Biological Fact Sheet - Cooling Water Intake Structure
Bureau of Habitat, Steam Electric Unit

Name of Facility: Astoria Generating Station
Owner/Operator: Astoria Generating Company, L.P.
SPDES #: NY-000 5118
Location: Queens County, New York
New York City
East River

1. Description of Facility

The Astoria Generating Station is located on the East River, just east of Wards Island and west of Rikers Island. The station contains four units (numbered 20-50) with rated capacities of 180, 350, 380 and 380 megawatts. Unit 10 was retired in December 1993. Unit 20 is restricted to operate for only a limited period during peak summer demand. The facility has a combined flow of condenser cooling water and service water of 1254 million gallons per day. The shoreline intake structure employs a total of 14 dual flow traveling screens to keep the station's condensers clear. Materials currently washed off the screens are sluiced into the plant's cooling water discharge canal which empties into the East River.

2. Ecological Resource

The East River is part of the Hudson-Raritan Estuary System, extending approximately 170 miles from the dam at Troy, NY to Sandy Hook, NJ. The estuary system connects to the coastal marine waters of the New York Bight, between Sandy Hook, NJ and Rockaway Point, NY, and to the western end of the Long Island Sound through the East River.

The East River is a tidal strait extending about 16 miles from the battery to Throgs Neck at Long Island Sound. At Hell's Gate, a natural sill divides the strait into two distinct hydrological sections. The upper or northeast section of the East River, where the station is located, is influenced by Long Island Sound. Here the river is broader, with shallow bays and marshes (LMS 1994).

More than 140 species of fish have been reported from the Hudson-Raritan Estuary System, representing marine, estuarine, freshwater and diadromous fish, as well as species adapted to northern and southern climates. Under a 1992 consent order with the Department, Con Edison conducted a series of studies to assess the Station's impact on aquatic resources in the East River, and determine best technology available for the cooling water intake system. Impingement and entrainment studies were conducted in1993. Approximately 1.74 million fish representing 61 species were estimated to be impinged during 1993. Atlantic herring (72%), bay anchovy (6.1%), conger eel (4.1%), winter flounder (3.4%), Atlantic tomcod (2.8%), and northern pipefish (2.1%) were the principle species impinged. An estimated 160 million eggs, larvae and juvenile fish were entrained over that same year, with eggs accounting for approximately 78% of the total. Thirty four species of fish were entrained, with the most

numerous being fourbeard rockling, winter flounder, bay anchovy and grubby (LMS, 1994) .

An additional study required under the DEC Consent Order R2-2985-90-4 determined that the potential for thermal harm exists for some summer-abundant species of impinged fish, such as Atlantic silverside and winter flounder, exposed to high temperatures in the cooling water discharge canal (Con Ed 1999). A mark recapture study, using several thousand live juvenile alewives, was conducted to determine suitable location(s) for a dedicated pipe to return fish directly to the East River without travel through the discharge canal. The study reported two sites with low fish reimpingement rates (<1.0%) that would be suitable for locating a fish return pipe (Normandeau Associates 1999).

Impingement and entrainment studies at the Astoria station were last conducted in 2006-2007. Approximately 3.01 million fish, representing 71 species were estimated to be impinged over the 12 month period. Scup (34%), bay anchovy (31%), Atlantic menhaden (4%), northern pipefish (4%), flounder (3%), naked goby (3%), and Atlantic butterfish (2%) were the dominant species collected. Approximately 629.8 million fish eggs and larvae were estimated to be entrained over the 2006-2007 sampling program. Eggs constituted 75% of the total annualized entrainment. Tautog, bay anchovy, seaboard goby Atlantic menhaden and fourbeard rockling represented 86% of the total annualized entrainment.

3. Alternatives Evaluated

Closed cycle cooling was evaluated within the context of Article X repowering application for the Astoria Generating Station. Other alternatives studied included the installation of wedge wire intake screens and modified Ristroph type traveling intake screens for the existing once through cooled system.

