulating the discharge of pollutants from new or existing outlets or point sources into the waters of the state, upon condition that such discharges will conform to and meet all applicable requirements of the [FWPCA] ... and rules, regulations, guidelines, criteria, standards and limitations adopted pursuant thereto relating to effluent limitations, water quality related effluent limitations ...[2]

The discharge must also meet all applicable requirements of the ECL and the implementing regulations at 6 NYCRR Parts 700, et seq. and 750, et seq. The permitting objective is to prospectively control the discharge of point-source pollutants, including heat, by establishing chemical-specific limits and other requirements intended to assure that water quality standards in the receiving water body are achieved. Additional environmental objectives are to assure that aquatic communities are not unduly harmed by discharges, and to protect the public health and best usage of the water body.

Generally, thermal discharges to the waters of the State must meet water quality standards to assure the protection and propagation of a balanced, indigenous population of shellfish, fish, and wildlife in and on the body of water.[3] In addition, thermal criteria apply to all waters of the State receiving thermal discharges.[4] These criteria may be modified upon application of a permittee to the Department if the Department finds them to be unnecessarily restrictive and that modification

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32 "Pollutant" is defined as any "dredged spoil, solid waste, incinerator residue, sewage, garbage, sewage sludge, munitions, chemical wastes, biological materials, radioactive materials, heat, wrecked or discarded equipment, rock, sand and industrial, municipal, and agricultural waste discharged into water." ECL § 17-0105(17).

33 ECL § 17-0801.

34 6 NYCRR § 704.1(a).

35 NYCRR § 704.2.

would still assure the protection and propagation of a balanced, indigenous population of shellfish, fish, and wildlife in and on the body of water into which the discharge is to be made.[36] The discharge of heat as a pollutant, a "thermal discharge", is addressed in the Department's regulations at 6 NYCRR Part 704.

In making a modification to thermal criteria, the Department typically imposes a "mixing zone" which limits the physical extent within which heated water can exceed specific applicable criteria.[37] Outside of the mixing zone, thermal criteria must be met to assure compliance with water quality standards. Temperature limitations are established and imposed on a case-by-case basis for each facility subject to Part 704 jurisdiction. NYS has adopted the federal CWA §316(b) BTA requirement for CWIS as part of the Department's thermal discharge criteria at 6 NYCRR §704.5.

The HRSA facilities which are the subject of this FEIS, Indian Point, Bowline Point, and Roseton, must demonstrate their compliance with water quality standards.[38] Since 1981, these facilities' operations, and their resulting thermal discharges, have been conditioned by their SPDES permits. Their current permits were due to expire in 1992 but were extended under SAPA.

According to the Consent Order, the HRSA facilities were required to use their "best reasonable efforts" to operate the respective plants to keep the volumes of water withdrawn for cooling at the minimum required for efficient operation.[39] The original 1981 HRSA contained similar general language, and also provided charts for each facility which identified average maximum river temperatures and specified approximate flows for each unit at Indian Point and for all units at Bowline and at Roseton for different periods throughout the year.

The thermal limitations associated with the HRSA facilities' existing SPDES permits include the following:

Bowline Point:

As of the 1987 - 1992 SPDES permit term, Bowline did not exceed the thermal criteria and a mixing zone did not need to be specified to meet the water quality standard. The use of multiport high velocity diffusers provided sufficient mixing with ambient water sufficient to meet thermal criteria. As a consequence, additional specifications to meet thermal criteria have not been imposed. The SPDES permit provides a daily maximum discharge temperature (102°F).

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[36] 6 NYCRR § 704.4.

[37] 6 NYCRR § 704.3.

[38] *See* App. F-II.

[39] *See* App. F-III.

Roseton:

As of the 1987 - 1992 SPDES permit term, Roseton did not exceed the thermal criteria and a mixing zone did not need to be specified to meet the water quality standard and additional specifications to meet thermal criteria were not imposed. The use of multiport high velocity diffusers provided sufficient mixing with ambient water to meet water quality criteria. The SPDES permit provides a daily maximum discharge temperature (99°F).

Indian Point:

As of the 1987 - 1992 SPDES permit term, thermal discharges from Indian Point did not meet applicable thermal criteria. To control thermal discharges, the SPDES permit for Indian Point Units 2 and 3 requires that the maximum discharge temperature for condenser cooling water not exceed 110°F. In addition, the daily average discharge temperature between April 15 and June 30 is not to exceed 93.2°F for an average of more than ten days per year during the term of the permit, beginning in 1981, provided that it not exceed 93.2°F on more than 15 days during that period in any year.

The Consent Order also provided that Indian Point give "due regard to ambient river water temperature, plant operating status, and the need to meet water quality standards or other permit conditions".[1] Figures B-1 and B-2 to Attachment D of the Fourth Amended Consent Order provide graphic representations of "Predicted Condenser Cooling Water Flow Rate Schedules to Achieve Efficient Operations of Indian Point [Units 2 and 3]". That Consent Order provides that there may be some deviation from these schedules because "the minimum flow rate for any given period is dependent upon ambient river water temperature".

These provisions alone, however, are not sufficient for Indian Point to meet thermal criteria. Thermal modeling indicates that the thermal discharge from Indian Point causes water temperatures to rise more than allowed, which is four degrees (F.) over the temperature that existed before the addition of heat, or a maximum of 83°F, whichever is less, in the estuary cross sections specified in 6 NYCRR §704.2(b)(5).[2] A mixing zone was not specified in the previous SPDES permit for the Indian Point facility.

Even though thermal discharges from Bowline and Roseton meet water quality criteria, their thermal contribution to the Hudson River is additive with that of Indian Point and must be taken into account in determining whether the water quality standard is met. If the standard is not met, the circumstances can trigger the water quality standard requirement to assure the protection and propagation of a balanced, indigenous population. If analyses specified in the proposed SPDES permits are unable to make this assurance to the Department's satisfaction, the next level of action would be for the Department to determine how thermal discharges would be limited to ensure that water quality standards are met.

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40 *See* App. F-III.

41 1999 DEIS, Appendix VI-3-A, Thermal Modeling of Ebb and Flood Tide Thermal Plumes (CORMIX model).

New York has adopted the appropriate regulations for the operation of the SPDES permit program, including standards for the development and issuance of permits as well as for the types of effluent limitations to be imposed in these permits.[42] In addition to the federally developed categorical effluent limitations, The Department has developed approximately 100 water quality standards for various pollutants in its regulations and less formal "guidance" values for many more pollutants.[43] The Department has also categorized through regulation all significant water bodies in the State, based upon the best use of each water body.[44]

The Department's overall SPDES permitting activity is intended to implement the declared public policy of the State of New York that water resources not be wasted or degraded and "shall be adequate to meet the present and future needs for domestic, municipal, agricultural, commercial, industrial, power, recreational and other public, beneficial purposes."[45]

Goals for water discharge permitting are also articulated in the ECL:

> Reasonable standards of purity and quality of the waters of the state be maintained consistent with public health, safety and welfare and the public enjoyment thereof, the propagation and protection of fish and wildlife, including birds, mammals and other terrestrial and aquatic life, and the industrial development of the state, and to that end, to require the use of all known available and reasonable methods to prevent and control pollution, wastage and unreasonable disturbance and defilement of the waters of the state.[46]

Any source proposing to discharge pollutants requiring a SPDES permit must file an application with The Department at least 180 days before the proposed commencement of the discharge[47] or, if renewing an existing SPDES permit, at least 180 days before the expiration of the existing permit.[48] Submission of a timely renewal application continues the terms of the existing SPDES permit until the renewal permit is issued by the Department.[49] If the Department determines to

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[42] *See* 6 NYCRR Part 750.1

[43] 6 NYCRR Part 703; Department Technical and Operational Guidance Series (TOGS) § 1.1.1.

[44] *See* 6 NYCRR Parts 701 and 800 to 941.

[45] ECL § 15-0105(3).

[46] ECL § 15-0105(7); *see also,* ECL § 17-0101.

[47] 6 NYCRR § 750-1.6

[48] 6 NYCRR § 750-1.16

[49] SAPA § 401(2).

issue the permit, it prepares a draft permit, including proposed effluent limitations and other conditions.[50]

The Department is required to provide public notice of every draft SPDES permit which gives a description of the discharge and the terms of the draft permit, and sets forth a public comment period of no less than 30 days during which interested parties may submit written comments concerning the application.[51] During the public comment period any person, including the applicant, may submit written comments or request a hearing. The Department is required to hold a legislative hearing to receive unsworn public comments if it determines that there is significant public interest and sufficient reason for such a hearing.[52] If no hearing is held, only the written comment period occurs, and the Department will issue a final SPDES permit following the close of the public comment period.

In certain instances, an adjudicatory hearing may also be held, where evidence and sworn testimony is presented before an Administrative Law Judge (ALJ). Any interested party, as well as the applicant, may request an adjudicatory hearing with respect to any aspect of a draft SPDES permit so long as the request is made during the public comment period.[53] At such a hearing, parties have an opportunity to contest issues the ALJ has determined to be adjudicable.[54]

The Department is required to determine the existence of the following facts in a SPDES permit renewal context:

1. That the permittee is in compliance with or has substantially complied with all the terms, condition, requirements, and schedules of compliance of the expiring SPDES permit;
2. That The Department has up-to-date information on the permittee's production levels, waste treatment practices, and the nature, contents, and frequency of the permittee's discharge, pursuant to new forms and applications or monitoring records and reports; and
3. That the discharge is consistent with currently applicable effluent and water quality standards and limitations, and other legally applicable requirements.[55]

Upon a determination of the existence of these facts, the Department may issue a renewal permit.

The Department also has authority to modify SPDES permits for a number of reasons, including significant changes in a discharger's operations or new

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[50] 6 NYCRR § 750-1.9

[51] 6 NYCRR § 750-1.9

[52] 6 NYCRR § 750-1.9

[53] 6 NYCRR § 750-1.1(d)

[54] 6 NYCRR § 624.4(b)(5), (c)

[55] 6 NYCRR §750-1.16

information, such as the promulgation of new standards by either the State or USEPA.[56] Permits can also be modified or revoked in response to violations of permit conditions, misrepresentations by the permittee, or changes in conditions.[57]

Legislative Findings and Commissioner's Powers

In enacting legislation to preserve and protect the water resources and wildlife of the State of New York, the NYS Legislature made findings of fact and vested the Commissioner of the Department of Environmental Conservation with broad powers and authority germane to the regulation of electricity generating facility operations that use and impact such resources.

The Legislature has found:

> The State of New York owns all fish, game, wildlife, shellfish, crustacea and protected insects in the state, except those legally acquired and held in private ownership. Any person who kills, takes or possesses such fish, game, wildlife, shellfish, crustacea or protected insects thereby consents that title thereto shall remain in the state for the purpose of regulating and controlling their use and disposition.[58]
>
> The general purpose of powers affecting fish and wildlife, granted to the department by the Fish and Wildlife Law, is to vest in the department, to the extent of the powers so granted, the efficient management of the fish and wildlife resources of the state. Such resources shall be deemed to include all animal and vegetable life and the soil, water and atmospheric environment thereof, owned by the state or of which it may obtain management, to the extent they constitute the habitat of fish and wildlife as defined in § 11-0103 ... .[59]
>
> New York State has been generously endowed with water resources which have contributed and continued to contribute greatly to the position of preeminence attained by New York in population, agriculture, commerce, trade, industry and outdoor recreation.[60]
>
> All fish, game, wildlife, shellfish, crustacea and protected insects in the state, except those legally acquired and held in private ownership, are owned by the state and held for the use and enjoyment of the people of the state, and the state has a responsibility to preserve, protect and

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[56] 6 NYCRR § 750-1.18

[57] 6 NYCRR § 750-1.20

[58] ECL § 11-0105.

[59] ECL § 11-0303(1); *see also*, ECL §s 11-0303(2) and 11-0305.

[60] ECL § 15-0103(2).

> conserve such terrestrial and aquatic resources from destruction and damage and to promote their natural propagation.[61]
>
> It is in the best interests of this state that provision be made for the regulation and supervision of activities that deplete, defile, damage or otherwise adversely affect the waters of the state and land resources associated therewith.[62]

The Department Commissioner has the power to:

> Promote and coordinate management of water, land, fish, wildlife and air resources to assure their protection, enhancement, provision, allocation, and balanced utilization consistent with the environmental policy of the state and take into account the cumulative impact upon all such resources in making any determination in connection with any license, order, permit, certification or other similar action or promulgating any rule, regulation, standard or criterion.[63]
>
> Provide for the propagation, protection, and management of fish and other aquatic life and wildlife and the preservation of endangered species.[64]
>
> Provide for the protection and management of marine and coastal resources and of wetlands, estuaries and shorelines.[65]

New York State Coastal Management Program

The NYS Coastal Management Program was developed under authority of New York State Executive Law 910-22 and 19 NYCRR Part 600. The operative sections of the Executive Law provide 11 points of policy that have been detailed in a single set of 44 decision-making criteria in the Coastal Management Program and final environmental impact statement. The Department, as a state agency, must find that all direct and funding actions, and any permitting actions that are the subject of an EIS under SEQR, are consistent with the Coastal Management Program.[66] In addition, SEQR regulations provide that, for any state agency action in a coastal area, a draft EIS must contain an identification of the applicable coastal resources/waterfront revitalization policies and a discussion of the effects of the

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[61] ECL § 15-0103(8).

[62] ECL § 15-0103(13).

[63] ECL § 3-0301(1)(b).

[64] ECL § 3-0301(1)(c).

[65] ECL § 3-0301(1)(e).

[66] 6 NYCRR 617.9(e); 19 NYCRR 600.4(a)

proposed action on such policies.[67] The SPDES permit renewals that are the subject of this DEIS will not result in any new effects on coastal zone policies. Coastal zone consistency forms are contained in DEIS Appendix IV-5.

State law also requires that state agencies provide timely notice to local governments whenever an identified action will occur within an area covered by an approved local waterfront revitalization program (LWRP). The NYS Secretary of State is required to confer with state agencies and local governments when notified by a local government that a proposed state agency action may conflict with the policies and purposes of its approved LWRP, and may modify the proposed action to be consistent with the local plan.[68] None of these facilities is in an LWRP area.

The consistency provisions of the New York State Coastal Management Program enable the Department to consider the full range of coastal policies prior to undertaking and approving a specific action.

Hudson River Estuary Management Program

In 1987, ECL §11-0306 was amended in order to establish a Hudson River estuarine district including "the tidal waters of the Hudson River, including the tidal waters of its tributaries and wetlands from the federal lock and dam at Troy to the Verrazano-Narrows."[69] This section also directed the Department to establish a Hudson River estuary management program "in order to protect, preserve and, where possible, restore and enhance the Hudson River estuarine district."[70] The district was also to consider the remainder of the Hudson River, New York Bight, and the waters around Long Island, as they impact the Hudson River estuary.

A Hudson River estuary management advisory committee, consisting of representatives of commercial fishing, sportsmen, research, conservation, and recreation, as well as a Hudson River estuary coordinator, was created within the Department to manage the Hudson River estuary management program and assist in the development and implementation of the program.[71]

A Hudson River estuarine sanctuary was also established "for the purpose of protecting areas of special ecological significance within the Hudson River estuarine district and associated shorelands ...".[72] The sanctuary also serves as a "long-term estuarine field laboratory for research and education concerning the Hudson River ecosystem."

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[67] 6 NYCRR 617.14(d)(10)

[68] Executive Law 915-a.

[69] ECL §11-0306(1).

[70] ECL §11-0306(2).

[71] ECL §11-0306(4).

[72] ECL §11-0306(5)

The Department and the advisory committee were directed to develop a continuing estuary management program "for the preservation, protection, restoration and enhancement of the Hudson River estuarine district and associated shorelands including but not limited to its natural resources, its fish and wildlife and the habitats within it."[73] The strategy was required to include, among other things, the following:

> ...
>
> e. Evaluation of the impact of the uses of water on the Hudson River estuarine district including present and future demands for water and their impact on the balance of fresh and salt water in the estuary.
> f. Identification of areas of potential ecological significance which may require rehabilitation.
> g. A status report on the levels of toxicants in and their effects on important estuarine indicator species and for species that have potential or existing recreational or commercial value.
> h. Identification of the anthropogenic activities and the conservation and management problems that pose an existing or potential threat to the resources and the functioning of the estuary.[74]

In enacting ECL §11-0306, the Legislature made the following findings and declarations:

> The legislature further finds that the Hudson River estuary is of statewide and national importance as a habitat for marine, anadromous, catadromous, riverine and freshwater fish species and that it is the only major estuary on the east coast to still retain strong populations of its historical spawning stocks. Such species are of vital importance to the ecology and the economy of the state and to the recreational and commercial needs of the people of the New York state and neighboring states. A lack of sufficient and reliable research and documentation has resulted in recurring disputes on the movements, life cycles and habitats of these species.
>
> The legislature further finds that the Hudson River estuary possesses a fishery of outstanding commercial and recreational value, and the economic potential of the Hudson river estuary's fishery is at present underdeveloped. Improper management and use of the Hudson River estuary will deprive present and future generations of the benefit and enjoyment of this valuable resource.
>
> The legislature further finds that the protection of estuarine species throughout their life history; the protection of their spawning habitat, nursery habitat, wintering habitat and feeding and foraging habitat; and the protection, enhancement and restoration of the state's natural resources upon which these species and their habitat depend requires a specific program for the proper management of the Hudson River estuary.

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[73] ECL §11-0306(6).

[74] *See* ECL §11-0306(6)(e)-(h).

> It is hereby declared to be the policy of the state to preserve, protect and, where possible, restore and enhance the natural resources, the species, the habitat and the commercial and recreational values of the Hudson River estuary.

Hudson River Valley Greenway Program

Article 44 of the ECL was amended in 1991 to establish a Hudson River Valley Greenway Communities Council (Greenway Council) to assist Hudson River Valley communities in the 10 counties of Westchester, Putnam, Dutchess, Columbia, Rennselaer, Albany, Green, Ulster, Orange, and Rockland in their plans for development. Article 44 was enacted as companion legislation to the Hudson River estuary management program discussed earlier.[75] The statute authorizes the Greenway Council to provide and support cooperative planning to establish a voluntary regional compact among Hudson Valley localities to protect the valley's natural and cultural resources and promote regional planning. The ECL also provides that, upon compact effectiveness, state agency actions for which an EIS is being prepared under SEQR, including Department actions, must be assessed in light of the Greenway compact and applicable rules and regulations, and that the Greenway Council should review and comment in writing on the DEIS.[76] As of early 2003, six counties and several localities were actively engaged in Greenway Compact planning and programs.[77]

Endangered Species Act

Past operations at the Roseton Units 1 & 2, Bowline Units 1 & 2 and Indian Points Units 2 & 3 have occasionally resulted in the impingement of shortnose sturgeon on the facilities' traveling screens. Shortnose sturgeon are currently listed as endangered under the federal Endangered Species Act.[78] In previous permit proceedings, the generators supplied the NMFS with all data on shortnose sturgeon that were collected in biological sampling programs. In testimony to the EPA in 1979, NMFS concluded in a Biological Opinion made pursuant to Section 7 of the Endangered Species Act that the once-through cooling system of the power plants did not pose a threat to the shortnose sturgeon population in the Hudson River. The generators are currently in the process of obtaining updated Incidental Take Permits from NMFS.

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[75] ECL §11-0306

[76] ECL §44-0115(3).

[77] Hudson River Valley Greenway Communities Council website, http://www.hudsongreenway.state.ny.us/commcoun/commcoun.htm

[78] Endangered Species Act of 1973, 16 U.S.C.A. §§ 1531 - 1544.

The New York State Energy Plan

The NY State Energy Plan (SEP) is published every four years pursuant to § 6-104 of the State Energy Law (effective until January 1, 2003). The SEP was last published in 2002.

§ 6-102 of the State Energy Law creates the State Energy Planning Board. Among other things, the State Energy Law requires that the State Energy Planning Board include in the SEP twenty-year forecasts of the demand for electricity and energy supply requirements needed to supply that energy demand; an assessment of the ability of existing energy supply sources and transmission systems to satisfy such energy requirements; and identification and analysis of costs, risks, benefits and uncertainties of energy supply source alternatives for satisfying energy supply requirements which are not reasonably certain to be met by existing energy supply sources.