4. Discussion of Best Technology Available

According to 6NYCRR Part 704.5 - *Intake structures* and Section 316(b) of the federal Clean Water Act, the location, design, construction, and capacity of cooling water intake structures must reflect the "best technology available" (BTA) for minimizing adverse environmental impact. The identification of BTA is a technology driven determination, however, the final decision may also consider cost in determining whether the technology can be reasonably borne by the facility and whether one technology or suite of technologies and/or operational measures is more cost effective than another providing essentially the same resource protection (Riverkeeper II, 2007, Riverkeeper I, 2004).

Feasibility of Closed Cycle Cooling

A consent order (original DEC # R2-2985-90-4) was entered into at this facility, on December 28, 1992 to mitigate the excessive mortality of fish through the operation of the plant's cooling water intake. The order provided for a series of studies to determine BTA for minimizing adverse impacts. The required studies were conducted, and the permittee proposed the use of modified traveling intake screens and a fish return system as BTA for the facility. The

Department rejected this proposal in May 2000, as it did not minimize adverse environmental impacts, particularly that associated with the entrainment of early life stages of fish and additional technologies including closed cycle cooling and aquatic barriers were considered.

In September 2000, the permittee notified the Department that they intended to apply for a license to repower the facility under the State's Article X Electric Generation Siting Law. Part of the repowering process would be to convert the existing once through cooling system to a closed cycle system using mechanical draft wet/dry cooling towers. Closed cycle cooling was evaluated within the context of Article X repowering application, and the Department determined that the approximate 97% decrease in cooling water use and protective intake structure (a combination of 2.0 mm wedge wire intake screens and experimental aquatic filter barrier cartridge system) constituted BTA for minimizing adverse environmental impact for the repowered facility.

The State of New York Board on Electric Generation Siting and the Environment's issued a Certificate of Environmental Compatibility and Public Need on June 25, 2003 (PSC Case 00-F-1522), which contained requirements for the repowering of the Astoria Generating Station, including the specifications for the closed cycle cooling system. However, financing for the repowering project was never secured, and the new facility has not been constructed. Closed cycle cooling for the existing once through cooled units 20-50 would require several times the number of cooling tower cells than that required by the repowered facility, and there is not enough real estate available for the required cooling towers to fit on this site.

Alternative technologies other than Closed Cycle Cooling

Since it is not feasible to retrofit the existing Astoria Generation Station with closed cycle cooling and is premature to evaluate a partial retrofit, an alternative suite of BTA requirements has been developed. In keeping with the Department's established, environmentally-protective BTA requirements for existing facilities with cooling water intake structures, a minimum 90% reduction in impingement mortality and 70% reduction in entrainment will be required in this permit.

Alternatives for the facility as it exists now (without repowering), were assessed in terms of location, design, construction and capacity, to determine the technology/operational measures that constitute BTA starting with closed cycle cooling. The assessment is summarized here.

A. Location

A Submerged Off Shore Velocity Cap is the only potentially feasible technology that constitutes an alternative locations to the existing shoreline intake. However, this alternative was rejected due to its highly uncertain effectiveness. In addition, significant issues with construction and hazards to navigation exist. All other alternatives evaluated withdrawing cooling water from the existing shoreline intake, therefore location is not considered further.

B. Design

Alternatives such as modified Ristroph screens, angled traveling intake screens, wedge wire screens, behavioral deterrents, aquatic filter barrier, and the fish net barrier require redesign of the station's intake. The aquatic filter barrier and fish net barrier were not considered to be feasible due to problems with excessive currents, biological fouling and unsuitable substrates for anchoring. Sufficient room does exist to install 2.0 mm wedge wire screens under the existing dock. However, significant issue exist with biofouling and the screens cleaning ability in this location, and when coupled with the extremely large volume of cooling water used by Units 30-50 (967 MGD), significant study would be required to determine the availability of this technology at this site. Behavioral deterrents (light and sound) produce highly variable results and due to the species present, turbidity of water and biofouling of equipment, any impingement reductions would likely be minimal. Angled screens would entail a significant and costly intake redesign that is not likely to result in impingement mortality reductions superior to modified Ristroph screens. Ristroph type modified screens are feasible and will provide a high degree of impingement mortality reduction at this site. Furthermore, the use of fine mesh panels (approximate 1.0 mm) is being tested as a means to meet the entrainment reduction requirements in the permit.