The SEP is intended to be a reflection of the State's policies for promoting and adopting "flexible, yet stringent, environmental policies that balance the need for more energy with the need for improved public health and safety."[1] Among its major policy strategies and recommendations, it includes supporting "the continued safe operation of nuclear, coal, natural gas, oil, and hydroelectric generation as part of a diverse portfolio of electricity generation resources".[2]

The SEP does not take into account the specific need to renew the Roseton, Bowline or Indian Point SPDES permits or the need to complete this EIS. However, the SEP does observe that mortalities to aquatic organisms associated with impingement and entrainment from the operation of CWIS and thermal discharges from older electricity generation facilities are negative environmental impacts for which minimization should be provided.[3] The SEP finds that, since the 1998 SEP was released, the State has made significant gains in reducing the environmental impacts associated with energy generation and consumption. It also finds that the impacts of energy generation on the State's aquatic resources are analyzed and addressed through existing regulatory programs.[4] The SEP will inform the Department's assessment of the impacts to and general alternatives for mitigation of adverse environmental impacts from the Roseton, Bowline and Indian Point generation facilities.

NYS Environmental Quality Review Act (SEQR)

SEQR requires that NYS agencies and local governments consider the potential adverse environmental impacts of decisions they make, including approval of applications from regulated entities.[5] SEQR provided the Department's authority for

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79 2002 SEP, p. S-1.

80 2002 SEP, p. S-4.

81 2002 SEP, p. 2-56.

82 2002 SEP, p. 2-58.

83 ECL Article 8

requiring an EIS on the proposed renewal of the facilities' SPDES permits. Before issuing a final decision on each of the applications, the Department will be required to make findings based on this FEIS concluding whether, among other tests, the selected alternative(s) will minimize or avoid adverse environmental impacts, "... to the maximum extent practicable ...".

MITIGATION AND ALTERNATIVES

Available Mitigation Technologies

Based on information in the 1999 DEIS, including DEIS Appendices VII and VIII, and on information obtained and analyses conducted since the DEIS was prepared, the Department believes that a range of available technologies exist to minimize aquatic resource mortality from the cooling water intake structures (CWIS) at the Indian Point, Roseton, and Bowline Point generating stations. This discussion will focus on conclusions relating to potential applicability to the HRSA facilities of a range of technology and management systems to reduce impacts on aquatic organisms from their CWIS operations. The "Response to Comments" section of this FEIS contains more detailed descriptions, background and updates on several of the technologies, and several supporting reports are attached in Appendix F- V.

At present, the existing cooling water system at each of the HRSA generating stations is a "once-through" system, that is, Hudson River water is taken into the cooling system, circulated past the condenser coils to absorb waste heat from operation of the generation equipment, and discharged back to the Hudson River at a higher temperature than at the intake. In the process, some larger aquatic organisms are impinged on intake screens and many more are entrained within the circulating cooling water. Under the HRSA and Consent Orders, and currently by concurrence of the generators, Indian Point has achieved some reductions in intake volumes through the use of variable flow pumps while Roseton cycles pumps on and off to reduce water volumes used. Additionally, Indian Point has installed Fletcher-modified Ristroph traveling screens to help reduce impingement mortality at those facilities, and Bowline Point uses a seasonally-deployed fine mesh barrier net to reduce both impingement and entrainment mortality.[84] While these represent some level of improvement compared to operations with no mitigation or protection, there are still significant unmitigated mortalities from entrainment and impingement at all three of the HRSA facilities.

In addition to proposing a "Fish Protection Point" (FPP) management system as the generators' preferred alternative,[85] the DEIS presented information on a wide range of other technologies to reduce water intake volumes, prevent impingement or entrainment, or reduce thermal discharges, and also discussed a range of management options which might achieve one or more of the same goals.[86] Those alternatives described by the generators included:

- outages, that is, reduction of water demand by ceasing generation at specified plants during specified time periods;

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[84] DEIS § VIII; Radle, E. W. and M. J. Calaban, 2003. Implementation of CWA 316(b) in New York. Proceedings (in press), A Symposium on Cooling Water Intake Technologies to Protect Aquatic Organisms. Washington, D. C., May 2003.

[85] DEIS § VII.

[86] DEIS § VIII.

- technology to reduce water demand, including dry, wet, and wet/dry (a/k/a "hybrid") cooling towers;
- minimizing flow rates with variable speed pumps or modified pumping schedules;
- barrier systems to minimize numbers of aquatic organisms impinged or entrained, including Ristroph traveling screens, fine-mesh screens, cylindrical wedge-wire screens, barrier nets, and fine-mesh barrier systems;
- behavioral deterrent systems designed to "steer" one or more classes of aquatic organisms away from CWIS, including acoustic systems, electrical barriers, air bubble curtains, several light systems, water jet curtains, and hanging chains;
- district heating/cooling, that is, exporting waste steam to a nearby industrial or institutional user, which in effect makes the receiving steam circulation system function as a large heat diffuser and thereby reduces the need for cooling water intake from and discharge to a water body like the Hudson;
- replacement of power provided by the HRSA plants with power from other sources, which would essentially mean exporting impacts by importing power;
- a so-called "multiple choice" alternative which would have required a commitment to not extend the Nuclear Regulatory Commission (NRC) Indian Point licenses; to operate the existing Bowline Point and Roseton plants until 2015 and then repower those stations with closed-cycle cooling; and provide 32 weeks of outages annually, until the NRC licenses expire for Indian Point and until 2015 for the other two plants;
- enhancements provided elsewhere than the HRSA plants, such as fish stocking and habitat improvement; and
- dismissal of a "no action" alternative, as the Department must by law take one of only 3 actions on SPDES renewal applications - approve, approve with conditions, or deny.

Alternatives Assessment

Generally speaking, the most effective aquatic resource protection can be achieved by greatly reducing actual water usage, particularly during seasons of peak abundance of entrainable life stages.[87] Complete retrofit of the HRSA plants to closed-cycle ("dry") cooling systems would result in an approximately 95% water demand reduction and so must be given serious consideration for feasibility at each of the HRSA stations. Despite all of the benefits, however, closed-cycle systems do not come without impacts, and those potential impacts must also be weighed for each site. The success of closed-cycle cooling in other NYS deployments causes this technology to be given a relatively high level of consideration among available technologies, while not excluding other proposals.

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[87] In the Matter of an Application for a State Pollutant Discharge Elimination System (SPDES) Permit by Athens Generating Company, LP, Commissioner's Interim Decision, June 2, 2000, pp. 11 - 17 (Athens Interim Decision). *See also* Wantuck, R. L., 2003. Resource Agency Views of Technology Employed to Prevent Fish Mortality at Cooling Water Intakes. Proceedings (in press), A Symposium on Cooling Water Intake Technologies to Protect Aquatic Organisms. Washington, D. C., May 2003.

Among the potential impacts of closed-cycle cooling are so-called "energy penalties" associated with operation of cooling towers, that is, losses of generation efficiency under certain operating and climatic conditions plus the energy required to run component systems like fans. In addition, there are certain expenses associated with installing closed-cycle cooling.[88] Actual costs tend to vary widely depending on individual site characteristics combined with plant and tower configurations, so potential costs to install cooling towers can only be estimated based on a specific design proposal for an individual site.[89]

Several classes of cooling tower system designs exist, each of which can substantially reduce water demand but also have associated "energy penalties" and other potential impacts of specific systems which must be evaluated based on individual proposals for particular sites. Dry, or closed cycle cooling systems rely on fans and air cooling with recovery of condensate for recirculation. "Wet" cooling towers use evaporative cooling, and "hybrid" or "wet/dry" towers have cooling cells with both evaporative and dry components.[90] Evaporative systems tend to produce condensate "plumes" which can be visible for considerable distances in some climatic conditions. Frequency of plume visibility and relative water losses can vary substantially depending on the operating parameters of a given system. Furthermore, evaporated water is permanently lost to the source water body; in the Hudson River system, there is evidence indicating that such losses could be sufficiently significant to affect salt levels. Thus, were a wet or hybrid tower to be proposed for any of the HRSA facilities, the potential impacts of evaporative losses, plumes, and energy losses would require careful evaluation based on a specific design proposal for that site.[91]

Finally, modern cooling tower systems, whether dry, hybrid or wet, require a sufficient amount of land to support a series or array of cooling "cells". Again, potential impacts would be site and design specific but include possible visibility from sensitive receptors as well as potential impacts on sensitive land resources. The mid-to-lower Hudson Valley has a number of sensitive visual receptors as identified in the Visual Impact Assessment Policy developed by the Department's Division of Environmental Permits, but the ability to more precisely evaluate potential visual impacts would depend on knowing precise height, configuration and site placement of any proposed tower system.[92] Similarly, prediction and evaluation of potential

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[88] Grogan, D. B. & Assoc., Inc. 2000. Hudson River Power Plants, Cooling Water System Design Assessment. Technical Report prepared for ESSA Technologies, Ltd., Richmond Hill, Ontario, Canada; included in Appendix F-IV of this FEIS.

[89] Maulbetsch, J. and K. Zammit, 2003. Cooling System Retrofit Costs. Proceedings (in press), A Symposium on Cooling Water Intake Technologies to Protect Aquatic Organisms. Washington, D. C., May 2003.

[90] Grogan, 2000; Maulbetsch, 2003; *see also* DEIS Section VIII and appendices for basic descriptions and diagrams of cooling tower systems.

[91] Grogan, 2000.

[92] Department Program Policy DEP 00-2, Assessing and Mitigating Visual Impacts. July 31, 2000. www.dec.state.ny.us/website/dcs/policy/visual2000.pdf

land resource impacts would require that proposed site placement and size of the tower array, at least, be known.

A modification of generating station design that can be incorporated with new construction or when an existing electric generating plant is "repowered", that is, has its core combustion and generating systems replaced, is combined-cycle generation. In the most basic terms, a combined-cycle plant is designed to use some of the waste heat from the initial combustion/generation process to power a secondary turbine. Use of combined-cycle technology greatly reduces the amount of waste heat which must be managed, thereby greatly reducing the total demand for cooling and, thus, the size of the necessary cooling system.

Other approaches can also reduce water demand, usage or flow rates, which can then result in reductions in entrainment, impingement, or both. Permanent, structural measures, such as modified intake structures to reduce intake velocities, are one example of this approach. In addition, management systems and seasonal adjustments like the outage schedule employed for the HRSA plants can reduce water withdrawn during critical seasons. Monitoring and verifying such systems can require substantial recordkeeping by generators and agencies. There are also potential conflicts resulting from outage requirements in a competitive market where actual generating schedules are determined by the New York Independent System Operator (NYISO). On the other hand, such systems may be more rapidly implemented as they do not typically require major new infrastructure construction.

Structural protection can be added at intakes to reduce entrainment, impingement, or both. Traveling screens, barrier nets, "aquatic filter barriers" (AFB) like the Gunderboom® Marine Life Exclusion System™ (MLES™), and wedgewire intake structures can all protect some or many life-stages from being trapped against or entering into cooling water intake systems.[93] Traveling screens are used at many intakes to reduce the load of small solids entering and potentially damaging the cooling system; in some cases, like at Indian Point, those screen systems have been modified to incorporate "fish return" components.[94] These screens are most effective at reducing impingement of larger aquatic organisms but do very little to reduce entrainment. Similarly, barrier nets are typically relatively coarse mesh (3 - 5 mm opening, or wider) and are more effective in reducing impingement than entrainment. Barrier nets have been used in a range of fresh- and saltwater systems in the United States.[95] A fine-mesh barrier net (3 mm opening) has been seasonally deployed at Bowline Point under the HRSA and subsequent Consent Orders.

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[93] *See also* Responses to Comments, following, plus individual technology assessments in App. xx - yy of this FEIS.

[94] Radle and Calaban, 2003.

[95] Taft, E., T. Cook, J. Black, and N. Olken, 2003. Fish Protection Technologies for Existing Cooling Water Intake Structures and Their Costs. Proceedings (in press), A Symposium on Cooling Water Intake Technologies to Protect Aquatic Organisms. Washington, D. C., May 2003.

AFB's are a variant on barrier nets. Instead of relatively coarse openings, AFB's have micropores which allow water passage but block most floating or suspended organisms and objects. These micropores are sufficiently fine to act as a barrier to many fish eggs and larvae as well as other floating and suspended aquatic organisms. Depending on a facility's intake configuration, an AFB can be installed as an in-water, surface-to-bottom "curtain" surrounding an open-water intake, or as panels running along a shoreline, parallel to river flow, to screen a shoreline intake. The Department has monitored a series of deployments of a "curtain" installation of the Gunderboom® MLES™ at the Lovett generating station, also on the Hudson River, on the opposite shore and slightly downstream from Indian Point (Figure 2, following this text section). In those deployments, the MLES™ showed effectiveness approaching that of closed cycle cooling for reducing both entrainment and impingement.[96] Other researchers have identified "fouling" (clogging openings with debris or organisms) as a concern with both barrier nets and AFB's at other locations,[97] and shoreline or channel bottom modifications can be necessary for deployment. Thus, again, site- and design-specific evaluations and impact assessments must be made of any proposed installation of AFB or barrier net system, and effectiveness monitoring should be required for some time after installation.

Wedge-wire intake screens have also been shown to be very effective in reducing impingement but variably successful in reducing entrainment.[98] Wedge-wire screens essentially provide a filtering hood over an intake that both physically blocks many organisms from entering the intake and reduces intake flow rates, by essentially "spreading" the intake's draw over a relatively large surface area. How effective a specific wedge-wire screen installation will be in reducing entrainment depends on the "slot" size of the screen and on the size distribution of potentially entrainable aquatic organisms in that water body. Two millimeter (mm) slots, or openings between metal parts to provide water passage, will generally block organisms 15 mm and larger; smaller slot openings will protect smaller organisms but also reduce the flow rate through a given area of screen. Where water volume and flow rate requirements of a generating facility plus the local populations of entrainable organisms match the capabilities of the wedge-wire screen system, this can provide an effective intake protection system, however, determining that match will require detailed, site-specific analyses.

Behavioral and deterrent systems like acoustic deterrents have also shown promise for reducing mortality of some species or classes of aquatic organisms in specific

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[96] *See* reports in Department application file for the 2003 Lovett SPDES renewal, Department # 3-3928-00010/00002 and 3-3928-00010/00045

[97] McLean, R. 2003. State of Maryland Perspectives on Cooling Water Intake Technologies to Protect Aquatic Organisms; and Henderson, P., R. Seaby and R. Somes. 2003. Filter Curtain Materials, Entrainment, Biofouling and Permeability. Both in Proceedings (in press), A Symposium on Cooling Water Intake Technologies to Protect Aquatic Organisms. Washington, D. C., May 2003.

[98] Taft, E., T. Cook, J. Black, and N. Olken. 2003. Fish Protection Technologies for Existing Cooling Water Intakes and Their Costs. Proceedings (in press), A Symposium on Cooling Water Intake Technologies to Protect Aquatic Organisms. Washington, D. C., May 2003.

situations. Most notably, sonic deterrent systems have been shown to be effective in protecting adults of some herring species from impingement at intakes in Lake Ontario, on the English Channel, and in Belgium.[99] Key design criteria of these deployed systems differ widely, including operating pitches, timing, and speaker placement. Because there are still wide differences in designs and an apparently narrow range of species susceptible to sonic deterrence, application at any of the HRSA plants would require site and resource assessments to determine likelihood of success as well as followup studies to monitor effectiveness. Other deterrent technologies do not have sufficient performance records to be considered available at this time.

The most promising BTA approach for the HRSA plants at this time appears to be combinations of technologies, or technologies plus management systems, deployed in such a manner as to provide increasingly effective aquatic resource protection. This conclusion is consistent with that of other researchers working with cooling water intakes at existing power stations.[100]

Significantly for NYS, this approach of combined technologies would also be consistent with the BTA determinations recently reached for several new or repowered electric generating stations on the Hudson River and estuary system, which have generating capacities similar to units at the HRSA facilities:

- Athens Generating Station (Athens), between Albany and Kingston;[101]
- Bethlehem Energy Center (Bethlehem), slightly south of Albany;[102]
- Bowline 3, adjoining Bowline Point 1 and 2, West Haverstraw;[103]
- Lovett Electric Generating Station, Stony Point;[104]
- Astoria Generating Company (Reliant/Astoria), Queens, New York City(NYC);[105]

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[99] Radle et al, 2003; Ross, Q. E., D. J. Dunning, J. K. Menezes, M. J. Kenna, Jr. and G. Tiller. 1996. Reducing Impingement of Alewives with High-Frequency Sound at a Power Plant Intake on Lake Ontario. North American Journal of Fisheries Management, 16:548-559; Maes, J., A. Turnpenny, D. Lambert, J. Nedwell, A. Parmentier and F. Ollevier. 2002. The Impact of Cooling Water Abstraction On Fish At The Electrobel Power Plant Doel (Belgium) After Installation Of A Fish Guidance Sound System. Journeew D'etude Du Cebedeau, Nov/Dec 2002. Pp. 75-78.

[100] Taft et al, 2003; Maulbetsch et al, 2003.

[101] Athens Interim Decision.

[102] In the Matter of The Applications for Clean Air Act Title IV and SPDES permits by PSEG Power New York, Inc. (Bethlehem Energy Center), Interim Decision, January 31, 2002.

[103] In the Matter of the Application for a SPDES permit and Air Pollution Control permits by Mirant Bowline, LLC. (Bowline 3 Decision), Decision, March 19, 2002.

[104] Lovett Electric Generating Station, SPDES Permit (and supporting Fact Sheets), DEC # 3-3928-00010/0002; NY-0005711; February 6, 2003.

[105] In the Matter of the Application of Astoria Generating Company, L.P. for a Certificate to Construct and Operate a 1,816 MW Electric Generating Plant pursuant

- Astoria Energy (SCS/Astoria), Queens, NYC;[106] and
- New York Power Authority (NYPA/Astoria), also in Queens, NYC.[107]

Locations of these facilities are shown on Figures 2 and 3, following this section.

For the Athens project, a new plant employing combined-cycle technology, potential impacts on aquatic resources were found to be a very compelling concern, and a dry cooling system was determined to be BTA. At Bethlehem, a repowering incorporating combined-cycle technology, third parties voiced strong concerns over potential visibility of the taller structures required for a full dry cooling system as opposed to wet or hybrid cooling tower systems, but significant numbers of species and life stages susceptible to both entrainment and impingement were present at the site. Thus, for that project, a plan was developed and approved to construct hybrid cooling towers, install a wedgewire structure over the intake, and seasonally deploy an MLES™ to further screen the intake during peak periods of potential entrainment. The MLES™ installation at Bethlehem will be flat panels generally paralleling the shoreline.

Bowline 3, a new combined-cycle plant, will use a combination of technologies similar to that at Bethlehem. In addition, Bowline 3's sponsors propose to use discharge water from Bowline 1 and 2, when available, instead of Hudson River water for its cooling water source. This management strategy could further reduce the amount of fresh river water required for the new generating plant. At the Reliant/Astoria facility, a repowering project on the Queens side of the East River, combined-cycle generation with hybrid towers plus intake protection will be provided; the towers will use a reverse osmosis treatment system to minimize salt drift impacts. The SCS/Astoria and NYPA/Astoria projects, both new plants employing combined-cycle generation, will use dry cooling.

In each of these recent decisions, consistent with established law, the aquatic and other natural resources present at and site-specific constraints of each project factored into the individual BTA determination. Each BTA decision must also be found to maximize fish protection while minimizing or avoiding other impacts "... to the maximum extent practicable ..." to satisfy SEQR as well as CWA §316(b). These decisions reiterate that each SPDES permit application involving a CWIS will present an opportunity to make an independent BTA decision.[108] By their very nature, BTA decisions are application-specific, based on site-specific characteristics rather than

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to Article X of the Public Service Law (Reliant/Astoria Decision), Recommended Decision, April 3, 2003.