C. Construction

Construction impacts are considered to be major for closed cycle cooling (if it was feasible), and for wedge wire screen installation. Installing 2.0 mm wedge wire screens is possible under the existing dock. This would require blasting and removal of bedrock below the dock to achieve sufficient depth for installation of the 9 foot diameter screens, and the installation of bar racks between the piers to handle heavy debris loads. For other feasible alternatives, construction is minor and confined within the boundary of the station.

D. Capacity

Alternatives such as closed cycle cooling and use of variable speed pumps affect the volume of cooling water used (a.k.a. capacity). If Astoria were to repower, closed cycle cooling would be feasible (i.e. enough space exist to locate them on this site), and is expected to achieve a 97% decrease in cooling water use from design flow. Variable speed pumps, required in the SPDES permit, are estimated to reduce cooling water use by about 45% on an annual basis.

5. Determination of Best Technology Available

Staff recommend the installation of modified Ristroph screens with seasonal use of fine mesh panels at Units 30, 40 and 50 to achieve BTA at the Astoria Generating Station. This alternative, in addition to the use of variable speed pumps already required for each unit, is expected to provide a 90% reduction in impingement mortality and a 70% reduction in entrainment from full flow baseline. The cost of this alternative is very moderate at 0.4% of annual gross revenue.

Closed cycle cooling would result in the greatest IM&E reductions (>95% reduction in both impingement mortality and entrainment), however, adequate space does not exist given the fact that cooling towers for the existing facility would occupy several times the area than cooling towers for the repowered station. Only if Astoria Generating Station were to be repowered would this technology be feasible. Although wedge wire screens provides the next greatest IM&E reductions (>95% reduction in impingement mortality and 71% reduction in entrainment), they were rejected due to the uncertainty over their feasibility at this site. Considerable studies are necessary to determine if wedge wire screens could reliably operate here, including the effectiveness of the air-burst cleaning system, corrosion and biofouling potential. The Brooklyn Navy Yard, with a design capacity of 99 MGD is the largest facility in New York State utilizing 2.0 mm wedge wire screens. Astoria Units 30-50 use almost ten times that volume of water. The IM&E performance of Ristroph modified screens with fine mesh panels is expected to be approximately equivalent to the wedge wire screen alternative. Although a pilot study would also be necessary to determine the suitability of fine mesh panel Ristroph screens, the basic Ristroph technology is proven, and the likelihood of success for this alternative is substantially greater.

Submittal of an approvable pilot study plan and implementation schedule would be required as a necessary first step to determine if the fine mesh panel Ristroph screens can handle typical debris loads, and to determine entrainment exclusion and survival of larval fish.

If fine mesh panels are determined to be not feasible, or if verification monitoring indicates that entrainment reduction is less than the permit's required 70%, the applicant will be required to submit an approvable plan to further reduce entrainment losses to meet the entrainment performance requirement.

6. Monitoring Requirements

The permit requires the submittal of a two year study (*Verification Monitoring Plan*) to verify that the BTA requirements have been achieved.

7. Legal Requirements

The requirements for the cooling water intake structure in this State Pollutant Discharge Elimination System permit are consistent with the policies and requirements embodied in the New York State Environmental Conservation Law, in particular - Sec.1-0101.1.; 1-0101.2.; 1-0101.3.b., c.; 1-0303.19.; 3-0301.1.b., c., i., s. and t.; 11-0107.1; 11-0303.; 11-0535.2; 11-1301.; 11-1321.1.; 17-0105.17.; 17-0303.2., 4.g.; 17-0701.2. and the rules thereunder, specifically 6NYCRR Part 704.5. In addition, the requirements are consistent with the Clean Water Act, in particular Section 316(b).