[106] In the Matter of an Application by Astoria Energy LLC for a Certificate to Construct and Operate a 1000 MW Electric Generating Plant pursuant to Article X of the Public Service Law (SCS/Astoria Decision), Order and Opinion Granting Certificate, November 21, 2001.

[107] In the Matter of an Application by the New York Power Authority for a Certificate to Construct and Operate a 500 MW Electric Generating Plant pursuant to Article X of the Public Service Law (NYPA/Astoria Decision), Recommended Decision, December 17, 2001.

[108] Athens Interim Decision, p.12.

pre-established quantitative goals applicable to applications generally. This appropriately addresses the unique physical and regulatory aspects of each site, including issues that are land-based and water body-specific, as well as its particular technological limitations or parameters.

Fig.3, facing page. Locations of Selected New and Existing Power Plants on the Lower Hudson Estuary, Hudson River, NY.[109]

[109] Scale reduced from original by about 55%.

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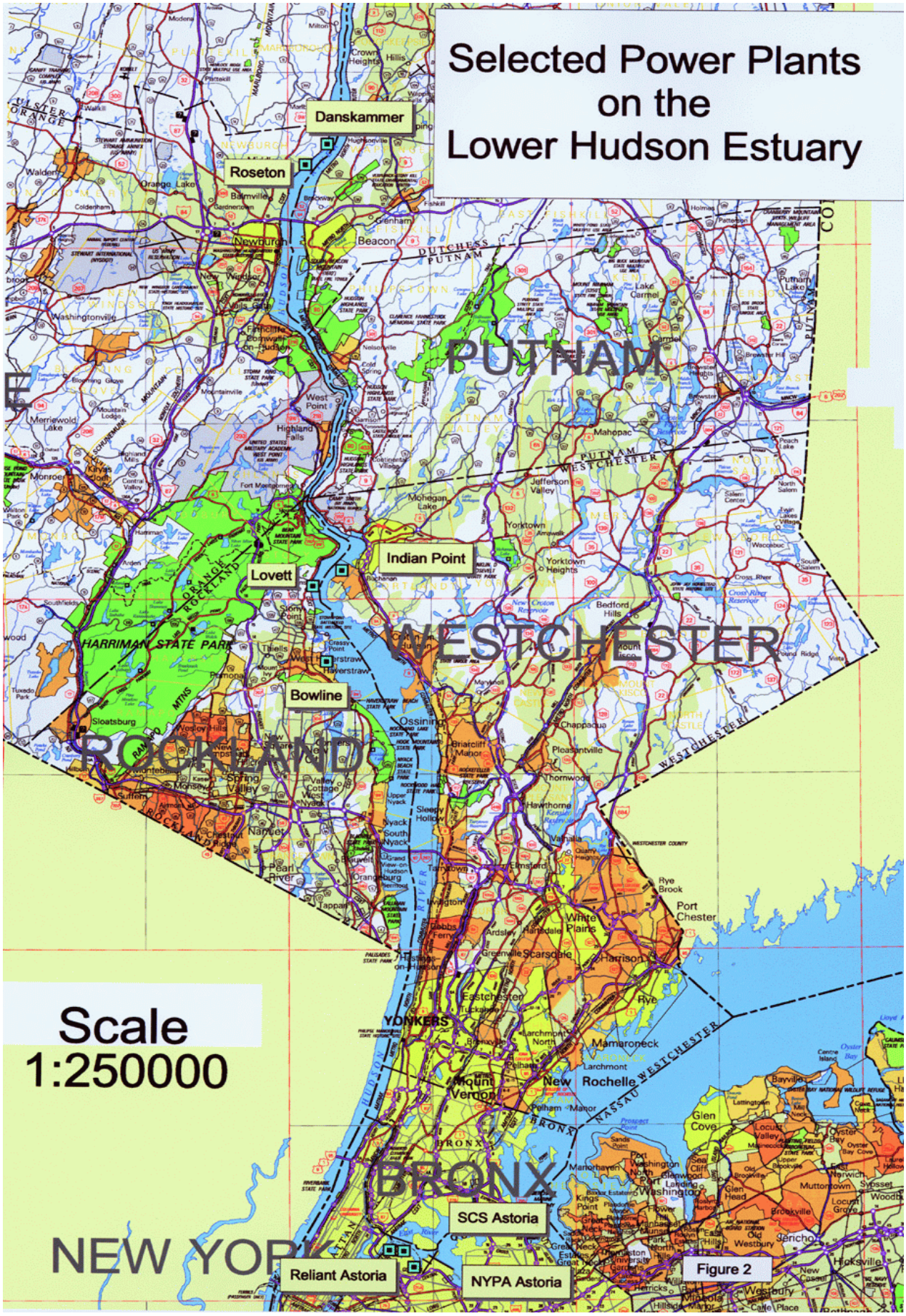
Selected Power Plants
on the
Lower Hudson Estuary
Danskammer
Roseton
Indian Point
Lovett
Bowline
SCS Astoria
Reliant Astoria
NYPA Astoria
PUTNAM
WESTCHESTER
ROCKLAND
BRONX
NEW YORK
HARRIMAN STATE PARK
YONKERS
Scale
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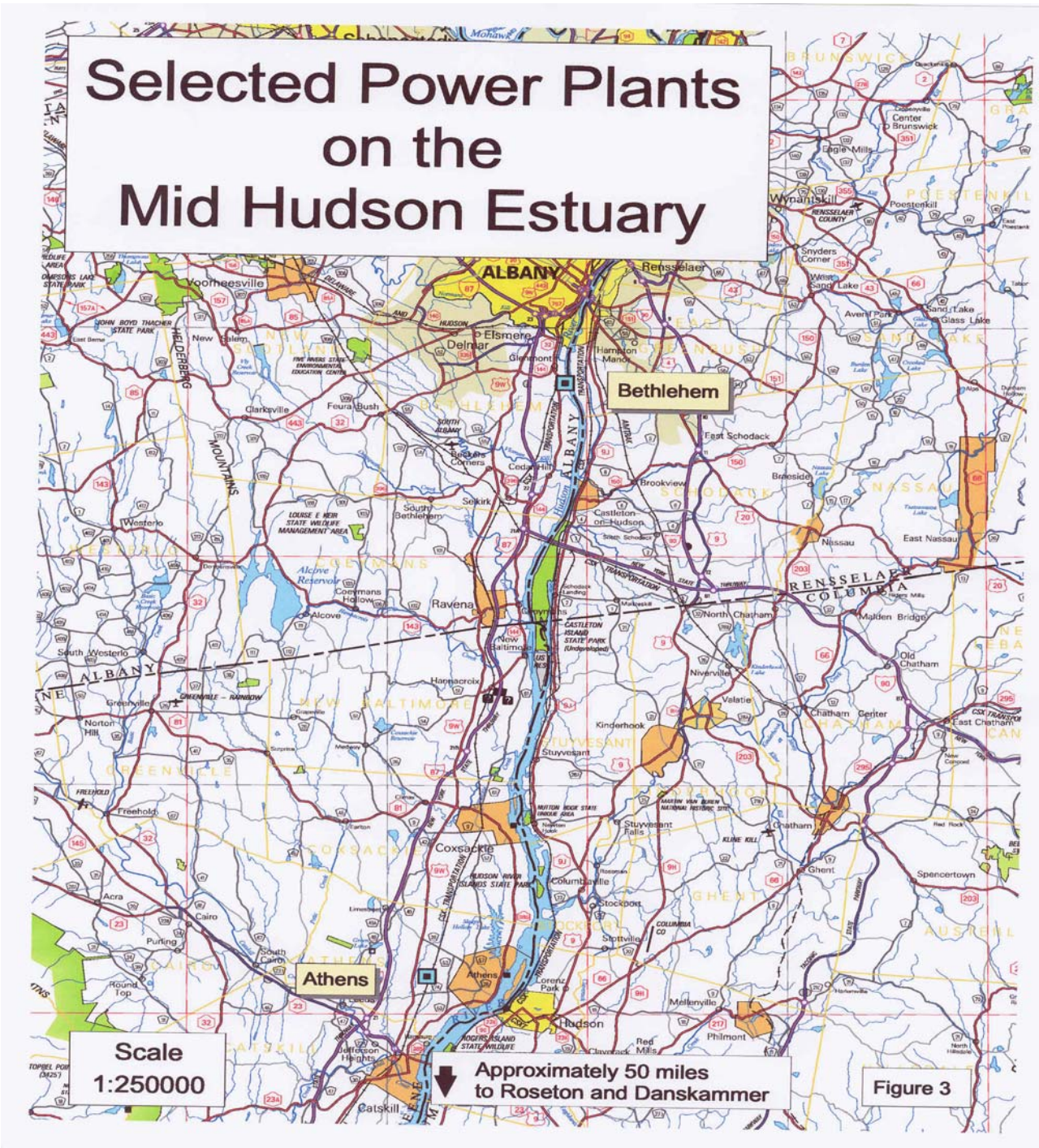
Figure 2

Fig.3. General Location Map, Athens Generating Station and Bethlehem Energy Center, Hudson River, NY[110]



[110] Scale reduced from original by about 20%.

PUBLIC COMMENT SUMMARY

Table 3 (following pages) presents a summary of comments received on the 1999 DEIS, both in writing and orally, at the June 8, 2000, legislative hearing. Comments addressing similar themes are grouped together. The final page of this summary contains a list of all commentors with a key to name abbreviations. Full texts of all written comments plus the hearing transcripts are attached in Appendix F-I.

Table 3. Summary of Public Comments Received on DEIS[111]

TOPIC ⇓	PUBLIC COMMENTS
FISH POPULATIONS	
1. "Cropping" (that, is, consumption of some portion of one or more populations) by power plants is not a legitimate use of NYS's fisheries and other aquatic resources.	EA: continued operation of plants at current levels of entrainment and impingement are inconsistent with prior NYS statements that power plants should not "crop" fish stocks NMFS: alternatives discussion weakened by presumption that "cropping" aquatic resources by power plants is acceptable Riverkeeper: DEIS provides no basis for concluding that mitigation measures should be accepted instead of closed-cycle cooling - technology and policy have advanced to point where [continued] fish mortality at power plants is an unnecessary anachronism
2. Many species in the Hudson River system are actually declining. While the striped bass (SB) population is up, that increase may be the result of other management decisions and activities. Historic baseline or trend data not substantially discussed.	EA: some fish stocks actually showing declines - utilities' own data shows substantially reduced year classes and abundance for several species PISCES: DEIS seriously underestimates potential impacts on bay anchovy, especially early in season Riverkeeper: DEIS assessment of health of populations and estuary "overly sanguine" - system actually far from equilibrium with several species in decline; shad and tomcod deserve "more sober assessment" of current low levels Scenic: plants have killed billions of fish over last 20 years; evidence of long-term declines

[111] A list of all commentors and abbreviations is included at the end of this table.

TOPIC ⇓	PUBLIC COMMENTS
3. Several commentors question one or more of the assumptions used in one or more of the population models; in particular, density-dependence is unproven.	DEC (@ hearing): accepting DEIS for comment doesn't mean agency agrees with it EA: concur with Riverkeeper's conclusion that assumptions for models are flawed so underestimate impacts of plants on Hudson River fish; because analyses do not include pre-power plant conditions, no basis for saying plants have not changed conditions PISCES: large changes in fish species abundance over time plus small decrease in total species richness/diversity suggest that Hudson estuary far from equilibrium; density-dependence unproven, and in SB probably causes serious understatement of importance of numbers of fish killed; by assuming density-dependence and not considering other factors, models ignore disproportionate impacts of reductions in strong year classes Riverkeeper: model does not accurately represent impacts of entrainment so should not be basis for decisions; does not account for year-to-year variability in year class strength; models force-fit some data, with biased or unsupportable conclusions
4. Climate, disease, and the changing ecology of the Hudson River system are not considered in the population models	ASA: 20+ years of studies and data are represented in the DEIS DEC (@ hearing): accepting DEIS for comment doesn't mean agency agrees with it Jacobs - M: cites Croton Landfill cleanup NMFS: SB analyses neglect other factors in assessing current abundance - need to take a wider view Riverkeeper: their experts conclude that the DEIS 'contains a naive ecological analysis which completely ignores the role of climate and disease in determining population'
5. Thermal analyses need to be updated to reflect recent, more extreme conditions	PISCES: use of 1981 thermal data for far-field model may seriously underestimate thermal impacts Riverkeeper: thermal model based on older data so don't reflect extreme summer conditions of later years; DEIS does not address general warming in Hudson estuary

TOPIC ⇓	PUBLIC COMMENTS
FISH PROTECTION POINTS	
6. Fish protection points (FPP) would provide operational flexibility but even less protection than conditions in the Hudson River Settlement Agreement (HRSA)	ASA: existing technologies at all 3 plants plus proposed operating schemes would achieve future fish protection levels similar to those required in last 20 years DEC (@ hearing): accepting DEIS for comment doesn't mean agency agrees with it EA: HRSA levels not sufficient level of protection; FPP likely to lead to larger fish kills so is not sound approach NMFS: FPP are comparable to HRSA standards, but those standards were only intended to be interim and should not now be considered as meeting objectives of the Clean Water Act (CWA); should be looking to "... build[s] on the prior successes rather than simply taking advantage of them" NRDC: DEIS scheme would weaken fish protection in Hudson PISCES: FPP appear designed more to benefit power plants than fish and may result in increased entrainment and impingement mortality; "banking" between years could lead to excessive population impact if critical year classes hit by disproportionate entrainment Riverkeeper: their experts conclude that FPP system is really just a way to trade credits and has "serious weakness and seems designed to aid power plant profitability rather than to protect fish"; could actually result in greater harm being inflicted on fish populations, for example, trading credits among years could lead to devastating impacts on strong year classes; represents an extreme initial negotiating position Scenic: concur with NRDC & Riverkeeper; continuation of Settlement Agreement conditions not acceptable objective; DEIS scheme would weaken fish protection in Hudson

TOPIC ⇓	PUBLIC COMMENTS
MITIGATION	
7. DEIS includes little information on acoustic deterrence and barrier systems.	PISCES: insufficient information on acoustic deterrents
8. DEIS significantly overstates costs and energy impacts of closed cycle cooling	NRDC: have changed opposition to cooling towers with changes in technology since the 1970's NYRU: cooling tower analyses should include more analysis of their potential environmental impacts Riverkeeper: cooling technology changes have eliminated prior objections to towers

TOPIC ⇓	PUBLIC COMMENTS
9. DEIS alternatives and proposed action do not present a fair picture of available alternatives	ASA: once-through with protection measures best balance of all interests CHV: tragedy to allow continued killing of billions of fish by antiquated cooling technologies; require plants to be brought up to modern standards COE: look at boom in Tompkins Cove DEC (@ hearing): accepting DEIS for comment doesn't mean agency agrees with it; draft permits and supporting documents will consider multiple alternative technologies Downs: plants should get on schedule to either convert to dry cooling or close NMFS: alternatives discussion weakened by presumption that "cropping" aquatic resources by power plants is acceptable; accepting these proposals would not meet CWA obligation to protect public trust resources NYRU: Gunderboom ® should be included in DEIS; incorporate results of river flow pattern research into mitigation alternatives; restoration projects must be regional in scope and on same scale as impact PISCES: insufficient treatment of barriers Riverkeeper: their experts conclude that the DEIS "constructs an argument in favor of the lack of impact ..."; DEIS provides no basis for concluding that mitigation measures should be accepted instead of closed-cycle cooling - technology and policy have advanced to point where [continued] fish mortality at power plants is an unnecessary anachronism Scenic: DEIS does not consider pre-plant conditions; permits should require closed-cycle or 32-week outages

TOPIC ⇓	PUBLIC COMMENTS
OTHER TOPICS	
10. The DEIS needs to consider effects of New York's recent conversion to a competitive energy market, take the State Energy Plan into account, or impose parity among facilities.	Downs: if permits create easier standards for older plants, competitive market will not shift generation to newer, less-impacting plants EA: conversion to market system means there will be pressures to run as much as possible so imperative that renewal permits include conditions "highly protective of Hudson River fish ..."; in deregulated market, there would be increased incentive for these plants to run in preference to newer, more protective units unless these plants are compelled to retrofit to closed-cycle or shut down Gordon/Kennedy/Lee: competitive market increases urgency to impose environmental controls on older facilities NRDC: should be parity of permit conditions between these "old" and newer plants on Hudson; look to Athens decision for model; need to now move rapidly to final decision NYRU: outages or reduced operations can be "alternatives to reduce cooling water use", but deregulated market may make harder to control or achieve so should factor that uncertainty into permit terms or conditions Riverkeeper: need to follow Athens decision model and truly minimize impacts

TOPIC ⇓	PUBLIC COMMENTS
11. Radiation discharges are not discussed in the DEIS, but should be.	Baiman: history of radiation discharges causes multiple concerns (cites NYS Health Department reports); should shut down all the nuclear plants EA: submitted NYS Health Department radiation survey numbers Elie: [DEIS] should consider radiation Gabrielle: wants more information on radiation impacts especially on reservoirs; do not renew Indian Point permits Jacobs - B: monitoring of leak from Indian Point 1 should be included in this permit Jacobs-M: EIS needs to consider radioactive discharges, including results of monitoring reports from NYS Department of Health which show increased levels in summer; renewals should prohibit all pollutant discharges Likes: concerned that any radioactive release is permissible; prefer that plants be closed; actual discharge should be monitored for radioactivity Schepart: should consider reports by NYS DOH on radiation levels in Hudson - records show radiation discharges in excess of health limits; should include radiological limits in new permits Weinstein: look at radioactive discharges and chemicals used in piping system

TOPIC ⇓	PUBLIC COMMENTS
12. Several commentors expressed generalized opposition to renewal for one or more facilities	Carlin: downwind - close Indian Point Downs: ironic to be looking at continuation of these withdrawals in face of Athens decision Goodman: do not permit Indian Point Jacobs - S: evacuation plans appear inadequate; laws should be fully enforced Jordan: don't renew Indian Point - poorly maintained facilities should be shut down Mirabito: do not issue permits Moon: concerns with Indian Point plant safety (radiation leaks, old equipment); shut the plant down Nelson-Epstein: close Indian Point Riverkeeper: 10-year SPDES permit term as proposed in DEIS would be illegal; thermal discharges, at least at Indian Point, do not meet water quality standards so should not renew permit(s) Scenic: power plant entrainment & impingement not a valid use of resources; 10-year permit would be illegal Smallev: move from unconscionably hazardous energy sources; shut plants down Wren: oppose nuclear power so don't renew Indian Point permit

List of Commentors

Oral Comments

Benas, Richard (DEC) for NYS Department of Environmental Conservation
Clempner, Jean
Downs, Roger with Susquehanna shad restoration project
Elie, Marilyn of Westchester Citizens Awareness Network
Gabrielle, Susan
Hudson Riverkeeper (Riverkeeper) by David Gordon, Esq.
Jacobs, Barbara
Jacobs, Mark of Westchester Greens and of WESTPAC (Westchester People's Action Coalition)
Jacobs, Stanley
Kennedy, Katherine for Natural Resources Defense Council (NRDC)
Lee, Cara for Scenic Hudson (Scenic)
Likes, Philip
Moon, Dan
Schepart, Margo of Westchester Citizens Awareness Network
Smallev, Jillian [phonetic sp, from transcript]
Weinstein, Lucille
Young, John (ASA) for generators/utilities

Written Comments

Baiman, Sydney
Carlin, Lynne
Citizens for the Hudson Valley (CHV) by Dimitri Sevastopoulo
Environmental Advocates (EA) by Kyle Rabin
Gabrielle, Susan
Goodman, Sidney J.
Hudson Riverkeeper (Riverkeeper) by David Gordon, Esq.
Jacobs, Mark of Westchester Greens and of WESTPAC (Westchester People's Action Coalition)
Jordan, John of Catskill Alliance for Peace
Likes, Philip
Mirabito, Stephen
National Marine Fisheries Service (NMFS), by Michael Ludwig
Natural Resources Defense Council (NRDC) by Katherine Kennedy
Nelson-Epstein, David
New York Rivers United (NYRU) by Ivan Vamos
PISCES Conservation Ltd (PISCES) by Peter Henderson, Ph.D., for Riverkeeper, Scenic Hudson, and Natural Resources Defense Council
Scenic Hudson (Scenic) by Cara Lee
Schepart, Margo
U. S. Army Corps of Engineers (COE), by Richard L. Turner
Wyler, Megan

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RESPONSES TO COMMENTS

Consolidated responses follow to each of the comment themes identified in Table 3 (preceding). Each topical response is considered to reply to all of the comments identified within that theme group.

Fish Populations - 1. "Cropping" (that, is, consumption of some portion of one or more populations) by power plants is not a legitimate use of NYS's fisheries and other aquatic resources.

Some commentors have suggested that fish populations should not be "cropped" by power plants. In other words, they object to any argument that electric generating facilities be permitted to cause injury or death to any life stages of fish and other aquatic organisms, provided only that specified populations of adult fish of selected species be maintained.

The Department agrees that fish should not be "cropped" by power plants. Instead, the Department asserts, and is supported through statute, regulation, policy and practice, that it is in the public interest to minimize the loss of fish and other aquatic resources at electricity generation facilities. The Department further asserts that significant impacts to aquatic resources are not an inevitable result of electric power generation.

The mission of the Department is to provide for the best uses of the State's waters and of its fish and wildlife resources. These resources belong to the people of the State and are held in trust for the use and enjoyment of current and future generations of New Yorkers. The Department's obligations regarding fish and wildlife are described in ECL Articles 11 and 13; its obligations regarding the waters of the State are described in ECL Articles 15 and 17. (*See also* FEIS Regulatory Setting - Legislative Findings and Commissioner's Powers.)

The State's fish and wildlife

Fish and wildlife are the property of the State but numerous uses of fish and wildlife which result in their deaths are permitted. Recreational and commercial fishing, hunting, trapping, scientific collection, and relief from nuisance or damage are examples. In each instance, the permissible methods of take are defined explicitly in statute or regulation.

Fishing, hunting, trapping and scientific collection are highly regulated. The species, age (or its surrogate, size) and sometimes even the sex of the animal to be taken are specified. The time of year is also determined for most species of game, through "open seasons." Generally, breeding seasons are avoided and the "crop" of fish or wildlife is made available to its human consumers when populations are highest or the values in flesh or fur are at their peaks. In order to ensure that populations are

not over-exploited, populations are monitored, either directly or indirectly. At a minimum, the goal of management for such harvested species is to ensure sustainable populations.

Similar considerations apply when permitting the destruction of wildlife which pose a threat to human safety or property. Generally, the taking of such wildlife is permitted either as a last resort or where the magnitude of the take is believed to be insignificant to the species' population or its ecological function.

That fish should not be wasted as a part of energy production was made clear by former Commissioner Jorling, in 1991 letters to the generators, in which he stated:

> "The inadvertent mortality of fish by utilities is not a legitimate use of fishery resources. Therefore, the Department will not allocate a portion of fishing mortality to utilities and will seek elimination if possible, and otherwise minimization, of mortality caused by utilities...".[112]

The State's waters

The waters of New York, too, are the property of the State. Numerous uses are recognized and permitted. New York's waters are used for human consumption, recreation, agriculture, industry, commerce, navigation, and as habitat for fish and wildlife. New York State laws and regulations recognize these uses and provide a regulatory framework which ensures that water quality is maintained at levels which can support particular uses. Generally, the "cleaner" waters are classified for those activities which require the highest water quality, such as for drinking. The goal of the regulatory program is to maintain or improve water quality to enable the designated "best usage."[113]

The waters near the Hudson River plants have been classified as either Class A, B, C, SB, or SC. Each of these classifications has "fishing" as at least one of the designated best use(s). Each also includes the condition that, "... These waters shall be suitable for fish propagation and survival ...".

Historically, the water classification system recognized industrial cooling and process water as "best usages" for Class D water supplies. The listing of these activities as "best usages" was removed by amendments to the regulations prior to 1972. Currently, the least protective designation in NYS is Class D. In fresh surface waters, the best usage of even Class D waters is fishing and the waters must be "... suitable for fish survival ...". [114]

If a water cannot achieve the usages for which it has been designated, it is deemed to be impacted. Pursuant to § 305(b) of the CWA, the Department biennially publishes a report on the State's water quality which, among other things, describes

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[112] Copies of letters in Appendix F-V.

[113] 6 NYCRR Parts 800 - 941.

[114] *See* 6 NYCRR § 701.9

such impairments.[115] The NYS Water Quality Report for 2002 lists the Hudson River downstream from the federal dam at Troy as being impacted by cooling water use by power plants. As discussed more thoroughly below and in several other responses, the effects of the use of Hudson River water for generating plant cooling include the loss each year of a substantial percentage of annual fish propagation. Under alternative density-dependent hypotheses, maximum sustainable yield of shad could double if entrainment mortality at all generation facilities was eliminated.[116] Thus, current levels of impingement and entrainment impair and may preclude the best usage components of propagation and survival. The thermal effects of power plants on Atlantic tomcod and rainbow smelt also appear to preclude or impair fish survival.[117]

Ecosystem values

Numerous public agencies have formally recognized the especially significant values of the Hudson's fisheries. For example, the NMFS has designated the Hudson an Essential Fish Habitat, in recognition of the role it plays in maintaining 34 commercially important fish species. The National Oceanic and Atmospheric Administration has designated four sections, Piermont Marsh, Iona Island, Tivoli Bays and Stockport Flats, as a National Estuarine Research Reserve. NYS Department of State has designated 41 sections of the Hudson as significant tidal habitat, and the USFWS has recognized a number of regionally significant habitats along the River, including Papscanee Marsh, Vosburg Swamp and the Esopus Estuary.

Impacts on the aquatic community

Hudson River fish populations have been studied both intensively and extensively. Survival and mortality investigations have been conducted over long periods of time to measure the impacts, primarily mechanical and thermal, of the power plants on particular fish populations. Although the DEIS asserts that the generating facilities have caused no harm to the aquatic community, numerous findings suggest otherwise. Henderson and Seaby (2000) summarize the differing views:

> "The DEIS concludes that there is no evidence of community change that can be attributed to the power stations. 'While changes in the composition and abundance of this fish community have been observed,

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[115] CWA § 305(b); 33 U.S.C. § 1315.

[116] Deriso, R., K. Hattala & A. Kahnle, 2000. Hudson River Shad Assessment and Equilibrium Calculations: Revision of the 1995 Report to include data through 1997. *In*: ESSA Technologies, Ltd. 2000. Review of the Draft Environmental Impact Statement for SPDES Permits for the Bowline Point 1 & 2, Indian Point 2 & 3, and Roseton 1 & 2 Steam Electric Generating Stations. Report to the Parties to the Application. Prepared by ESSA Technologies, Ltd., Richmond Hill, ON, for NYSDEC, Albany, N.Y. 31 pp. plus appendices.

[117] *See* Atlantic Tomcod and Rainbow Smelt discussions under response 4 in this section of the FEIS.

all appear attributable to factors other than power plant operations.' (VI-36) Second, a key conclusion in the DEIS is that the Hudson ecosystem is healthy. For example, the DEIS states: 'The relatively large number of taxonomic groups collected in these surveys as post yolk-sac larvae demonstrates that the Estuary is a species rich environment and is consistent with the Hudson being [a] healthy ecosystem.' (V-159). The conclusion relies on no particular measure of ecological quality and probably represents a simplistic assumption that because there are many fish present it must still be in good health. This observation would be more convincing if it considered how many species would be expected in the estuary in a completely natural state.

...

"From these observations it is concluded that: 'the fish community in the system remains healthy and robust' ([1999 DEIS] Section VI page 36). All the observed changes are attributable to causes other than those linked to the operation of power plant[s] including, water chestnut growth, zebra mussel invasion, changes in commercial fishing, increases in salinity and improved water quality in New York harbour.

"The available facts can be interpreted differently. The following account better reflects the available data.

"Large temporal changes in fish species abundance together with a small decrease in total species richness and diversity suggest that the Hudson estuary ecosystem is far from equilibrium. There is a small long-term decline in both species richness and diversity within the fish community. These losses are not confined to rare or infrequent visitors. A number of common or once abundant fish have long-term trends of declining abundance including tomcod, Atlantic sturgeon, bluefish, weakfish, rainbow smelt, white perch and white catfish. The rate of decrease in abundance of a number of these species is in their [sic] range of 5-8% per annum. If these trends were to continue, they will quickly result in profound changes in the fish community.

"Since the improvement in water quality in New York harbour [from sewage treatment plant completion], blue crab, Atlantic silversides and striped bass have increased in abundance. In the case of striped bass this is probably related to a decrease in fishing pressure as well as increased habitat for juveniles at the mouth of the estuary. The power stations can affect the fish populations by increasing mortality, principally via entrainment, so that the populations are no longer able to fully replace themselves. For the species which breed in the Hudson estuary and have young stages vulnerable to entrainment, the estimated power station mortality rate is sufficiently high to cause a significant reduction in adult numbers.

"Because the tomcod is a short-lived fish which stays for its entire life within the Hudson estuary, is not commercially fished and suffers the highest level of entrainment mortality of any fish in the estuary, it is a key species to study for the detection of power station effects. The

> population of this fish is in long-term decline and entrainment losses must be considered a probable contributory cause. This would not be the case if strong density-dependence were operating after the early juvenile stages. However, there is no compelling evidence in favor of density-dependence and good reasons to believe it is not operating. Not least of which is the rapid decline in abundance.
>
> ...
>
> "In conclusion, it is not possible to dismiss the influence of the power plants on the fish community, particularly when it is proposed to further increase fish mortality rates. The present community is far from equilibrium and undergoing considerable change. The DEIS's simple declaration [of] it as 'healthy' is a complacent over-generalization." [118]

The aquatic resource mortality from power plants is not comparable to the "selective cropping" that occurs in a regulated fishing or hunting season. Under such regulation, only selected species are harvested, and the forage base remains intact or is improved because fewer individuals higher on the food chain are available to consume lower food chain organisms. Furthermore, fishing and hunting seasons are generally established during that part of the annual cycle which provides both maximum benefit to the users and ensures the sustainability of the population. Mortality at these Hudson River power plants is not limited to a specific, benign season; it occurs throughout the annual cycle, whenever the plants operate their "once-through" pumps. Finally, although impingement and entrainment mortality is measured, it is typically measured only for several of the 140 species of fishes found in the Hudson. Information about the impact on the full suite of aquatic organisms is limited.

Rather than "selective cropping", the impacts associated with power plants are more comparable to habitat degradation; the entire natural community is impacted. These "once-through cooling" power plants do not selectively harvest individual species. Rather, impingement and entrainment and warming of the water impact the entire community of organisms that inhabit the water column.

For example, these impacts diminish a portion of the forage base for each species that consumes plankton (drifting organisms in the water column) or nekton (mobile organisms swimming through the water column) so there is less food available for the survivors. In an intact ecosystem, these organisms serve as compact packets of nutrients and energy, with each trophic (food chain) level serving to capture a diffuse resource and make it more concentrated. Ichthyoplankton (fish eggs, larvae and very small fish which drift in the water column) and small fish feed on a base of zooplankton (drifting animal life) and phytoplankton (drifting plant life). The loss of these small organisms in the natural community may be a factor that leads to

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[118] Henderson, P. A. and R. M. Seaby , 2000. Technical Comments on the Draft Environmental Impact Statement for the State Pollutant Discharge Elimination System Permit Renewal for Bowline Point 1 & 2, Indian Point 2 & 3, and Roseton 1 & 2 Steam Generating Stations. June 2000, Pisces Conservation Ltd. (PISCES report; included in App. F-I.)

harmful algal blooms.[119] The small fish themselves serve as forage for the young of larger species, which serve as forage for larger individuals, and so on up the food chain, more correctly understood as a "trophic pyramid".

Once-through cooling mortality "short-circuits" the trophic pyramid and compromises the health of the natural community. For example, while an individual bay anchovy might ordinarily serve as food for a juvenile striped bass or even for a common tern, entrainment and passage through a power plant's cooling system would render it useful only as food to lower trophic level organisms. It could no longer provide its other ecosystem functions of consuming phytoplankton, digesting and concentrating it into its tissues, and ranging over a wide area, distributing other nutrients as manure. This is just a single example from a very complex natural system, where the same basic impact is multiplied millions of times over more than one hundred fish species.

The direct reduction of the quantity of organisms within the water column by water intakes is known as draw-down. The draw-down of organisms can be understood from the work which HydroQual performed for one of the generators to quantify probabilities of entrainment or re-entrainment for passive particles such as plankton.[120] This study produced multiple profiles of the velocities at various depths across multiple sections of the Hudson in the vicinity of the HRSA generating stations. The measurements were done continuously through time and gave an hourly, three-dimensional profile of water particle travel through time and space in the Hudson; both high flow and low flow conditions were considered. Figures 4 and 5 demonstrate the probability of any single egg or larva or other plankton organism being entrained within seven days of momentarily occupying a single location.[121]

The actual draw-down is likely even greater because the three HRSA generating plants (combined with other facilities in the same river reaches) act cumulatively on the entire aquatic community; many organisms live in this reach of the River for more than seven days; and any organisms coming from upstream, such as tomcod, would also be subject to the draw-down from the Danskammer and Lovett Stations (located in the same river reach but not part of the HRSA nor the subject of this FEIS; *see* Fig. 2 at end of Regulatory Setting). The most important effect of drawdown is that it dramatically reduces food availability within the ecosystem and, thus, survivability of multiple species over significant stretches of the Hudson River.

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[119] Capriulo, G. M., G. Smith, R. Troy, G. H. Wikfors, J. Pellet, and C. Yarish. 2002. The planktonic food web structure of a temperate zone estuary, and its alteration due to eutrophication. Hydrobiologia 475/476: 263-333.

[120] HydroQual, Inc. 1999. Modeling the Entrainment of Passive Particles Into Hudson River Power Plants. *For* Orange and Rockland Utilities, February 1999, by HydroQual, Inc., Mahwah, NJ.

[121] *From* HydroQual, 1999.

[122] HydroQual, 1999.

Fig. 4. Entrainment Probability at Low Flow[122]

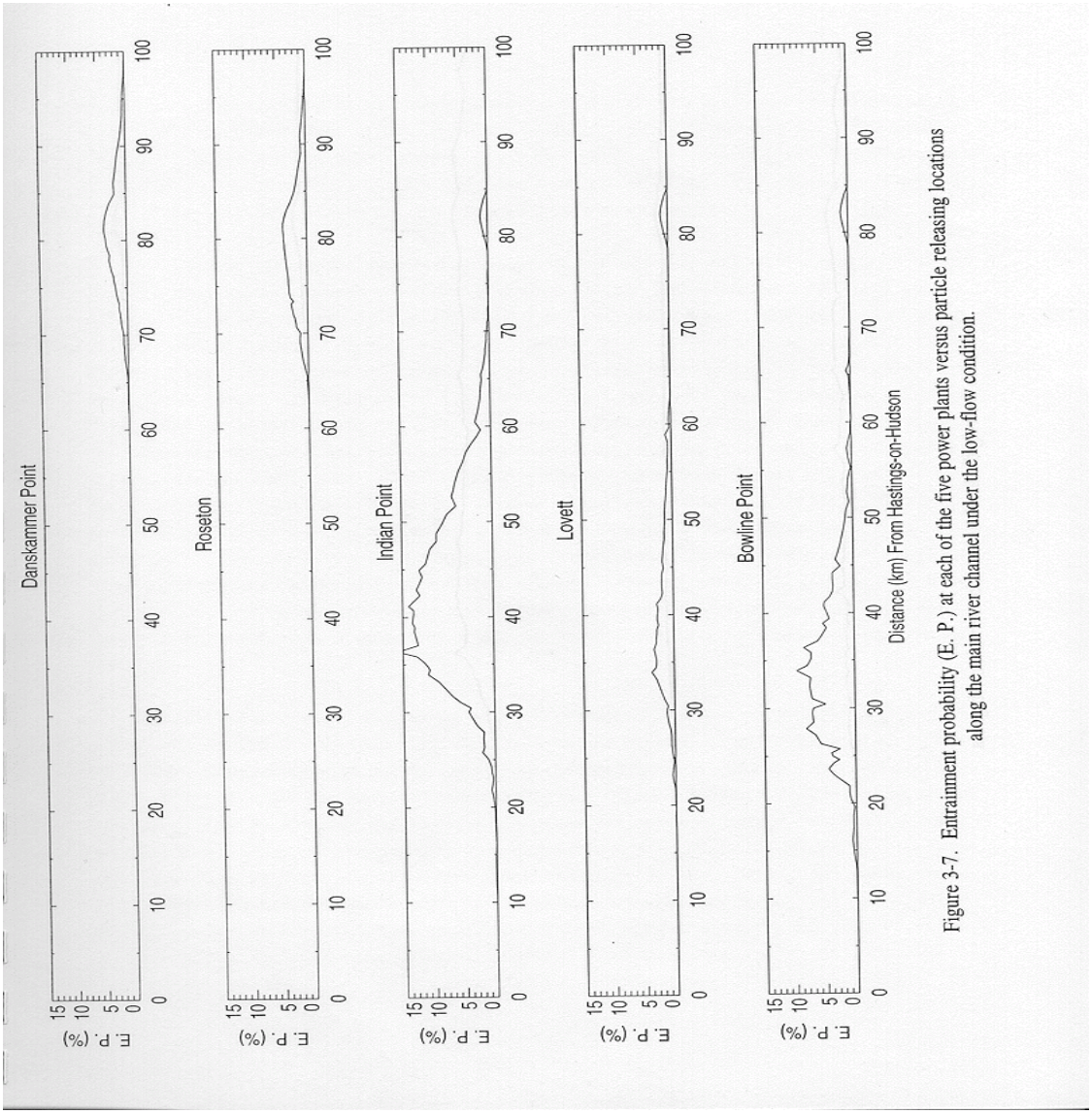

Figure 3-7. Entrainment probability (E. P.) at each of the five power plants versus particle releasing locations along the main river channel under the low-flow condition.

Fig. 5. Entrainment Probability at High Flow[123]

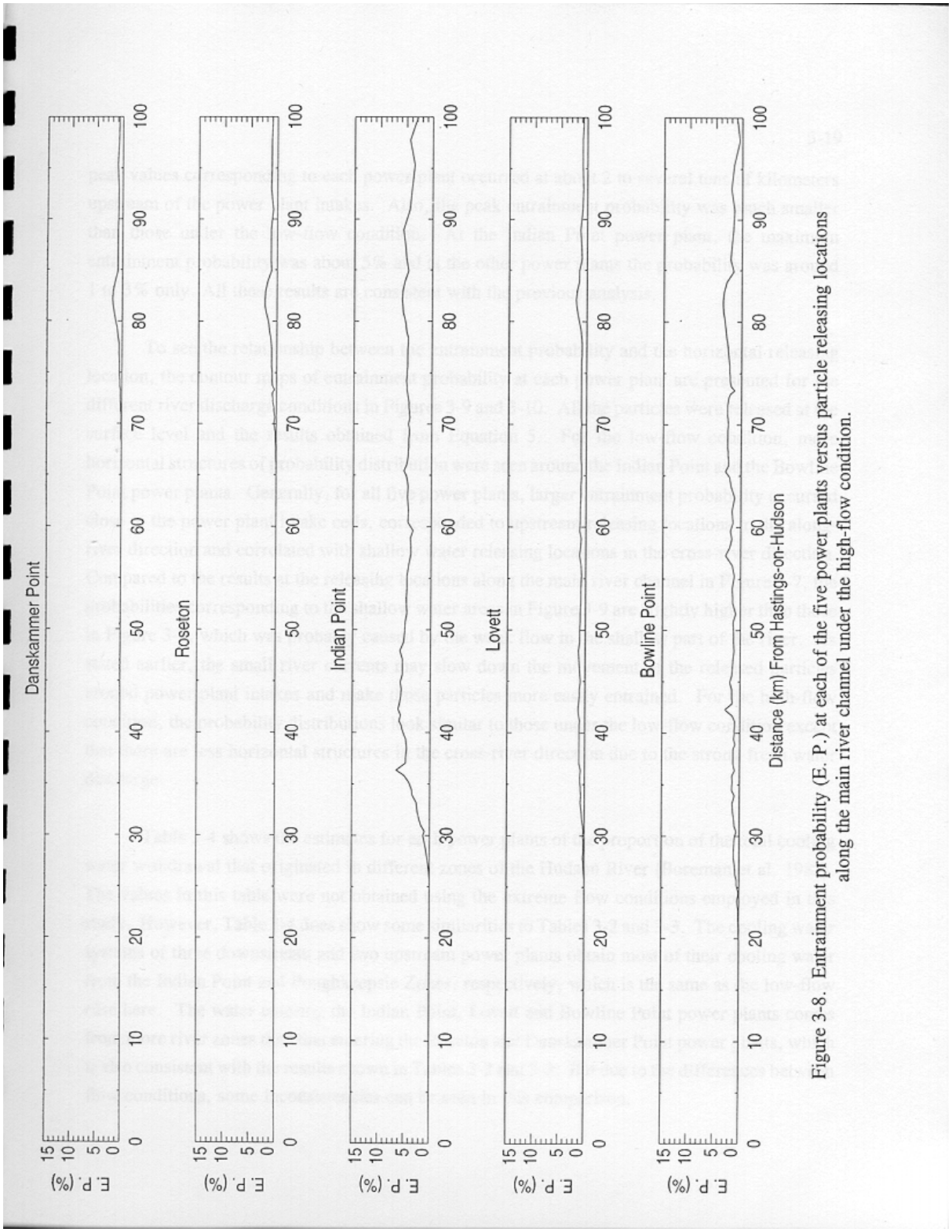

Figure 3-8. Entrainment probability (E. P.) at each of the five power plants versus particle releasing locations along the main river channel under the high-flow condition.