8. Summary of Changes

Table 1. Deletions (Former Permit Conditions)

A. Footnotes (Interim and Final)	Reason for Deletion
Condition No. 15	Requirement to study a filter fabric exclusion system has been complied with.
Condition No. 16	Requirement to conduct an impingement and entrainment study has been complied with.
Condition No. 17	The Design Construction Technology Plan has been submitted and approved by the Department.
Condition No. 18	The Proposed Suite of Technologies or Operational Measures has been submitted to the Department.
Condition Nos. 19-26	Modified and renumbered as Condition Nos. 15-20

Table 2. Deletions (Former Permit Conditions)

Final Additional Requirements	Reason for Deletion
Condition No. 12.c.	Requirement to conduct a program to test the operation of a fabric filter exclusion system at this site have been completed, and it has been determined that the system as designed do not meet the intake requirements for a closed cycle cooling system at this facility.

Table 3. Deletions (Former Permit Conditions)

D. Biological Requirements	Reason for Deletion
Requirement No. 1.	Requirement to install a closed cycle cooling system is addressed within the context of a facility repowering through Final Additional Requirement No. 12.a, and 12.b.
Requirement No. 2.	Requirement to conduct a thermal criteria study is addressed elsewhere, under A. Footnotes (Interim and Final) Condition No. 26.

Table 4. Additions (New Permit Conditions)

A. Footnotes (Interim and Final)	Reason for Addition/Change
Condition No. 14	Requires the installation ands operation of Variable Speed Pumps at Units 30, 40 and 50 by December 31, 2013.
Condition No. 15	Requires the submission of a plan and schedule to install Ristroph modified screens and a low stress fish return at Units 30-50. The plan will further include a schedule to test the effectiveness of using fine screen mesh panels on a seasonal basis.
Condition No. 16	Requires the submission of a Verification Monitoring Plan.
Condition No. 17	Requires the installation of intake screens and fish return system by the end of the permit term**.**
Condition No. 18	Requires the submission of a contingency plan to meet entrainment reduction performance levels if fine mesh screens are determined not to be feasible, or if the Verification Monitoring Study shows entrainment reductions do not meet the requirements of this permit.
Condition N. 19	Reporting Requirements
Condition No. 20.a.	Permittee shall receive permission from the Department prior to undertaking any modifications to the cooling water intake.
Condition No. 20.b.	Requires a Thermal Criteria Study

9. References

Con Ed. 1999. Thermal Tolerance Assessment for Astoria Generating Station. Prepared by Consolidated Edison Company of New York, Inc. April 1999.

ENSR Corporation. 2005. New York State Department of Environmental Conservation State Pollution Discharge Elimination System: Request for Information Response for Astoria Generating Station, Queens, New York. Prepared for Reliant Energy, by ENSR Corporation, September 2005.

ENSR Corporation. 2007. CWA 316(b) Impingement Mortality and Entrainment Characterization Study (IMECS): Astoria Generating Station. Document No. 12096-002. July, 2007.

LMS. 1994. Astoria Impingement and Entrainment Studies. January 1993 - December 1993. Prepared for the Consolidated Edison Company of New York, Inc. by Lawler, Matusky and Skelly Engineers, May 1994.

Normandeau Associates. 1999. Fish Reimpingement Study at Astoria Generating Station. Prepared for Consolidated Edison Company of New York, Inc. By Normandeau Associates, April 1999.

Riverkeeper I, *Riverkeeper, Inc. v. U.S. Envtl. Protect. Agency*, (2nd Cir. 3 February 2004)

Riverkeeper II, *Riverkeeper, Inc. et al. v. U.S. Envtl. Protect. Agency*, (2nd Cir. 25 January 2007)

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