[123] HydroQual, 1999.

Fish Populations - 2. Many species in the Hudson River system are actually declining. While the striped bass (SB) population is up, that increase may be the result of other management decisions and activities. Historic baseline or trend data is not substantially discussed.

In Section VI (p. 36), the DEIS concludes that "...the fish community in this system remains healthy and robust, and consistent with that expected in a large temperate estuary like the Hudson." It further states that "While changes in the composition and abundance of this fish community have been observed, all appear attributable to factors other than power plant operation."

The Hudson River has been the subject of more than 25 years of fisheries investigations, and, as such, is one of the most intensively studied rivers in the world. These studies have revealed that, although overall species richness (the total number of species) is high, with more than 200 species recorded, diversity (which incorporates consideration of abundance and distribution amongst the species) is relatively low; most of the River's fish production is concentrated among a few of these species. Overall species richness and overall abundance of fish larvae in the river have increased since 1974. However, increases in species richness are mainly due to an increase in use of the River by marine species, and increases in abundance can be attributed to increases in but two species, striped bass and Atlantic silversides. Species richness and abundance in both young-of-year and older fish have decreased over this same period, especially among freshwater species, as described below.[124]

Several species of fish in the Hudson River estuary, such as American shad, white perch, Atlantic tomcod and rainbow smelt, have shown trends of declining abundance.[125] The American shad stock in the Hudson river has been in decline since the early 1990's. White perch eggs, yolk-sac and post yolk-sac larvae abundance has remained stable since the mid 1980's; however, indices of young-of-year and older fish have shown declines since the late 1970's.[126] Atlantic tomcod juvenile abundance has shown no trend, but adult abundance over the last 10 years has been lower than in previous years and continues to show high interannual

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[124] Dey, W., S. Jinks and N. Decker, 2003. Changes in the Fish Community Throughout the Hudson River Estuary. *At* Hudson River Environmental Society Presents: Hudson River Fishes & Their Environment. March 20-21, 2003, Marist College, Poughkeepsie, NY. No published proceedings.

[125] ASA Analysis and Communications. 2002. 1999 Year Class Report for the Hudson River Estuary Monitoring program. August 2002.

[126] Wells, A. W. 2003. Status of White Perch in the Hudson River. *At* Hudson River Environmental Society Presents: Hudson River Fishes & Their Environment. March 20-21, 2003, Marist College, Poughkeepsie, NY. No published proceedings.

variability.[127] Rainbow smelt have been virtually absent from the collections from the long river and fall shoals surveys since 1995.[128]

Declines in the abundances of several species and changes in species composition raises concerns and questions regarding the health of the River's fish community. The Hudson River environment has undergone a number of significant changes in recent decades. In addition to changes directly attributable to power plants, these changes include: water quality, especially as a result of major improvements in sewage treatment; invasions by exotic species such as water chestnut and zebra mussels; hazardous substances contamination, especially PCBs, organochlorine pesticides and heavy metals; global climate change, which includes both increasing annual mean temperatures and higher frequencies of extreme weather events; and the management of individual species, such as striped bass, which have undergone strict regulation for both the recreational and commercial fisheries. Each is a stressor, to a greater or lesser extent, on the River's biota. For example, the zebra mussel invasion, which began in 1991, is thought to have caused very large reductions in the biomass of plankton and non-zebra mussel macroinvertebrates. Overall, it is estimated that the biomass of these forage invertebrates has dropped by approximately 50 percent, leading to large changes in the fish community.[129]

The impingement, entrainment and thermal impacts caused by the HRSA facilities are well-documented elsewhere in this FEIS and in other portions of the HRSA proceedings. The millions of fish that are killed by power plants each year represent a significant mortality and are yet another stress on the River's fish community. Although the primary cause of these population changes cannot conclusively be attributed entirely to the operation of these three steam electric generating stations, the mortality that they cause must be taken into account when assessing these population declines.

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[127] Young, J., M. T. Mattson , Q. E. Ross and D. J. Dunning. 2003. Population Fluctuation of Atlantic Tomcod in the Hudson River Estuary. *At* Hudson River Environmental Society Presents: Hudson River Fishes & Their Environment. March 20-21, 2003, Marist College, Poughkeepsie, NY. No published proceedings.

[128] The "long river", or Longitudinal River Ichthyoplankton Survey (LRS) encompasses the entire length of the Hudson River Estuary, from the Battery (River Mile, RM, 1) to the Federal Dam in Troy (RM 152). The LRS yields ichthyoplankton data to support calculations of standing crop, temporal and geographical indices, and growth rates for selected Hudson River species (Atlantic tomcod, American shad, striped bass, white perch and bay anchovy). LRS sampling is concentrated during the spring, summer and early fall when eggs and larvae of the selected species have been historically abundant.
Fall Shoals Survey (FSS) samples are collected every other week from the Battery to the Federal Dam in Troy from mid-summer through the fall. The FSS objective is to provide data on young-of-year (YOY) fish to support calculation of standing crop and temporal and geographical indices of for selected Hudson river species (Atlantic tomcod, American shad, striped bass and white perch). *From* ASA 2002.

[129] Strayer, D. L., N. F. Caraco, J. J. Cole, M. L. Pace, S. Finlay, K. A. Hattala, and A. W. Kahnle. 2003. Ecological Changes From Two Recent Species Invasions in the Freshwater Tidal Hudson River. *At* Hudson River Environmental Society Presents: Hudson River Fishes & Their Environment. March 20-21, 2003, Marist College, Poughkeepsie, NY. No published proceedings.

Fish Populations - 3. Several commentors questioned one or more of the assumptions used in one or more of the population models; in particular, density-dependence is unproven.

The DEIS relies on fish population modeling to support the generators' conclusion that entrainment mortality is not significant for two species, tomcod and striped bass, based upon compensatory density dependence.[130] Bay anchovy do not have a population model presented in the DEIS. However, a Production Foregone model that is based upon data from the Chesapeake Bay predicts that bay anchovy populations in the Hudson River could remain stable if there were an annual influx of migrants from a general east coast population. A population dynamics model is not presented for white perch in the DEIS. Thus, estimated impacts of entrainment and impingement for this species are highly speculative. The American shad population model in the DEIS shows significant variation in abundance between 1990 and 1997; the stock apparently has not recovered from low numbers in recent years and may be over-exploited unless high density-dependence is assumed. Models were not prepared for other species.

The Department concludes that the models and analyses presented in the DEIS are somewhat useful, but that there are significant questions and concerns regarding the inputs and assumptions for each species analysis which may result in very different conclusions than those presented in the DEIS. It is noteworthy that the analyses and conclusions performed by three different sets of professional fisheries population modelers, in three different countries and with different backgrounds, all point out significant concerns within each model and that alternative results could easily be presented. These modelers represent the generators, the Department and ESSA Technologies, Ltd., and environmental organizations; this is a diverse group that is not predisposed toward a common outcome. What is clear from the data and analyses presented in the DEIS is that entrainment and impingement, primarily the former, are eliminating a significant portion of the above-listed species in their egg and larval forms, as well as many more species which spawn or spend part of their life stages in the lower Hudson River. While it is reasonable to conclude that some of these losses may be compensated for by increased survival of organisms not killed, it is not possible to determine the impact of these losses on adult populations with much confidence.

Fisheries scientists are keenly aware of dramatic natural changes in fish populations, both on an annual basis and long term. There are a great many natural reasons for these changes. The Hudson River is a dynamic system with many environmental

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[130] The *Dictionary of Ichthyology*, Brian W. Coad and Don E. McAllister, Revised: 13 May 2003, provides the following definitions:
Density dependence = the dependence of a factor influencing population dynamics (such as survival rate or reproductive success) on population density. The effect is usually in the direction that contributes to the regulative capacity of a stock.
Compensatory survival = a decrease in the rate of natural mortality that some fish show when their populations fall below a certain level. This may be caused by less competition for food and living space.

For a general discussion of the concepts, *see* Boreman, John. 2001. Surplus Production is a Myth. 10 pp. Included in Appendix F-V.

parameters differing from apparently natural causes each year. Flow, temperature, salinity, dissolved oxygen, nutrients and others fluctuate markedly. Many of these same parameters are influenced by human activities, too. Addition or deletion of pollutants, invasion by exotic species of plants and animals, habitat management, and fishing pressure and regulations all combine with the withdrawal of billions of gallons of water each day, for cooling purposes at steam electric stations as well as for other industrial or public water supply uses, and with very large amounts of thermal inputs, to contribute to changes in the River. Attempts to identify, measure and understand specific impacts are complicated by the array of interacting and potentially confounding variables. The inherent uncertainties of data management and especially population models cast further doubt on available information and analyses.

Data in the 1999 DEIS and comments on the topic of population dynamics and modeling identify entrainment rates for fish eggs and larvae as significant impacts. They also indicate that neither the terms of the HRSA and subsequent Consent Orders nor the applicants' proposed actions would reduce this impact to levels consistent with BTA requirements. The body of analyses in the fish population models presented in the DEIS indicates that the models overestimate the role of density dependence and thereby underestimate impacts associated with entrainment and impingement. This leads the Department to conclude that this modeling effort alone will not conclusively show whether or not fish populations are significantly affected by entrainment and impingement. Therefore, the Department has determined to not rely on these models to make conclusions for this FEIS or for the SPDES permits to be issued for each of the three HRSA power plants.

Detailed reviews of population dynamics models are presented in the ESSA Technologies, Ltd. report *Review of the Draft Environmental Impact Statement*, dated October 20, 2000, and the reviews of the Atlantic Tomcod, Bay Anchovy, Striped Bass, and American Shad models appended to it.[131] Additional comment on the models, as well as other topics, was provided by Dr. Peter Henderson of Pisces Conservation, Ltd. representing the Riverkeeper, Scenic Hudson and NRDC.[132]

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[131] ESSA Technologies, Ltd. 2000. Review of the Draft Environmental Impact Statement for SPDES Permits for the Bowline Point 1 & 2, Indian Point 2 & 3, and Roseton 1 & 2 Steam Electric Generating Stations. Report to the Parties to the Application. Prepared by ESSA Technologies, Ltd., Richmond Hill, ON, for NYS DEC, Albany, NY. 31 pp plus Appendices; the full set of ESSA reports is included as Appendix F-V to this FEIS.

[132] PISCES, 2000.

Atlantic Tomcod

The Atlantic Tomcod population in the Hudson River appears to be declining rapidly. This conclusion is supported in the DEIS by 1989-97 early life-stage data.[133] The DEIS further asserts that, "... Adult abundance in recent years is distinctly lower than it was in the 1970s ...".[134] Because this species is at the southern edge of its geographic range, observed declines could be the result of increasing river temperatures, whether from thermal discharges, global climate change, or other unidentified factors. Nevertheless, the population stability predicted by the population model in the DEIS is predicated upon a conclusion that significant density-dependent mortality occurs for this species at the life stage *after* most entrainment mortality has occurred. If the conclusion proves to be based upon limited data or errors in analysis (as suggested by ESSA Technologies, Ltd. in their initial DEIS review),[135] then the Hudson River tomcod population is *not* determined by this density-dependent mortality and the generators proposed actions could instead increase the conditional entrainment mortality rate (CEMR) of this species.[136]

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[133] 1999 DEIS, p. V-43, Figure V-65

[134] 1999 DEIS, p. VI-11

[135] Parnell, I., D. Marmorek, and R. Deriso. 2000. Review of the Assessment of Atlantic Tomcod. Companion Report to Chapter 3 *in* ESSA, 2000.

[136] Conditional Entrainment Mortality Rate (CEMR) is the probability of a fish dying from passage through the cooling water system of a power plant. It is expressed as a percentage and measures how many fewer Hudson River fish exist at the end of their first year of life (actually at September 1) than would exist if not for the loss to entrainment. The actual computations are based on measurements of mortality rates of all life stages of fish. These stages include eggs, larvae, juveniles and even some small adults; larger fish usually do not become entrained because they can swim well enough to escape from the intake current or are protected by mechanical devices such as racks or screens installed expressly to prevent entrainment. Because much of the raw data involves early life stages, the mortality rates of eggs and larvae are "normalized" to a rate expected of young-of-the-year fishes on September 1. This statistical process is based on existing information about expected mortality (or its inverse, survival) of each life stage from natural causes, such as predation.
This survival information varies among species. For most species, natural mortality of early life stages is very high. For example, for striped bass, about 75 percent of eggs die before they hatch to become yolk sac larvae. Similarly, mortality can be as high as 89 percent as the yolk sac larvae mature to become post-yolk sac larvae. This natural attrition continues throughout the life cycle. Typically, only two-hundredths of one percent of striped bass eggs would survive to become juveniles on September 1; this is a survival rate of .0002. The CEMR, then, accounts for such natural mortality rates when it is used to calculate mortality attributable to entrainment at power plants.
See Public Service Electric and Gas Company (PSE&G). 1999. 316(b) Demonstration for the Salem Nuclear Generating Station. Appendix L in Application for Certification of a Major Electric Generating Facility Under Article X of the New York State Public Service Law, Appendix 8b. 2000. TRC Environmental for KeySpan Energy.

Population declines could continue and ultimately result in the elimination of this species in the lower River.[137]

Striped Bass

The DEIS presents arguments in support of the generators' proposed action, and the resulting mortality of this species due to entrainment and impingement, that are based upon the assumption of strong density dependence within the striped bass population in the Hudson River. ESSA Technologies, Ltd. has noted that this conclusion is based upon data and model assumptions that, if not faulty, may not be the only data and assumptions that could be employed in the model.[138] For example, fishing mortality estimates presented in the model are inconsistent with recent tagging analyses and stock assessments developed for Atlantic coast stocks.[139] An alternative analysis could be presented that indicates much lower density-dependence; such an indication would lead to a prediction of a much greater impact from entrainment and impingement.

White Perch

A population dynamics model was not prepared for this species because the Technical Workshops concluded that the data do not support development of a defensible model. However, juvenile and age-1 abundance indices suggest that white perch numbers in the Hudson River are declining.[140] This contrasts with the DEIS conclusion that the population appears resilient enough to sustain its population in the future under similar levels of power plant mortality. These conditional mortality rates (CMR) are stated to be approximately 21 percent over the period of analysis presented. As with other species, use and interpretation of other available information can easily result in very different conclusions regarding impacts

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[137] *See also* Everly, A. W. and J. Boreman. 1999. Habitat use and requirements of important fish species inhabiting the Hudson River Estuary: Availability of Information. NOAA Tech. Memorandum NMFS-NE-121. US Dept. of Commerce, National Marine Fisheries Service, Northeast Fisheries Science Center, Woods Hole, MA. http://www.nefsc.noaa.gov/nefsc/publications/tm/tm121/tm121.pdf
Of the 140 species that occur in the Hudson River Estuary, Everly and Boreman also chose Atlantic Tomcod as one of their 11 representative species for their study. Tomcod were chosen as important and representative of the fish community of the Hudson River as euryhaline nonmigratory species. The life history synopsis on p.14 illustrates the exposure of this species to entrainment, impingement, and thermal pollution impacts from once-through cooling, by virtue of its life cycle in the Hudson River.

[138] Deriso, R., D. Marmorek, and I. Parnell. 2000. Review of the Assessment of Striped Bass. Companion Report to Chapter 5, *in* ESSA, 2000.

[139] Deriso et al, 2000.

[140] Parnell, I. and D. Marmorek. 2000. Review of the Assessment of White Perch. Companion Report to Chapter 6, *in* ESSA, 2000.

of entrainment and impingement. In their earlier reviews, the HRSA technical workshops and the review by ESSA Technologies, Ltd. recommended that topics and issues stemming from data limitations be considered in the DEIS analysis. This was not done.

American Shad

American shad population impact analysis in the DEIS is based upon Hudson River Shad Assessment and Equilibrium Calculations: Revision of the 1995 Report to Include Data Through 1997, by Dr. Richard Deriso, Kathryn Hattala, and Andrew Kahnle.[141] Ms. Hattala and Mr. Kahnle are Department staff and Dr. Deriso is a consultant to ESSA Technologies, Ltd., the Department contractor that assists in review of population dynamics modeling, among other topics. This analysis was the only model which employed more than one level of density dependence to determine abundance. The DEIS concludes that the American shad population appears healthy and able to sustain itself within the constrains of the proposed action. This is the least conservative conclusion that can be drawn from the data presented. More likely is the conclusion that the stock has not shown any recent recovery from very low levels ("At the present time, shad stocks in the Hudson River are at an all-time low" [142]), and both entrainment and fishing mortality rates need to be minimized.

Bay Anchovy

Bay anchovy population modeling presented in the DEIS was developed to analyze this species in the Chesapeake Bay and used data from that water body, not from the Hudson River. The model's author, Dr. Kenneth Rose, presented many analytical caveats that should be used in the application of the model; the model is very sensitive to different assumptions. The discussion of the model results presented in the DEIS, however, does not acknowledge these limitations. This model estimates production foregone, in contrast to other population dynamics models. The analysis overestimates the predatory demand of striped bass and bluefish because their populations have increased so markedly and suggests that anchovy spawner immigration serves to avoid population extinction caused by entrainment and impingement in the Hudson; this immigration would come from the Atlantic coast stock. This assumption appears to ignore entrainment and impingement impacts from the many other coastal power plants which affect the coastal anchovy population. Therefore, the conclusions concerning bay anchovy presented in the DEIS are not sufficiently supported by the model.

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[141] Appended to ESSA, 2000.

[142] DEIS, p. V-101

Fish Populations - 4. Climate, disease, and the changing ecology of the Hudson River system are not considered in the population models.

Any measurement of ecological impacts attributable to power generating stations is confounded by the changing ecosystem itself. As will be discussed here and in following sections, the Hudson River ecosystem has undergone numerous profound changes in the last few decades, many of which are continuing. The population models presented in the DEIS do not account for such fundamental and dynamic ecosystem influences as climate, disease, water quality, flow and invasive species. For example, n the years since the 1999 DEIS was published, Atlantic tomcod have continued to decline, contrary to the predictions of the model presented in the DEIS.[143] Rainbow smelt numbers, too, have declined significantly during this period.

In addition, many assumptions in the model and the selective use of datasets for the various models cast doubt on the validity of many of the conclusions presented in the DEIS.[144] For example, different years of data are used throughout the DEIS in order to demonstrate a lack of correlation between post-yolk sac (PYS) and juvenile fish of a selected species. Although the DEIS asserts that this relationship between PYS and juveniles demonstrates density-dependent compensation, other, more plausible explanations are available.

If one is to entertain the concept of density-dependent compensation as a mechanism by which fish populations respond to changing stressors within their environment, it must be evaluated against the many changes which can impact the population, not only the indiscriminate cropping imposed by cooling water intakes. Even if density dependent compensation exists, it cannot be presumed that the ability to make up for natural and anthropogenic induced mortality is infinite. The factors above, which are only recent examples of changes affecting fish in the Hudson, illustrate how many factors can consume portions of any compensation ability fish populations may have.

Climate Change

Over the past decade a large body of data has been collected in a variety of scientific disciplines which indicates that climatic changes are occurring on a global scale.[145] Growing evidence suggests that temperature has increased over the past century at an accelerated rate. One indicator of this change has been increased ocean temperatures. Of the marine waters of the world, coastal areas and estuaries are most susceptible to climatic changes due to their relatively shallow depth and proximity to land. These coastal areas are also the most biologically productive as

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[143] ASA, 2002.

[144] PISCES, 2000.

[145] Kennedy, V., et al. 2002. Coastal and Marine Ecosystems and Global Change. Prepared for the Pew Center on Global Climate Change, Arlington, VA.

the majority of marine fishes spawn, and many mature in near shore or inshore areas. Though estuaries only represent approximately 0.5 percent of the world's marine environment, they support about 5 percent of global fish production.[146]

Many scientists believe that the accelerated increase in global temperatures is due primarily to anthropogenic impacts. Chief among these is the emission of "greenhouse gases" produced by burning fossil fuels. The accumulation of these emissions in the atmosphere causes air temperatures to increase; this indirectly increases temperatures of oceans, estuaries and other surface waters. Because of their proximity to land, estuaries and coastal waters are also directly influenced by other human activities which may increase temperature, such as by storm water runoff from impervious surfaces, wastewater effluent and cooling water discharges. A review of data collected over a 51-year period indicates increases in water temperature of the Hudson River Estuary in the last half of the twentieth century.[147]

Very small changes in water temperature have been shown to affect many species of fish, particularly during early life stages.[148] Temperature changes may influence spawning success, early life stage development, and survival of ichthyoplankton and adults.[149] Most vulnerable would be cold water species, and impacts upon these species would be an early indicator of changes which could eventually affect any and all species inhabiting a water body.

Rainbow Smelt

Rainbow smelt may be disappearing from some reaches of the Hudson because of thermal discharges from electric generating stations. The rainbow smelt *(Osmerus mordax*) is a small soft-bodied species which inhabits coastal areas of North America from Labrador to as far south as Virginia. Smelt also occur naturally as landlocked populations in some lakes in New England and eastern Canada. In 1912, smelt were introduced into Crystal Lake in Michigan. From there they spread throughout the Great Lakes where they are now found in abundance.[150] Coastal populations support

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[146] Kennedy, 2002.

[147] Ruggiero, R. Hudson River Temperature Data Collected at the City of Poughkeepsie Water Treatment Facility. Unpublished; submitted to Department March 6, 2003. Copy in Appendix F-V.

[148] Kennedy, 2002.

[149] USEPA - New England, 2002. CWA NPDES Permit Determinations for Thermal Discharge and Cooling Water Intake from Brayton Point Station in Somerset, MA. July 22, 2002.

[150] Buckley, J. L. 1989. Species Profiles: Life Histories and Environmetnal Requirements of Coastal Fishes and Invertebrates (North American) Rainbow Smelt. USFWS Biological Report 82(11.106) TR EL-82-4.

recreational fisheries and modest commercial fisheries in New England .[151] Ecologically, smelt serve as forage for species such as striped bass and bluefish.[152]

Research conducted by the Massachusetts Division of Marine Resources has documented relatively stable populations of smelt in several rivers located in Massachusetts through 2000.[153] Studies conducted by Dominion Nuclear Connecticut, Inc. as a requirement of the operation of the Millstone Power Station also demonstrate a stable population of smelt in the Niantic River and adjacent areas of Long Island Sound through 2000.[154] In contrast, data collected by the Hudson River Estuary Monitoring Program, contained in the 1999 Year Class Report, document the apparent local disappearance of rainbow smelt.[155]

Because the Hudson River is located in the southern portion of the rainbow smelt's east coast range, one might reasonably conclude that observed increases in ocean and coastal water temperatures, as from global climate change, have caused a range shift northward, with the smelt abandoning its southernmost range. However, smelt populations at nearly the same latitudes as the Hudson River Estuary remain stable. This fact may indicate that localized influences have caused the apparent local disappearance of this species in the Hudson River. Thermal discharges, as from power plants, may be a principal factor in the disappearance of this species from the Hudson estuary. Such a trend, if continued, could impact other species. This circumstance warrants review of thermal contributions to the Hudson River Estuary.

Atlantic Tomcod

Atlantic tomcod declines, too, may be attributable to the effects of cooling water intakes at electric generating stations in the Hudson River. Like smelt, the Atlantic tomcod (*Microgadus tomcod*) is a cold water species that has declined dramatically since 1995.[156] Tomcod populations in the Hudson River have been monitored since 1974 with a mark-recapture program using box traps. In 1982, trawling, primarily south of the George Washington Bridge, was added as a means of collecting fish. The population of tomcod fluctuated but remained abundant through 1995, after

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[151] Chase, B. and C. Childs, 2001. Rainbow Smelt (*Osmerus mordax*) Spawning Habitat in the Weymouthfore River. Massachusetts Division of Marine Fisheries Technical Report TR-5.

[152] Buckley, 1989.

[153] Chase & Childs, 2001.

[154] Keser, M. 2001. Monitoring the Marine Environment of Long Island Sound at Millstone Power Station, 2000 Annual Report. Environmental Laboratory, Millstone Power Station, Dominion Nuclear, Waterford, CT.

[155] ASA, 2002.

[156] ASA, 2002, and prior (1996-99) Hudson River Year Class Reports. Normandeau Associates, Inc. (NAI). Letter reports and field data from M. Ricci to J. Kelly on the Striped bass and Atlantic tomcod Mark Recapture Program; April 26, 2002, and April 22, 2003.

which a steady decline has occurred. During the 2001-2002 and 2002-2003 sampling seasons, tomcod have become virtually absent.[157]

The tomcod has a much shorter life span in the Hudson River than in more northern systems, living only about 2 years. Three-year and older fish represent a tiny fraction of the population (0.6 percent in 1995-96 season) and the majority of the spawning stocks are 1-year-old fish.[158] In contrast, stocks in other areas in New England and Canada are much longer-lived and spawning stocks are dominated by 2-year-and-older fish.

Numerous studies have been conducted investigating anthropogenic impacts upon tomcod inhabiting the Hudson River Estuary and have revealed a very high incidence of liver cancer.[159] Recent research indicates a synergistic effect from elevated levels of polycyclic aromatic hydrocarbons (PAHs), which appear to damage hepatic DNA, leaving the fish more susceptible to PCB-induced early life-stage toxicities.[160]

In addition to chemical contaminants, other impacts upon the Atlantic tomcod population which have been investigated include: reductions in food sources; predation; and mortality due to cooling water intakes estimated at approximately 22 percent of each year class (1974-1997). The Hudson River is the southern extreme of the range for tomcod. While stocks in Massachusetts waters appear to be stable, preliminary observations suggest that the abundance of tomcod in Connecticut has declined.[161] As discussed above, these declines in populations at the southernmost portion of the species range could indicate temperature-induced impacts from climatic changes acting to shrink the species range. In the Hudson River this effect could be exacerbated by the addition of thermal discharges from power plants.

Atlantic tomcod spawning begins in mid-February and extends into mid-March in the Hudson River. The area of peak spawning is in the Highlands section of the river

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[157] NAI, 2002-03.

[158] Lawler, Matusky and Skelly Engineers (LMS),1999. Abundance and Stock Characteristics of Atlantic Tomcod Spawning Population in the Hudson River, Winter 1995-1996. Prepared for NYPA, White Plains, NY.

[159] Schreibman, M. and J. Young. 2002. Physiology Investigations of the Atlantic Tomcod. Aquatic Research and Environmental Assessment Center *and* ASA Analysis & Communications, Inc.

[160] Wirgin, I. 2003. Contaminants: Use of Atlantic Tomcod as a Model to Evaluate the Possible Toxic Effects of Pollutants on Hudson River Populations. *At* Hudson River Environmental Society Presents: Hudson River Fishes & Their Environment. March 20-21, 2003, Marist College, Poughkeepsie, NY. No published proceedings.

[161] Simpson, D. 2003. Personal communication from Connecticut Department of Environmental Protection to this Department regarding Connecticut information on Atlantic tomcod abundance in tributaries to Long Island Sound. Included in Appendix F- V.

near Con Hook approximately 5 river miles upriver from Indian Point.[162] When eggs and yolk sac larvae drift down river, in addition to being exposed to entrainment, they are also exposed to a thermal plume from Indian Point Units 2 and 3 which extends the entire width of the river on flood tide and across more than two thirds of the width on ebb.[163] In years of high freshwater floods, larvae are transported down river by current into the Haverstraw region or the Tappan Zee region while maturing. Post yolk sack tomcod then concentrate near the leading edge of the salt front (approximately 1 ppt salinity) and move with the tidal flow.[164] In dry years with low freshwater input, this front can be located in the Indian Point region. This results in tomcod larvae congregating in the leading edge of the salt front, being repeatedly moved past the Indian Point station discharge and intakes, potentially increasing the thermal and entrainment effects of the plant on this species.[165] Less than average rainfall from 1995 into 2002 reduced the freshwater flow in the Hudson River. This period corresponds to the period of rapid decline in numbers of Atlantic tomcod in the Hudson River.

Many factors are impacting tomcod populations: climatic trends leading to increased water temperatures; decreases in available food resources caused by improvements in waste water treatment and the invasion of zebra mussels; increased predation from increased striped bass populations; and the physiological effects of chemical pollutants.[166] These multiple stressors can exacerbate the effects of heat discharged from generating stations, particularly during low freshwater flow periods. Not only could increases in river temperatures decrease the survival of larval tomcod, but higher temperatures could also depress the growth rate of this species. Since the fecundity of females is proportional to size, higher water temperatures could result in fewer young produced. Should these factors, in combination with the mortality induced by entrainment, significantly depress tomcod populations in the Hudson River, further ecological repercussions could be expected to follow on populations including striped bass, for which tomcod are a significant food source.[167] Neither the tomcod nor the striped bass population model proposed in the DEIS, however, has any means to integrate these variables.

Comb Jellies

Members of the phylum Ctenophora are commonly known as comb jellies and are found in the Hudson River. In most years they become abundant in the lower reaches of the River and New York Harbor from June to September when increases

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[162] Dew, B. C. 1991 Early Life History and Population Dynamics of Atlantic Tomcod (*Microgadus tomcod*) in the Hudson River Estuary, New York. Doctoral thesis submitted to the City University of New York, NYC, NY.

[163] DEIS, Appendix VI

[164] Dew, 1991.

[165] Dew, 1991.

[166] Wirgin, 2003.

[167] Dew, 1991.

in salinity and temperature typically occur. Comb jellies are a voracious predator feeding on invertebrates and larval fishes. In areas of high comb jelly density, ichthyoplankton samples collected contain few larval fish.

An analysis of data collected to assess the impacts of the Brayton Point station located on Mount Hope Bay in Massachusetts determined that water temperature increases resulted in an increase in the population of comb jellies, as well as the extent of their range and the length of time they were present. The warming was directly attributable to the cooling water discharge of the plant.[168]

Observations of the comb jelly population in the Hudson River over the past 10 years indicate that a similar trend is occurring. While the warming climate may be influencing the abundance and distribution of comb jellies, thermal discharges, particularly in spawning and nursery areas of the Hudson River, should not be discounted.

Zebra Mussels

Zebra mussels (*Dreissena polymorpha*), an invasive species of bivalve first observed in the Hudson River in 1992, appear to have caused very significant reductions in primary production (plant life, including phytoplankton) in the freshwater portion upriver of River Mile 63. Between 1987 and 1991, before the invasion of zebra mussels, summertime concentrations of chlorophyll averaged 30 mg/m^3. During 1993 and 1994, concentrations dropped to 5 mg/m^3.[169] This ecological change is not presented in the DEIS or reflected in the models offered in the DEIS.

Densities of both phytoplankton and small zooplankton (rotifers, tintinnids, and copepods) dropped to 10 to 20 percent of their previous levels after zebra mussels invaded the Hudson.[170] This reduction directly affects planktivorous fishes and early-life-stages of fishes which feed upon small zooplankton. The copepod population did not change with the arrival of zebra mussels, however, *Bosmina* (a genus of water flea) declined by 50 percent.[171] The continued presence of copepods, a preferred prey of young fish, may have insulated higher trophic levels in the Hudson from the negative effects of the zebra mussel population.[172] However, in contrast to Dr. Strayer's assumption, the 1999 Hudson River Year Class Report provides clear evidence of several anadromous and resident species of fish in decline during the

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[168] USEPA, 2002.

[169] Caraco, N. F., et al. 1997. Zebra Mussel Invasion in a Large, Turbid River: Phytoplankton Response to Increase Grazing. Ecology 78(2), 1997, pp. 588-602. Ecological Society of America.

[170] Caraco et al., 1997.

[171] Strayer, D. L., et al. 1999. Transformation of Freshwater Ecosystems by Bivalves, A Case Study of Zebra Mussels in the Hudson River. BioScience, volume 49(1), pp. 19 - 27.

[172] Strayer et. al., 1999.

post-zebra mussel invasion period.[173] One group of organisms which has increased significantly since the appearance of zebra mussels is bacteria, but no information on any pathogenic effects upon fishes in the Hudson has been found.[174]

[173] ASA, 2002.

[174] Strayer et. al., 1999.

Fish Population - 5. Thermal analyses need to be updated to reflect recent, more extreme conditions.

The Department concurs with this comment. Thermal discharges were inadequately addressed in the DEIS. The DEIS asserts, with no supporting evidence, that "... [t]he surface water orientation of the plume allows a zone of passage in the lower portions of the water column, the preferred habitat of the indigenous species." Other data and analyses cast doubt on this assertion.

The sheer volumes of water necessary to meet the HRSA plants' cooling requirements are enormous. Together, Indian Point, Roseton, and Bowline are authorized to withdraw 1.69 trillion gallons per year for cooling water, and they discharge 220 trillion BTU of waste heat per year.[175] The volume of once-through cooling water is raised between 15° and 18° F, depending on the plant,[176] or an average of 16.2°F.[177]

Some graphics and imagery effectively illustrate the basis for the Department's concerns. A study by HydroQual, Inc., examined passive particle movement and also investigated thermal and salinity profiles in several river reaches, including the portion of the Hudson River where the HRSA plants are located.[178] Figures 6 and 7 of this FEIS (following pages), excerpted from that study, show two vertical temperature profiles of the Hudson River from NYC to just above the northernmost of the HRSA plants, one during a spring and the other during a neap tide. Based on these representations, it appears that there may be times and conditions where effluent-warmed waters occupy nearly the entire vertical water column.

The surface extent of thermal discharges from the HRSA plants is also a concern. Figure 8 is an aerial thermal image of the plume from Indian Point, Unit 3 only, on the east side of the Hudson plus the smaller plume from Lovett on the west bank.[179] In this image, the two plumes came very close to meeting on the surface, even with Indian Point running at less than its full capacity.

Because the HRSA facilities and two other steam electric generating stations are essentially clustered in two relatively compact stretches of the Hudson River, there

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[175] Power Plants with SIC code 4911, *in* Appendix F-V. Indian Point, Roseton, and Bowline are the first-, sixth, and seventh-largest users of water in the State, with a combined intake flow of 7,177 CFS (cubic feet per second).

[176] DEIS Chapter IV-B, Tables IV-6, IV-9, and IV-11. NOTE: ΔT (change in temperature) should read °F not °C.

[177] $\sum$ (volume each plant * ΔT each plant) / ($\sum$ volume of the 3 plants) = mean ΔT

[178] HydroQual, 1999.

[179] Note that Unit 2 discharge canal is cold, so the plume shown resulted from generation and discharge at Unit 3, only, at Indian Point, plus Lovett.

is a strong potential for thermal effects on the river and its aquatic resources to be additive. Given the extent of warming shown in the HydroQual graphs, combined with the recent dramatic declines in tomcod and rainbow smelt as discussed previously, the Department believes it prudent to seek additional thermal discharge data for each facility, including a mixing zone analysis, and anticipates requiring tri-axial thermal studies as conditions to each of the SPDES renewals. Depending on the results of those analyses, additional controls may be required to minimize thermal discharges.

Fig. 6. Temperature Profile of the Hudson River, NYC to Newburgh, During a Spring Tide[180]

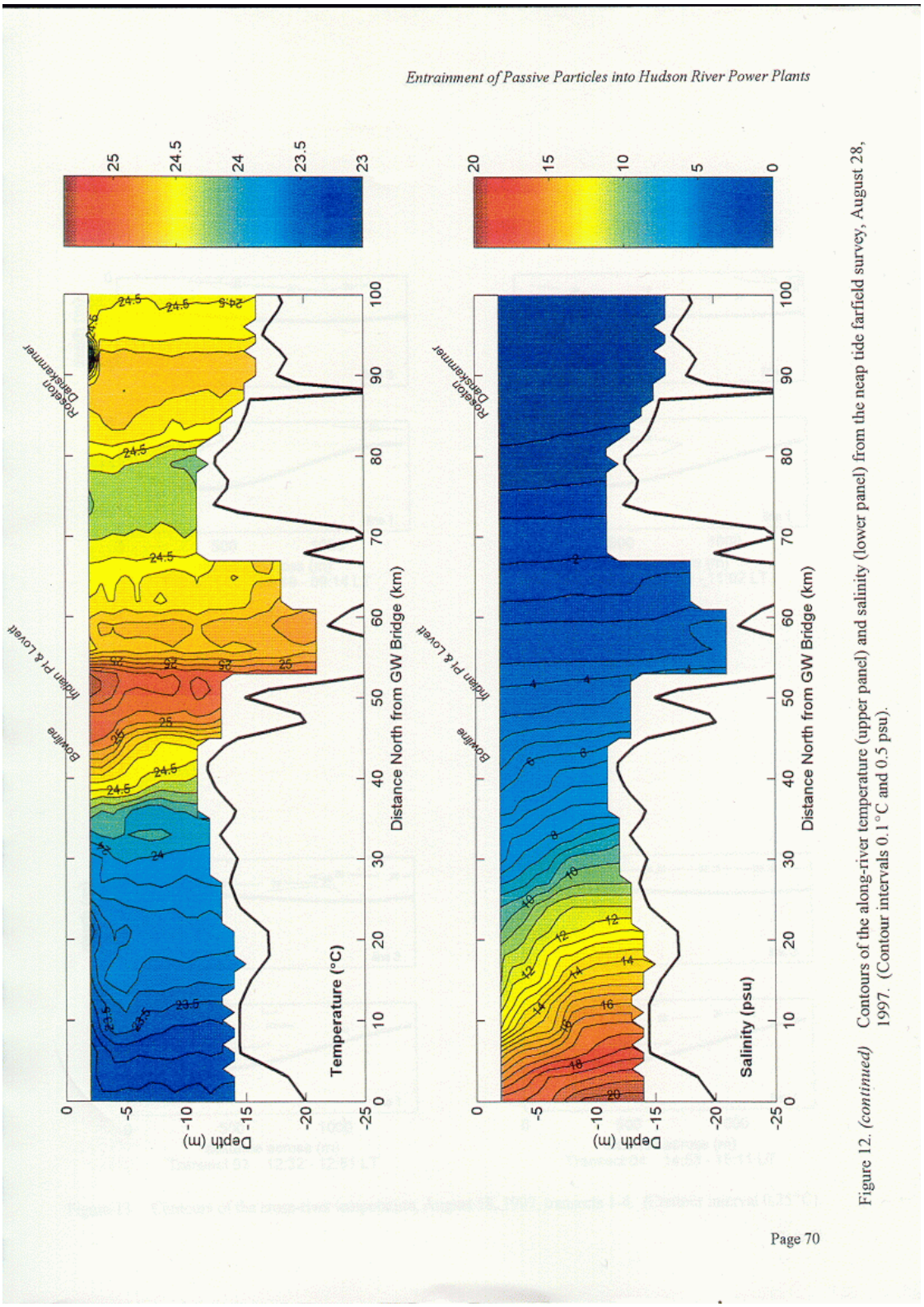


Figure 12. *(continued)* Contours of the along-river temperature (upper panel) and salinity (lower panel) from the neap tide farfield survey, August 28, 1997. (Contour intervals 0.1 °C and 0.5 psu).

[180] HydroQual, 1999.

Fig. 7 Temperature Profile of the Hudson River, NYC to Newburgh, During a Neap Tide[181]

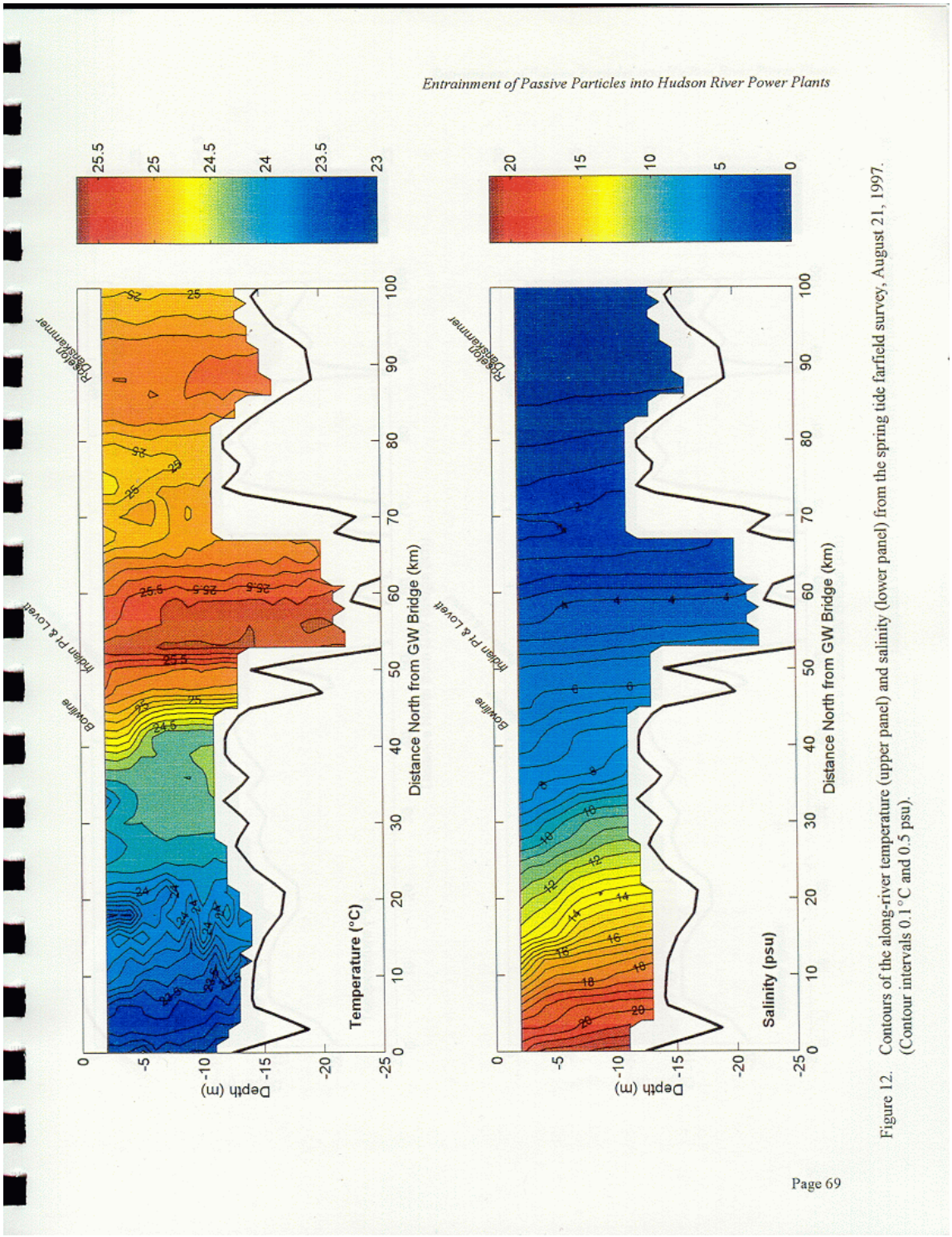
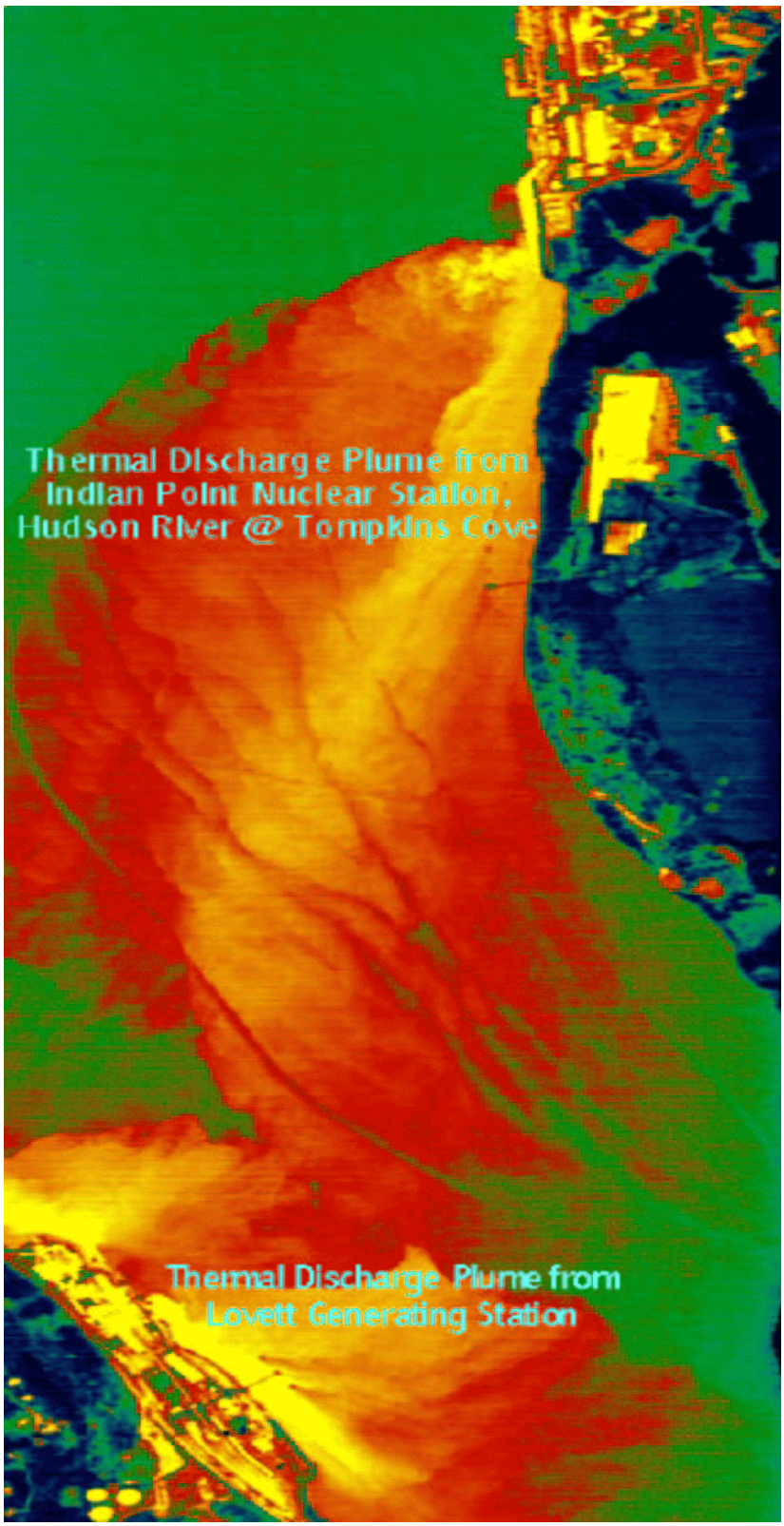


Figure 12. Contours of the along-river temperature (upper panel) and salinity (lower panel) from the spring tide farfield survey, August 21, 1997. (Contour intervals 0.1 °C and 0.5 psu).

[181] HydroQual, 1999.

Fig.8. Thermal Plumes from Indian Point, Unit 3, and Lovett Station, Tompkins Cove, Hudson River, New York State.



(Original photo ©Spectra Vista Corp, with permission)

Fish Protection Points - 6. Fish protection points (FPP) would provide operational flexibility but even less protection than conditions in the Hudson River Settlement Agreement (HRSA).

The Fish Protection Point system proposed by the generators in the 1999 DEIS would allow a great deal of operational flexibility for the three HRSA plants. While some consideration of the need for generation capacity is warranted, particularly during periods of high electricity demand, the proposed system would sacrifice reductions in fish mortality in order to maximize freedom of plant operations. As proposed, the DEIS' preferred alternative would be less protective of aquatic resources than measures under the HRSA and subsequent Consent Orders.

Tables 4-A, B and C (following) compare several alternative operating scenarios and entrainment or impingement mitigation strategies for the HRSA plants. The tables display predictions of conditional mortality rates for 6 fish species, the volume of water used, and the volume of water lost to evaporation under a variety of mitigation strategies at each of the 3 plants. The tables use italicized text to indicate those values which would result from the implementation of the strategies agreed upon in the 1981 Settlement Agreement; they serve as the basis for comparison. Values which would reduce environmental impacts, by providing a higher level of fish protection or by using less water, are indicated by bold text. Values which cause greater environmental harm, by providing lower levels of fish protection or using more water, are indicated by both bold text and gray shading. It is instructive to note that, with respect to fish protection, only the proposed Fish Protection Points strategy would result in lower levels of protection than would be provided by the 1981 Settlement Agreement strategies. At Bowline Point, a single species would suffer greater losses, but at both Roseton and Indian Point, protection would be reduced for 3 of the 6 species.

Table 4. Comparisons of Selected Mitigation Alternative Strategies

Key:

x.xx	Same as 1981 Settlement Agreement
y.yy	Better than 1981 Settlement Agreement
z.zz	Worse than 1981 Settlement Agreement
CEMR	Conditional Entrainment Mortality Rate[182]
MGD	Million Gallons per Day

A. BOWLINE POINT								
	Striped Bass	**American Shad**	**River Herring**	**Bay Anchovy**	**Atlantic Tomcod**	**White Perch**	**Water Volume**	**Water Evaporated**
Alternative	**CEMR**	**CEMR**	**CEMR**	**CEMR**	**CEMR**	**CEMR**	**MGD**	**MGD**
1981 Settlement conditions	*0.80*	*0.05*	*0.19*	*3.93*	*6.39*	*1.01*	*910.00*	*5.18*
Hybrid Towers (full year)	**0.10**	**0.00**	**0.00**	**0.14**	**0.53**	**0.02**	**43.20**	**12.96**
Hybrid Towers (seasonal)	**0.10**	**0.00**	**0.00**	**0.14**	**0.53**	**0.02**	**369.30**	**10.04**
Fish Protection Points	**0.77**	**0.02**	**0.12**	**3.93**	**7.13**	**0.27**	*910.00*	*5.18*
Gunderboom (full year)	**0.18**	**0.01**	**0.04**	**0.86**	**1.39**	**0.22**	*910.00*	*5.18*
Gunderboom (seasonal)+ net	**0.10**	**0.00**	**0.17**	**0.14**	**0.53**	**0.12**	*910.00*	*5.19*
32-week Outage	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**349.80**	**1.99**

Notes:

GG. Values for the CEMR for 1981 Settlement Conditions, Hybrid Towers and the Fish Protection Points are from the 1999 DEIS.

HH. Values for seasonal use of the Hybrid Towers (seasonal) are based on their use February 15 to September 15 (approximate dates) and were computed by Department staff.

II. Values for Gunderboom assumed an 80 percent efficiency, with full flow to the facility and were computed by Department staff.

JJ. Values for the 32-week outage are based on an outage from February 15 to September 15 (approximate dates) and were computed by Department staff.

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[182] *See* Footnote 134 of this FEIS.

Table 4 (cont). Comparisons of Selected Mitigation Alternative Strategies

Key:

x.xx	Same as 1981 Settlement Agreement
y.yy	Better than 1981 Settlement Agreement
z.zz	Worse than 1981 Settlement Agreement
CEMR	Conditional Entrainment Mortality Rate[175]
MGD	Million Gallons per Day

B. ROSETON								
	Striped Bass	**American Shad**	**River Herring**	**Bay Anchovy**	**Atlantic Tomcod**	**White Perch**	**Water Volume**	**Water Evaporated**
Alternative	**CEMR**	**CEMR**	**CEMR**	**CEMR**	**CEMR**	**CEMR**	**MGD**	**MGD**
1981 Settlement conditions	*2.40*	*0.78*	*3.28*	*0.51*	*1.67*	*4.92*	*923.00*	*5.18*
Hybrid Towers (full year)	**0.37**	**0.02**	**0.13**	**0.03**	**0.12**	**0.39**	**25.90**	**12.96**
Hybrid Towers (seasonal)	**0.37**	**0.02**	**0.13**	**0.03**	**0.12**	**0.39**	**370.00**	**10.04**
Fish Protection Points	**3.32**	**0.45**	**3.21**	**1.01**	1.59	6.39	*923.00*	*5.18*
Gunderboom (full year)	**0.50**	**0.16**	**0.68**	**0.11**	**0.35**	**1.03**	*923.00*	*5.18*
32-week Outage	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**355.00**	**1.99**

Notes:

AA. Values for the CEMR for 1981 Settlement Conditions, Hybrid Towers and the Fish Protection Points are from the 1999 DEIS.

BB. Values for seasonal use of the Hybrid Towers (seasonal) are based on their use February 15 to September 15 (approximate dates) and were computed by Department staff.

CC. Values for Gunderboom assumed an 80 percent efficiency, with full flow to the facility and were computed by Department staff.

DD. Values for the 32-week outage are based on an outage from February 15 to September 15 (approximate dates) and were computed by Department staff.

Table 4(cont). Comparisons of Selected Mitigation Alternative Strategies

Key:

x.xx	Same as 1981 Settlement Agreement
y.yy	Better than 1981 Settlement Agreement
z.zz	Worse than 1981 Settlement Agreement
CEMR	Conditional Entrainment Mortality Rate[175]
MGD	Million Gallons per Day

C. INDIAN POINT								
	Striped Bass	**American Shad**	**River Herring**	**Bay Anchovy**	**Atlantic Tomcod**	**White Perch**	**Water Volume**	**Water Evaporated**
Alternative	**CEMR**	**CEMR**	**CEMR**	**CEMR**	**CEMR**	**CEMR**	**MGD**	**MGD**
1981 Settlement conditions	*7.82*	*0.64*	*1.20*	*10.38*	*12.04*	*4.94*	*2505.0*	*12.82*
Hybrid Towers (full year)	**1.20**	**0.01**	**0.04**	**0.45**	**1.16**	**0.26**	**69.00**	**34.56**
Hybrid Towers (seasonal)	**1.20**	**0.01**	**0.04**	**0.45**	**1.16**	**0.26**	**982.00**	**26.40**
Fish Protection Points	**10.69**	**0.18**	**0.81**	**13.22**	**13.95**	**4.35**	***2419.0***	*12.82*
32-week Outage	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**964.00**	**4.94**

Notes:

AA. Values for the CEMR for 1981 Settlement Conditions, Hybrid Towers and the Fish Protection Points are from the 1999 DEIS.

BB. Values for seasonal use of the Hybrid Towers (seasonal) are based on their use February 15 to September 15 (approximate dates) and were computed by Department staff.

CC. Values for Gunderboom assumed an 80 percent efficiency, with full flow to the facility and were computed by Department staff.

DD. Values for the 32-week outage are based on an outage from February 15 to September 15 (approximate dates) and were computed by Department staff.

The proposed system would allow the trading of fish protection credits among the HRSA plants and their operators. Such trading would alter fish protection significantly in years in which one plant was off-line because credit for the inactive facility could be applied to one or both of the other two. The nature of the aquatic resource impacts would change because the different plant locations support different species and different life stages of fish. For this reason, trading among facilities and different operators could lead to unpredictable and probably less effective mitigation. As of the writing of this FEIS in mid-2003, Roseton and Bowline operate as peaking load facilities, as opposed to base load operation which was the case when the DEIS was published in 1999. If trading of credits among facilities and operators were to be incorporated into the permits of the HRSA facilities, credits from Bowline and Roseton could allow Indian Point to operate with little or no mitigation. This scenario would be contrary to the site-specific nature of BTA determinations required by 6 NYCRR Part 704 and CWA §316(b). Carrying credits accumulated in one year forward to subsequent years would *not* be a change from HRSA requirements. However, as proposed in the DEIS, credits could be carried forward and transferred to another facility. As discussed above, trading credits between the three facilities would add a new dimension of uncertainty to fish protection. Allowing credits accumulated at one facility in one year to be credited to another facility in a subsequent calendar year would be likely to compound this uncertainty.

Fish protection credit would also be added for the difference between SPDES flows (maximum pumping rate) and efficient flows at Indian Point, in contrast to the HRSA where credits were earned by operating Indian Point at mitigative flows (less than efficient). This change would lower the baseline from which credit for mitigation is measured. While not necessarily a reduction in fish protection from HRSA levels in and of itself, it would be coupled with a proposed level of protection less than HRSA levels. The lower starting point would mask some of the resultant reduction in fish protection.

The proposed measures specific to Indian Point would provide a significant reduction of fish protection by eliminating any requirement for outages (days off line). The preferred alternative proposes to achieve fish protection at that site solely through flow reductions without any outages. This would eliminate the previous HRSA requirement for 42 unit-days off line each calendar year.

The cumulative effect of the three changes described above would produce a scenario much lest protective than current conditions. In addition, no new measures to reduce fish mortality at Roseton and Bowline are proposed. These relaxations in mitigation appear inconsistent with "anti-backsliding" prohibitions of the Clean Water Act.[183]

The following excerpt from the review of the 1999 DEIS written by ESSA Technologies Inc., for the Department, summarizes differences between the generators' preferred alternative and HRSA conditions.

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[183] CWA §303(d)(4)(B); 33 U.S.C. §1313(d)(4)(B); *see also* 40 CFR 131.12, 40 CFR 122.62, and 40 CFR 122.44.

"The proposed action put forward in the DEIS is a derivative of the Settlement Agreement scheme with some very critical differences. The proposed action:

1. translates the prior entrainment mitigation outage targets based on units of days to targets based on the aggregate Conditional Mortality Rate (CMR) due to entrainment for five target species: striped bass, American shad, bay anchovy, river herring and tomcod;

2. proposes that unlike the prior Credit Points, the new Fish Protection Points (FPPs) may be carried forward across years as well as traded between stations;

3. consistent with stipulated maximum flow requirements in the 1981 and 1987 SPDES permits for Indian Point, the proposal calculates and adds to the protection target the number of FPPs equivalent to the difference between "SPDES flows" and efficient flows for Indian Point Units 2 & 3;

4. proposes to continue the operation of current Modified Ristroph screen technology at the Indian Point Station for reduction of impingement mortality;

5. proposes to continue deployment of the barrier net at the Bowline Station for reduction of impingement mortality;

6. proposes to continue the management and mitigation regime for "thermal and chemical" discharge as carried out under the prior 1981 and 1987 permits, and

7. proposes to meet the requirements for entrainment mitigation exclusively through the management of station flows without necessarily invoking requirements for unit outages as previously required."[184]

[184] ESSA, 2000; Section 2.2.

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Mitigation - 7. DEIS includes little information on barrier systems and acoustic deterrents.

The Department concurs that additional information and updates to the data used in the DEIS are necessary. Additional information on several technologies follows.

Wedge-Wire Screens

Recent designs in water withdrawal technology have included development of wedge-wire screens to "filter" water prior to entrance into a system. Wedge-wire screens usually are designed with small openings, for example 2 mm slot width, but they can be designed with larger or smaller openings. Screening of water being withdrawn from a source water body is standard practice to eliminate fouling and clogging of pumps and cooling systems by detritus or large fishes, thus older power generation facilities typically employed traveling screens with approximately 3/8 inch mesh openings. This design excludes sticks, macrophytes (large aquatic plants) and large fishes from being entrained with the cooling water but does not exclude smaller organisms or particles. Bowline Point, Roseton and Indian Point facilities incorporate various types of large-mesh traveling screens, often with improved collection mechanisms and fish/detritus return mechanisms, in their intake designs.

The advantage of fine mesh wedge-wire screens is that the small openings prevent small aquatic organisms from being entrained into the circulating water system. Two millimeter slot width has been employed in new facility designs and it is expected that this opening will prevent ichthyoplankton larger than 15 mm from being entrained. In general, fishes greater than 15 mm length are greater than 2 mm in width, and are thus not susceptible to entrainment. The velocity of the water drawn into a system is directly associated with the size of the slot through which it is drawn. The Department imposes a low through-slot velocity to ensure that organisms are not impinged on the screen because they cannot swim away from the intake velocity. EPA recommends a through-slot velocity of 0.5 fps or less, but the Department has issued recent permits for intakes that generally have halve that velocity.[185] Additional protection is afforded by the current from tides or river flow on a wedge-wire screen because it assists in moving organisms away from the influence of the intake.

New power generation facilities recently approved in New York are all combined-cycle designs with closed-cycle cooling.[186] Combined-cycle facility produces two thirds of its power with a gas turbine (which does not require cooling), only one third of the facility requires cooling. This cooling requirement is further reduced by approximately 95 percent by employing closed-cycle cooling. Thus, typical cooling water requirements are 7 to 9 million gallons of water per day (MGD). This volume can be accommodated with two T-shaped sets of cylindrical screens six feet in diameter with 1 mm slot openings, with through-slot velocity of 0.2 feet per second.

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[185] Athens Interim Decision.

[186] Athens Interim Decision.

In contrast, a single-cycle power generating facility using once-through cooling, such as Roseton Generating Station, requires a maximum of 926 MGD for cooling at full flow operation (less at efficient flow). For such a once-through cooling system, even with larger screens at higher intake velocities, a great number of wedge-wire screens would be required to supply the necessary cooling water; engineering challenges, higher costs and loss of generating capacity would likely result.

Fish Barriers

Since the preparation and filing of the DEIS in 1999, a new technology for eliminating aquatic organisms from a cooling water intake structure has emerged and been permitted by the Department. The technology is known generally as an "aquatic filter barrier" (AFB); the Gunderboom® Marine Life Exclusion System™ (MLES™) is the system which has been deployed, studied and permitted in NYS. Despite its name, use of the MLES™ is not restricted to marine systems.

The MLES™ is a semi-permeable fabric barrier which surrounds an intake structure and allows water to enter while excluding most very small particles, including aquatic organisms. Additional components of the MLES™ include: the structures necessary to maintain the barrier in place, such as anchors and floatation; a cleaning device; monitoring equipment; and other miscellaneous equipment as necessitated by the specific site conditions. Because the system is flexible, it may be shaped to follow desired water depth or to increase surface area. The barrier may be constructed in sections, allowing easier maintenance, installation and retrieval. At present, only one company, Gunderboom, has a patent to construct this type of barrier. Thus, an MLES™ is commonly referred to by the "Gunderboom®" trade name.

Gunderboom® MLES™, alone and in combination with other technologies, have been determined to be BTA at a number of facilities on the Hudson River, and requirements for installation have been written into the SPDES permits. Those with MLES™ requirements include the new electric generation facilities at Bowline Unit 3 (700 MW combined cycle) and Bethlehem Energy Center (750MW combined cycle). The Empire State Newsprint Project, a 500 MW combined-cycle facility in Rensselaer, New York, was issued a draft permit for an MLES™ in 2001. Lovett Generating Station Units 3-5, an existing facility with a 450 MW generating capacity, was issued a SPDES permit which included an MLES™ in February, 2003.

The Bowline Unit 3 MLES™ may generally be described as a straight line fabric screen, 137 feet in length and 27 feet deep, that allows 7.5 MGD of intake flow (maximum). ® Flow-through velocity is predicted to be approximately 0.004 fps with a flow rate of approximately 1.4 gallons per minute per square foot. An air-flow backwash system, strain gauges, water level monitors, and special bottom sealing fabric are required as part of the system. Seasonal deployment of the MLES™, from February 15 through September 30, will allow protection during the reproductive seasons of major Hudson River fish species.

The Bethlehem Energy Center facility will employ a different MLES™ design, yet still use Gunderboom fabric material as the principal screening device. A 16' by 145' rectangular H-pile and sheet pile structure will be constructed to support twelve

removable filter panels orientated to the river flow. The structure is sized for a maximum of 8.5 MGD flow with a fabric flow-through rate of 3.1 gallons per minute per square foot. (0.007 fps). Seasonal deployment of the MLES™ from April through August will be necessary for adequate protection to organisms. These filter panels will be removed mechanically for maintenance and at the end of each seasonal deployment; monitoring by the plant operator to ensure water passage, of strain on the panels, and related variables will be required.

The SPDES permit issued for the existing Lovett Generating Station requires the permittee to provide information, analyses and plans necessary to install, operate and maintain an MLES™. It is anticipated that this structure will be a Gunderboom curtain in the river that surrounds the intakes of Units 3,4 & 5. This means the curtain will be subject to tidal influence and will have some movement with river currents and wind. Close attention to operational parameters and maintenance will be required. The permit includes a protocol for operation, maintenance, monitoring, and responses.

The draft permit for the proposed Empire State Newsprint Project (ESNP) specifies an MLES™ that is somewhat different from those already permitted. The intake will be constructed a distance into the river along the bottom. The proposed Gunderboom® barrier of the MLES™ will necessarily be offshore, too, surrounding the wedge-wire intake screens in an oval shape 90' by 60' and be attached to 16 fender piles permanently installed in the river. This system is designed for a maximum of 9.7 MGD, with a through-screen flow of 0.01 feet per second and a flow rate of approximately 4.0 gallons per minute per square foot through the Gunderboom® fabric. The MLES™ would be deployed and operational during the primary fish spawning season in that section of the Hudson River, April 15 - June 30.

The Department is working with other facility owners toward investigating this method of aquatic mitigation at other existing generation facilities within New York State where an MLES™ could potentially reduce impingement and entrainment mortality.

Acoustic Deterrent System

A number of behavioral deterrent systems (e.g. fish hammers, hanging chains, bubble curtains, strobe lights, mercury lights etc.) have been studied by utilities in New York State for reducing impingement impacts at cooling water intakes. High frequency sound is the only behavioral deterrent technology shown to be effective and currently in use as an impingement mitigation technology in New York. The technology is in use at the J. A. Fitzpatrick Nuclear Generating Station (NGS), located on the south shore of Lake Ontario, and has effectively reduced the impingement of alewife at the station. The fish deterrent system, known by the trademark “Fish Startle System”, emits a high frequency, broadband sound (122 - 128 KHz) at a source level of 190 decibels. The system has three major components: the integrated projector assemblies (IPAs), the power cable running from shore to intake, and the control panel. The IPAs contain the signal generators and transducers that emit the high frequency, broadband sound which has been shown to be strongly avoided by members of the clupeid family.

In 1989, the New York Power Authority, which owns and operates the Fitzpatrick NGS, started developing the mitigation system after learning that high frequency sound evoked a strong avoidance effect in some species of herring. Laboratory testing was successfully conducted on alewife, then a temporary sound system was developed and tested in Lake Ontario in 1991. Preliminary results showed that the number of fish in front of the intake was reduced by 81 to 87 percent when the system was operated. Between April and July 1993, a second full scale test was conducted. Paired impingement samples were collected with the system on and off and compared against impingement samples collected at the nearby Nile Mile Point Unit 1 NGS (control facility). The Nile Mile Point station is a similar sized NGS, with a similar offshore intake structure. The 1993 study reported the overall effectiveness of the system to be 84 percent (i.e., an 84 percent reduction in impingement as compared to the control facility).[187]

In 1995, the Department determined the acoustic deterrent system to be BTA for minimizing adverse environmental impact at the Fitzpatrick NGS, and the system was therefore incorporated as a condition of its SPDES permit. Because sound at this frequency and decibel level has been shown to be effective for certain clupeid species only (alewife, blueback herring and American shad), the technology by itself has limited application. However, in combination with other mitigative technologies, its application may be more widespread.

British researchers have been testing an acoustic deterrent system on a number of species at a nuclear generating station in Belgium since 1997. The effectiveness of the system is stated to vary among species, due to species-specific hearing sensitivities and the levels at which a species will react to a sound stimulus. System efficiencies (deflection of fish) from 21 percent for flatfish, to up to 98 percent for herring are reported.[188] This work is promising if it proves to be effective over a wide range of species.

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[187] Ross et al, 1996; Radle et al, 2003.

[188] Maes et al, 2003.

Mitigation - 8. The DEIS significantly overstates costs and energy impacts of closed cycle cooling.

A discussion of cooling tower design and operation was presented in Section VIII and Appendix VIII of the DEIS. The Department requested ESSA Technologies, Ltd., to review these analyses. This work was performed by D.B. Grogan Associates, Inc. and is included in Appendix V to this FEIS.

The information presented in the DEIS regarding cooling tower design and cost estimates is generally reasonable, based upon the assumptions used for this analysis. In order to determine BTA for individual sites, these assumptions should be modified or expanded to present further site-specific cooling tower alternatives which will result in different construction and operational costs, as well as different environmental impacts. Such additional analyses should include: tower designs based on a variety of wet/dry bulb scenarios; wet towers; a variety of tower fill and nozzle scenarios modified to increase operational efficiency; pre-treatment of cooling tower makeup water; and historical operation information from large, existing wet/dry (hybrid) systems.

The different closed-cycle cooling alternatives each result in different environmental impacts, including land use, aesthetics, fogging, evaporative losses, drift impacts, composition of the blowdown discharge, and thermal effects on the river. Energy efficiency, too, varies among the cooling technologies. For example, wet/dry cooling tower systems create a larger parasitic load when compared with wet systems. This results in a need for replacement power from other facilities whose air and water emissions may have an adverse environmental impact.

Costs of both construction and operation of closed systems are a concern when analyzing cooling system alternatives. The operational costs have been presented in the DEIS, but D.B. Grogan Associates, Inc. points out that the cost of lost electric generation may be significantly different in the present era of power deregulation and may be seriously underestimated in the DEIS.[189] Alternative designs that minimize this loss would significantly change the cost projections.

A recent EPA update, published on March 19, 2003, concerning 40 CFR Part 125, *Proposed Regulations To Establish Requirements for CWIS at Phase II Existing Facilities; Notice of Data Availability; Proposed Rule*, provides additional information on the cost of connecting a new facility to a closed-cycle system. It noted that the period of time for interconnections to be made for installations at existing facilities should be increased from EPA's earlier estimate and could require up to seven months at nuclear facilities. This could significantly increase the cost of closed-cycle systems unless very detailed planning and construction schedules are carried out to expeditiously complete this activity. Other revisions in EPA's analysis, however, show that compliance costs may actually be lower regarding energy penalties than originally forecast.

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[189] Grogan, 2000.

Mitigation - 9. DEIS alternatives and proposed action do not present a fair picture of available alternatives.

The Department concurs strongly with this comment. As discussed in the "Mitigation and Alternatives" section earlier in this FEIS, based on the more specific descriptions of newer technologies and recent advances in established technologies discussed in preceding responses, and on discussions in the original DEIS, including DEIS Sections VII and VIII and Appendix VIII, the Department contends that a range of alternatives exist from which site-specific aquatic resource protection programs can be developed which will meet the requirements for BTA. Furthermore, the Department maintains that some of the most promising approaches for existing plants like these three Hudson River facilities will be in combinations of technologies, or technologies combined with improvements to management systems.

Other Topics - 10. The DEIS needs to consider effects of New York's recent conversion to a competitive energy market, take the State Energy Plan into account, or impose parity among facilities.

The concept of parity, or leveling the playing field between two or more separate holders of the same type of permit, is not a Department policy *per se*; nor is it required in law or regulation. For each SPDES permit application that includes a cooling water intake structure, the Department must determine whether the location, design, construction, and capacity of the cooling water intake structure reflects the "best technology available" (BTA) to minimize adverse environmental impact.[190] The Department makes each BTA decision on a case-by-case, site-specific basis, without necessarily applying the technology(s) or methodology(s) to minimize impacts between separate facilities in a rote manner that supports comparisons.[191]

To make a BTA decision, the Department must assess the proposed action (issuance or renewal of a SPDES permit) against the environmental impacts (direct, indirect and cumulative) and determine whether the applicant's proposed method of addressing impacts outweighs alternative methods. This is necessarily a site-specific endeavor that requires examination of technologies having the potential to "fit" the facility and minimize adverse impacts to the extent warranted by the environmental harm in the source water body. A particular mitigative technology may not produce comparable reductions of impacts between two otherwise comparable facilities. Furthermore, for any particular mitigative technology a success differential is likely to exist between facilities with different types of generation systems, CWIS, and/or cooling systems.

Mandating parity between existing facilities and new facilities subject to BTA determinations would require that an agency be able to resolve inherent difficulties and numerous issues, such as: (a) environmental impacts may not be the same, (b) construction, operation, and maintenance costs may not be the same (even using the same technology), (c) water bodies may be different, (d) public reaction to the project and/or perception of the need for minimization of impacts may be different, and (e) impacts to the State's energy capacity may be different. Such a mandate would also limit a decision maker's flexibility to prescribe BTA remedies within the boundaries of the statute, which does not require parity between facilities or BTA decisions.

In cases where the issues listed above are not present, in other words, where there is a strong basis for comparison between facilities, it is reasonable to expect that similar technologies and associated costs would be involved in prescribing a BTA remedy. However, this does not necessarily translate to "parity" because it is more likely to occur between the same types of facilities (i.e., between existing facilities or new facilities but not between an existing facility and a new facility). The

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[190] 33 U.S.C. §1326(b); 6 NYCRR §704.5.

[191] Athens Interim Decision

distinguishing issues listed above as examples are more likely to create discrepancies that interrupt attempts to level the playing field between or among separate BTA determinations.

Parity thus does not present itself as a clear component of mitigation remedies in making a BTA determination. That does not prevent a decision making agency from assessing whether the level of costs imposed on an existing facility can generally be measured in terms of costs of mitigative technology installed by other (new or existing) facilities. However, the apparent physical, engineering discrepancies between an existing and a new facility and the potential biological differences between source water bodies militate against direct comparisons of such facilities.

In conclusion, parity is not defined in the context of making a BTA determination. Absent a policy or administrative or judicial decision which identifies an acceptable equation for leveling out inherent discrepancies, the differences between existing and new facilities (and, potentially, the source water bodies) present significant obstacles to imposing parity to make newer, less polluting facilities cost competitive with older facilities.

Other Topics - 11. Radiation discharges are not discussed in the DEIS, but should be.

Under the Atomic Energy Act of 1954 (AEA/1954), authority to regulate nuclear discharges is reserved to the federal government.[192] Discharges of cooling water from Indian Point Units 2 and 3 are regulated by NYS as SPDES discharges to the extent they contain effluent substances regulated pursuant to 6 NYCRR Part 703. Because Indian Point is a nuclear power generating facility, its construction, operation, and maintenance are regulated by the federal Nuclear Regulatory Commission(NRC), pursuant to the AEA/1954.

In 1962, the Atomic Energy Commission (AEC), the NRC's predecessor agency, and then-Governor Nelson A. Rockefeller, executed an "Agreement . . . for Discontinuance of Certain Commission Regulatory Authority" (Agreement). Pursuant to that Agreement the AEC discontinued its regulatory authority over certain radioactive materials ("byproduct materials, source materials, and special nuclear materials in quantities not sufficient to form a critical mass") so that NYS could apply its own licensing program to those substances. However, the AEC retained its licensing authority with respect to, among other things, the construction and operation of any production or utilization facility, including nuclear power generation facilities. Consequently, radioactive releases or discharges from nuclear power generation facilities are regulated, today, by the NRC, not NYS.

Under the authority of the AEA/1954 and 10 CFR Part 50, the NRC issues licenses and license extensions to nuclear power generating facilities and regulates any releases of radioactive material from licensed facilities. The current NRC licenses for Indian Point Unit 2 and Indian Point Unit 3 expire in 2013 and 2015, respectively.[193] The New York State SPDES permit for Indian Point Units 2 and 3 will control effluent discharges as to all substances controlled by the regulations set forth in 6 NYCRR Part 703 that are not otherwise controlled by the federal NRC authority in 10 CFR Part 50. Thus, the Department does not have the authority to require a SPDES permit renewal application to identify discharges that do not fall within its SPDES jurisdiction.

The 1962 Agreement fostered the creation of a licensing program at the state level for limited purposes where NYS had demonstrated to the AEC that sufficient technical expertise had been developed with regard to a short list of regulated substances. It bears repeating that in 1962, NYS did not undertake to acquire the AEC's authority to license nuclear power generation facilities or any radiation releases or discharges that could be associated with them, nor does NYS presently have or seek to develop the expertise necessary to administer such a licensing program.

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[192] Atomic Energy Act of 1954, 42 U.S.C. 2021; *see* §2021(c)(1).

[193] Entergy Nuclear Indian Point 2 and Entergy Nuclear Indian Point 3, operators of the respective nuclear generation plants, have stated in the media that they expect to begin the process of NRC license extension in 2006. Department staff understand from an independent inquiry to NRC staff that the 2006 date projected to start license extension is a reasonable one.

As noted above, New York State's SPDES permit renewal process is entirely separate from the federal NRC license extension process. However, the Department does have a role in the NRC license extension process. Because these facilities discharge cooling water into navigable waters of the United States, the Department's role in the NRC license extension proceeding will be to process and issue or deny the licensee's application for a state water quality certificate, pursuant to §401 of the Clean Water Act[194]. Obtaining a state water quality certificate is a prerequisite to extending an NRC license. For the NRC to make a decision to grant or deny license extension, Entergy Nuclear Indian Point 2 and Entergy Nuclear Indian Point 3 will need to deliver a NYS water quality certificate to the NRC applicable to both Units 2 and 3. In considering whether to issue or deny a water quality certificate for Indian Pont Units 2 and 3, the Department will apply the water quality standards set forth in 6 NYCRR Part 700, et seq.

In light of the foregoing, concerns for possible radioactive releases in the cooling water discharged from Indian Point, or concerns for possible health effects from radioactive emissions, should be addressed directly to the NRC, not the Department, either as a license compliance matter or in the course of license extension proceedings. Such concerns cannot be addressed in conditions to a SPDES permit.

[194] 33 U.S.C. §1341

Other Topics - 12. Several commentors expressed generalized opposition to renewal for one or more facilities.

These comments, while clearly deeply felt, did not raise substantive issues which can be addressed in the context of the issues and information included in this FEIS. Accordingly, no response or analysis is offered.

List of Appendices

Please note that appendices are not available on the website. However, you may request one or more of the appendices by contacting Betty Ann Hughes at bahughes@gw.dec.state.ny.us.

F-I. Notices and Comments on 1999 DEIS

- DEIS Notices
- Full texts of written public comments
- Public hearing transcripts
- Department comments (on CD; hard copy available on request)

F-II. Text of HRSA

F-III. Fourth Amended Consent Order

F-IV. ESSA reports

- On CD; hard copy available on request.

F-V. Other cited references and letters not readily available:

- 1991 letters by former Commissioner Jorling to HRSA utility executives
- Article by John Boreman
- Normandeau Associates, Inc. letter/reports
- Simpson letter
- List of Industrial Code 4911 Facilities in NYS
- On CD; hard copy available on request:
    - ASA 2002 (1999 year class report)
    - City of Poughkeepsie Hudson River Temperature Data (spreadsheet)

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